



Kick-Off Meeting of the Technical Working Group for the EMAS Sectoral Reference Document on Best Environmental Management Practice in the Fabricated Metal Products Manufacturing Sector

Minutes of the meeting

Brussels, 21-22 September 2016

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I. Introduction

The European Commission's Joint Research Centre (JRC) is developing a **Sectoral Reference Document (SRD)** on best environmental management practice for the manufacture of Fabricated Metal Products. 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).

The SRD for fabricated metal products manufacturing will cover the most relevant manufacturing and supporting activities and processes of the 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 are identified both of a technical and/or technological nature, such as improving the energy efficiency of a certain process, and of a more organizational or management type, such as chemical leasing or engaging in environmental improvement with suppliers. BEMPs are 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 (Figure 1).

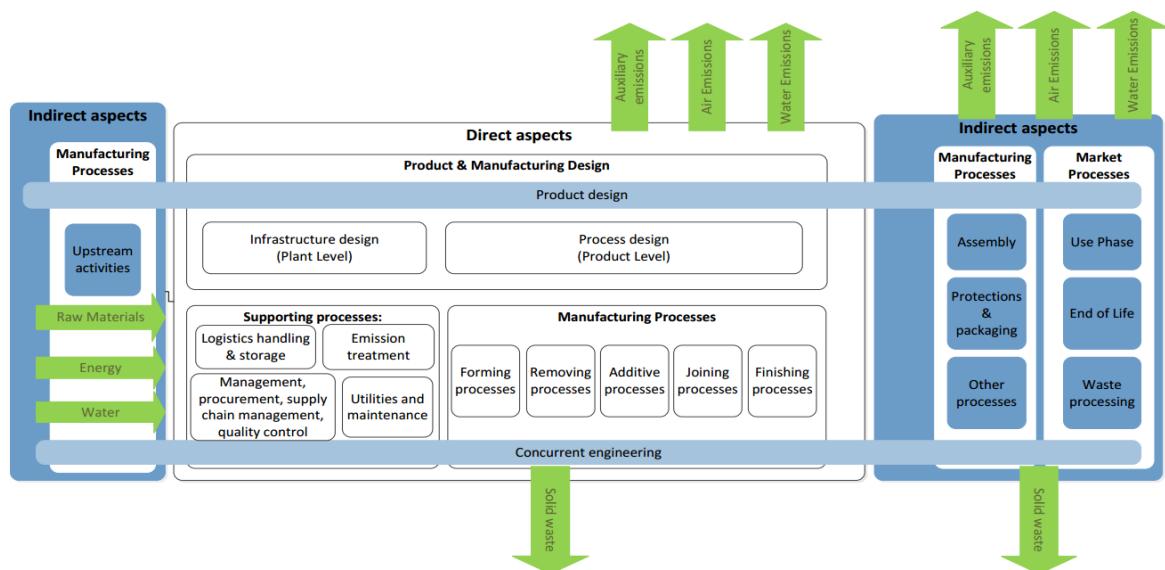


Figure 1 - Schematic overview of the direct and indirect aspects and environmental pressures of the manufacture of Fabricated Metal Products sector

Following the process conceived and used to develop SRDs for other sectors (and described in the guidelines on the “Development of the EMAS Sectoral Reference Documents on Best Environmental Management Practice”¹), the JRC will develop the SRD for the fabricated metal

¹ <http://susproc.jrc.ec.europa.eu/activities/emas/documents/DevelopmentSRD.pdf>

products manufacturing sector in close collaboration with the stakeholders of the sector and under the guidance of a Technical Working Group (TWG) comprising experts from the sector.

The kick-off meeting of the TWG for the fabricated metal products manufacturing sector was held in Brussels on 21-22 September 2016. The goal of the workshop was to establish the information exchange between the members of the TWG, to steer the development of the document, and to discuss its scope and the preliminary best environmental management practices identified.

VITO, along with their partners Sirris and Agoria, were contracted by the JRC to prepare a background report identifying the most relevant environmental aspects for the sector, and putting forward proposals of BEMPs and environmental performance indicators. The background report (available on-line²) will be used as a basis for the discussion with the technical working group and was sent to the TWG members prior to the workshop.

II. Opening of the workshop

The JRC opened the session and welcomed the participants.

- The meeting agenda was presented (see Annex A) and agreed by the participants.
- The TWG members introduced themselves and summarised their experience in the fabricated metal products manufacturing sector (the list of participants is attached in Annex B).
- Participants were informed that the meeting would be recorded. There were no objections to this.
- It was agreed to use first names to refer to the different TWG members and the same convention is adopted in these minutes of the meeting.

III. Purpose and goals of the meeting

The JRC introduced the framework of the EMAS Regulation and of the EMAS Sectoral Reference Documents (SRDs), the methodology for developing the SRDs and the purposes and goals of the meeting.

- The JRC presented the goal of the TWG kick-off meeting, which is to discuss and agree on the scope of the best practice report and Sectoral Reference Document, on the most relevant environmental aspects and pressures, and to discuss the proposed best environmental management practices (BEMPs) as well as collect ideas and inputs for other potential BEMPs. Further, first ideas about environmental performance indicators were going to be analysed. Discussions on the benchmarks of excellence were instead not in the objectives of the meeting as it would have been too early.
- The JRC stressed how essential it is that the TWG members contribute as much as possible to the development of the best practice report and of the SRD to ensure their quality and usefulness for the targeted companies (i.e. fabricated metal products manufacturers).

² http://susproc.jrc.ec.europa.eu/activities/emas/documents/BEMP_FabMetProd_BackgroundReport.pdf

- Over the coming months, feedback and inputs from the TWG will be collected and a draft best practice report, based on the background report prepared by the consultants, will be produced by the JRC. A final meeting of the TWG (possibly during September 2017) will validate the content of the draft best practice report (BEMPs and environmental performance indicators) as well as discuss and agree proposals of benchmarks of excellence.

IV. Introduction of the Sectoral Reference Documents on Best Environmental Management Practice and lessons learnt

The JRC gave an overview of the best practice reports and SRDs already developed or under development for another ten sectors, as well as their main elements and the structure used to describe the best practices. The approach and general structure will be the same for the best practice report and for the SRD for the fabricated metal products manufacturing sector.

The presentation focused on the meaning of specific terms used in the context of the SRDs (best environmental management practices, environmental performance indicators, benchmarks of excellence), along with examples from the SRDs for the retail trade and food and beverage manufacturing.

- **Best Environmental Management Practices (BEMPs)** are techniques, measures and actions that allow organisations to minimise their direct and indirect environmental impacts. They go well beyond common practice, but are fully implemented by best performers and are widely applicable. The TWG is responsible for assessing whether the practices identified refer to actual BEMPs, or are instead common, obsolete or emerging techniques. The approach used to identify BEMPs, by analysing the practices implemented by ‘frontrunners’ (i.e. companies that go well beyond their peers in terms of environmental performance in a certain area), was also presented.
- **Environmental performance indicators**, which can be quantitative or qualitative, allow organizations to measure their environmental performance in the field covered by each BEMP. The focus is on indicators that are already in use and environmentally meaningful; when outcome indicators are not feasible, indicators related to the implementation of certain actions can be used as a proxy.
- **Benchmarks of excellence** refer to a level of performance that is very ambitious (e.g. top 10 or 20% best performing companies in the sector for the specific aspect addressed by the benchmark) but already achieved by frontrunners. Benchmarks of excellence are a measure of what is possible, under stated circumstances. Benchmarks are not targets, but rather a source of inspiration.

The outputs of the process of defining BEMPs were also outlined:

- ✓ The **Best Practice Report** is intended to be a detailed technical guide that contains full details of the BEMPs. It is developed by the JRC in collaboration with the TWG and will be available in English. This is the document that companies interested in implementing best practices are recommended to consult. Information from the **Background Report** developed by the contractors (VITO with Sirris and Agoria) will be used in the best practice report.

- ✓ The final **Sectoral Reference Document (SRD)** is a short synopsis of the best practices, indicators and benchmarks. This is the official document that EMAS registered organisations will refer to. It is adopted as a Commission decision and will be available in all EU official languages.

Other key points of the presentation included:

- The key role of the TWG is to provide input to be taken into account when preparing the best practice report and validate the findings.
- The composition of the TWG may change from kick-off to final meeting, and experts which have not assisted to the kick-off meeting can join the work on the SRD. Expression of interest can be sent to jrc-ipts-emas@ec.europa.eu.
- Experts can send comments in an informal way, e.g. by just sending an email to jrc-ipts-emas@ec.europa.eu.

Discussed items & conclusions

- What is the frequency for updating these documents?
 - The European Commission has the intention to update the SRDs but there are no further details available at the moment. One option is that the JRC monitors the sector "continuously" and collects information from experts. This could tell when each document needs to be revised and the collected information could form the basis for the review.
- JRC is not sending questionnaires or surveys to companies concerning the implementation rate of techniques. This is not considered relevant since this work focuses on best practices implemented by frontrunners and it would be too time consuming to try to map the whole sector. Relevant information will be collected directly from targeted stakeholders e.g. companies, industry representatives, academics, during the TWG meetings and will build on the follow-up discussions and research on specific topics. The role of TWG members in terms both of providing feedback and offering access to their own networks of contacts within the sector will be very important.
- The sector is dominated by SMEs. Therefore it is important that these documents are useful for SMEs (which do not have the resources for undertaking this kind of research).
- Telephone calls and webinars on specific topics can be a useful and effective alternative to long e-mail conversations.

V. Overview of the Fabricated Metal Products sector and its environmental aspects

Firstly, VITO provided an overview of the fabricated metal products manufacturing sector. The sector belongs to the value chain of metals (ferrous and non-ferrous metals).

The most relevant processes that take place in fabricated metal product manufacturing companies include:

- Supporting processes:
 - Logistics handling and storage;
 - Management, procurement, supply chain management, quality control;

- Utilities and maintenance;
- Emission treatment.
- Manufacturing processes
 - Forming processes
 - Removing processes
 - Additive processes
 - Joining processes
 - Finishing processes
- Organisational level processes
 - Product design
 - Infrastructure design
 - Concurrent engineering

According to the statistical classification of economic activities, the sector corresponds to NACE 25. But the NACE subdivisions are artificial: some are defined at the level of sub-processes, others at the level of the end use of products:

NACE code	Description
25	Manufacture of fabricated metal products, except machinery and equipment
25.1	Manufacture of structural metal products (e.g. doors and windows)
25.2	Manufacture of tanks, reservoirs and containers of metal (e.g. radiators, boilers, tanks, etc.)
25.3	Manufacture of steam generators, except central heating hot water boilers
25.4	Manufacture of weapons and ammunition
25.5	Forging, pressing, stamping and roll-forming of metal; powder metallurgy
25.6	Treatment and coating of metals; machining
25.7	Manufacture of cutlery, tools and general hardware
25.9	Manufacture of other fabricated metal products (e.g. drums and containers, metal packaging, wire products, chains, screws, etc.)

The environmental aspects and related environmental impacts of the sector, including its value chain, were also presented. Based on data from EOARA, EUROSTAT and Allwood et al. a semi-qualitative indication (0, +, ++, +++) on the scale of the different impacts was given.

Discussed items & conclusions

NACE codes

- Focus in the Background Report is on NACE code 25 (based on agreement made at the beginning of the process between the JRC and VITO in accordance with the wording used in the list of priority sectors for which SRDs are being developed).
- Several TWG members advised that addressing only companies registered in NACE code 25 would be artificial because the processes carried out by NACE 25 companies are also common processes for other companies within e.g. NACE 24, 28, 29 or 33. The TWG recommended that other NACE codes than NACE 25 are also included in the scope of the work because the BEMPs identified in this work will also be valuable for those companies belonging to other NACE codes.

Conclusions:

The JRC will check the feasibility of extending the target group of the document beyond organisations belonging to NACE code 25, including organisations from other NACE codes

employing the same production processes. In some NACE codes, limiting the scope to organisations with similar processes than those in NACE code 25 will require defining the scope at the subgroup level (e.g. NACE codes 24.5, 28.15, 29, 32, 33).

The **JRC** will prepare a proposal to be shared with TWG and other relevant stakeholders.

Terminology of the different process steps

- 'Finishing processes' are only those taking place just before packaging (assembling). Perhaps use the term "post processing metallurgical treatment".
- Heat treatment is presented as part of finishing, but this does not reflect industry practice. Heat treatment has to be described as a separate process between "soft processing" (e.g. turning) and "hard processing" (e.g. grinding).

Conclusion: revise the terminology of the different process steps

- 'Shaping processes' is a better wording for 'forming processes'.

Conclusion: replace 'forming' by 'shaping'

- For some TWG Members, auxiliary emissions seems not to be a commonly used word for nuisance emission

Conclusion: check the terminology 'auxiliary emissions'

Environmental aspects and impact

- Land use is missing in the direct and indirect aspects. Although the direct impact on land of fabricated metal products manufacturers is generally low, some aspects like oil penetration into the ground (due to handling and storage) can have an impact.

Conclusion: the focus on the main aspects of the fabricated metal products manufacturing sector is correct. The specific aspect of land use and land pollution can be mentioned and may be relevant for one or two of the BEMPs.

- Waste heat is not listed as an environmental pressure. The reason is that the aspect of waste heat recovery is tackled in the environmental aspect 'energy'.

Conclusion: mention waste heat explicitly (to give it more visibility) as an environmental pressure; in any case, it is already considered in the relevant BEMPs.

- The used symbols (+/++/+++) are based on data from cases and expert judgement. Some participants questioned the relative weight. However, these are not important, as the important element is which environmental aspects are considered the most relevant, for the exact weight given to each.

Conclusion: the TWG agrees with the list of aspects that are considered relevant and not relevant, but is not confident with the individual scores given to each aspect for each environmental pressure. Therefore, in the best practice report and in the SRD, the aspects that are considered relevant and not relevant will be listed without providing the tables with the different weights/scores.

VI. Scope of the Sectoral Reference Document for the Fabricated Metals Products sector

Based on the overview, the scope of the background report was introduced:

- the scope will include both DIRECT and INDIRECT environmental aspects of the sector;

- the BEMPs must go further than the current legislative framework and duplication of work with other reference documents should be avoided; therefore we will not look for BEMPs in areas where relevant measures or techniques are covered under current or upcoming BREF documents or other legislation. An overview of the applicable European environmental legislation for the fabricated metal products manufacturing sector was given.

The following activities and environmental impacts are therefore considered "in scope":

Activity level

Supporting processes:

- Management, procurement, supply chain management, quality control;
- Utilities and maintenance;
- excluded:
 - Logistics handling & storage: not specific for this sector. Environmental aspects are low, comparing to other processes.
 - Emission treatment: not specific for this sector. Covered by IED, BREFs and other legislation.

Manufacturing processes

- Shaping processes (renamed)
- Removing processes
- Additive processes
- Joining processes
- Treatment processes (classification of manufacturing processes to be double-checked)

Organisational level

- Product design
- Concurrent engineering

Environmental impact level

- Use of resources
 - Materials
 - Energy
 - Water
 - Consumables
- Emissions to
 - Water
 - Air
 - Odour, noise and vibrations
- Waste
 - Non-hazardous waste
 - Hazardous waste
 - Liquid waste

Discussed items & conclusions

- Additional topics to consider in the definition of the scope:

- Which companies are in the target group – this will be decided later further to a proposal by JRC of NACE codes to include based on processes: see above discussion on the NACE codes.
- How to use the SRD and best practice report - clear guidance needed for the reader.
- Circular Economy, life cycle thinking – need to be addressed explicitly at the organisational level
- Storage (and use) of chemicals – not well covered at the moment
- Additional environmental issues to consider:
 - Land use
 - Waste heat recovery
 - Water based cleaning – cleaning water.

Actions:

- The **JRC** will look into the NACE-codes and identify which sub-divisions (e.g. 24.5, 28.15) could be included in the scope together with all companies belonging to NACE code 25. A proposal will be shared with the TWG and with other stakeholders.
- Clarify that the aspects covered by BREFs are covered in this document by referring to the BREFs. **JRC** to discuss with colleagues developing the BREFs on the suitability of the BATs for facilities smaller than the IED thresholds.
- **Mark** is available to give feedback on the link with the BREFs.

VII. Overview of the proposed BEMPs

VITO provided a brief overview on the proposed BEMPs described in the background report:

Supporting processes (Section 2.2 of the background report)

- Management, procurement and supply chain management (4 BEMPs)
- Optimisation of utilities (6 BEMPs)

Manufacturing processes (Section 2.3 of the background report)

- Manufacturing processes – generally applicable techniques (3 BEMPs)
- **Shaping** processes (3 BEMPs)
- Removing processes (2 BEMPs)
- **Treatment** processes (2 BEMPs)

Concurrent engineering and product design (Section 2.4 of the background report) (2 BEMPs)

The following sessions of the meeting discussed in depth each proposed BEMP and collected ideas for further BEMPs to be explored. Feedback and inputs were collected and are summarised in the following sections of these minutes.

VIII. BEMPs on supporting processes

A. Management, procurement and supply chain management

1. Extend the lean principles with measures for energy and material consumption (BEMP 2.2.1)

Participants agreed that this BEMP needs to be reconsidered and transformed into an overarching BEMP (see further for more details). The way the BEMP is proposed in the background report seems too close to common practice.

More in detail, the discussions highlighted that:

Description:

- The BEMP is not specific only for this sector.
- Lean manufacturing can be difficult to apply in SMEs and is already applied in large companies.
- The Gentani approach (implemented by Toyota) could be introduced as a further element.

Indicators:

- need more process specific indicators for material use, energy use, LCA.

Actions: Mark to provide contacts of Toyota's environmental manager.

2. Measures for stock reduction - while keeping customer demand flexibility (BEMP 2.2.2)

There was no agreement on this BEMP. The content will be moved to the new overarching BEMP. Members of the technical working group mainly questioned the overlap with the previous BEMPs and the unclear environmental benefits achieved.

3. Cross-sectoral and value chain collaboration by communication and integration (BEMP 2.2.3)

The BEMP was generally accepted. More in detail, the discussions highlighted that:

Description:

- Consider splitting the BEMP into more targeted BEMPs (new routes/uses for your own waste, taking back products, using waste from others in your processes).
- Cover sustainable sourcing and mention responsible sourcing in this BEMP or in a new one.
- Material passporting has been investigated by different companies and it could be an additional element for the BEMP.
- There are some initiatives for sustainable management of mineral ore and they could be an additional element for the BEMP.
- Need to focus the text of the BEMP even more on examples from the sector.
- Value-chain collaboration is already implemented in some sectors (e.g. in the automotive industry and its suppliers) however cooperation can be limited, initially because of confidentiality issues, later, because of limited improvement actions possible.
- Optimisation of supply chain could also include the avoidance of unplanned process interruptions.

Environmental aspects:

- Ensure land use and biodiversity aspects are tackled in this BEMP or elsewhere.

Applicability:

- Clarify applicability. Example company: Cisco.

Actions:

Mark will send information on 'Material passporting' and on carbon footprinting of supply chain by CROWN-PAINT .

Louis to provide references on responsible sourcing.

Orsolya: her company have good indicators, she can possibly provide some examples.

TWG members: provide good examples of cross-sectoral and value chain collaborations.

4. Chemical leasing & Chemical management services (BEMP 2.2.4)

Participants agreed that these techniques do not seem BEMP. There would probably be some room for the improvement of chemical management from SMEs. The JRC will check if a new BEMP on chemical use and storage could be developed, taking into account what is already common practice and what is included in the relevant BREFs.

5. New proposed BEMPs for management, procurement and supply chain management

- Develop a new overarching (horizontal) BEMP on setting environmental policy and targets including general principles such as
 - Life-cycle thinking
 - Circular Economy
 - Lean principles (see BEMP 2.2.1)
 - Stock reduction (see BEMP 2.2.2)
 - Business models (leasing/service based)
 - Co-design and open innovation
 - Industrial symbiosis.
- Investigate the feasibility of a new BEMP on chemical use and storage.
- Investigate the feasibility of a new BEMP on creating a platform among companies of the sector to share information on audits exercise of suppliers or service providers (based on the example of a platform for sharing audits of waste management facilities).

Action:

Lennart S. will provide information.

Lennart H. to send information on target settings and indicators.

B. Optimisation of utilities

1. Energy management (BEMP 2.2.5)

There was a general agreement among participants on the concept of this BEMP. More in detail, the discussions highlighted that:

Description:

- Introduce a link to the BREF energy efficiency.
- Include further dimensions in the BEMP: procurement (e.g. machinery), monitoring and displaying energy consumption, employee awareness on energy use.
- Consider the feasibility of a new BEMP covering the indirect aspects (e.g. commuting) and how to increase awareness of employees on these.
- Take into account the internal transport of materials and goods (i.e. within a facility/site).

Environmental benefits:

- Add emissions of greenhouse gases.

Indicators:

- Currently only activity based indicators that consider constant production are proposed (i.e. energy use per day/week/month/year).
- Further indicators, specific per product or site not having constant production, should be introduced (/product, /m³, /ton of product, /working hours).
- Is there a person responsible for the energy management (Y/ N indicator) could also be a suitable indicator.
- More broadly, for each of the different measures listed in the BEMP, a suitable indicator could be identified.

2. Efficient ventilation (BEMP 2.2.6)

There was an agreement among participants on the concept of this BEMP, although the economic and decision-making criteria should be further developed and explicitly stated. More in detail, the discussions highlighted that:

Description:

- Feasibility of the measures listed will vary broadly.
- Add the aspects of heat recovery (from waste heat) and air flow management (link to the BREF where possible).
- Mention the impact of the filtration system and the cost for filtration.
- Employee well-being should be mentioned as a benefit, even if not environmental, from a better ventilation system.
- Mention the stepwise approach: companies can first focus on the main hotspots and take the relevant measures to tackle them.
- In case the mandatory periodical audit of HVAC systems is removed from the energy efficiency directive, the topic of periodical audits could be considered within this BEMP.

Economics:

- Could be developed further: depending on the type of company, the share of energy use by ventilation may vary substantially.

Driving force for implementation:

- Energy savings are the main driver. Noise reduction is only a side effect (not the main driver).

Action: Data are available in the framework of the eco-design directive concerning ventilation units (Michael will provide information).

3. Optimal lighting (BEMP 2.2.7)

There was an agreement among participants on the concept of this BEMP, although some editing (especially indicators) is necessary. More in detail, the discussions highlighted that:

Description:

- Add more inspiring examples, possibly also from SMEs.
- Add the dimension of monitoring and auditing energy consumption, especially for SMEs. Energy monitoring for lighting in SMEs is already a big step ahead of common practice.
- Include some measures for the implementation of this BEMP suitable/addressed to SMEs.
- Consider natural lighting when planning lighting in a facility.
- Employee satisfaction of better lighting could be considered an additional benefit (although non-environmental important to mention, perhaps as driving force) from the implementation of this BEMP.

Indicators:

- Include both installed power (kW/m²) and energy consumption over a reference period (e.g. kWh/m²/year).
- The use of natural lighting could be introduced as indicator.
- Proposed indicators:
 - o percentage LED / low consuming light bulbs;
 - o percentage of the lighting controlled by sensors (motion sensors, daylight sensors).

4. Energy and water savings of cooling circuits (BEMP 2.2.8)

There was an agreement among participants on the concept of this BEMP, although extra information/figures are necessary. More in detail, the discussions highlighted that:

Description:

- Broaden and reorganise the structure of the BEMP following a hierarchy of measures (free cooling, re-use of waste heat, etc.) – link to the BREF on energy efficiency where relevant.
- Refer to the aspect of refrigerants and their intrinsic global warming potential as well as related energy usage (but being careful about energy efficiency trade-offs); consider making reference to Total Environmental Warming Indicator (TEWI).

Actions:

Lennart S. to share relevant information on absorption chillers to cool a data centre with waste heat.

Malte to send information about a heat recovery project in a small company.

TWG members: extra figures are welcome.

5. Efficient use of compressed air systems (BEMP 2.2.9)

There was an agreement among participants on the concept of this BEMP, although some additions are recommended. More in detail, the discussions highlighted that:

Description:

- Add further dimensions (e.g. carrying out a baseline analysis to understand the relevance of leakages; installing solenoid valves to the main switch of the machine closing delivery of

compressed air when machines are not running; using localised compressors; installing a second pipe for delivering compressed air to a new machine instead of increasing pressure).

- Compressed air as a service provided to the company is not feasible.
- There are cases where the reduction of the use of compressed air would be the best solution from an environmental perspective because of the large energy savings achievable.

Indicator:

- KWh/m³/min at a stated pressure level could be added in the document
- The overall leakage level (%) can be considered a good indicator and a benchmark of excellence could also be formulated.

Actions:

Peter to send data on overall leakage levels and a proposal for the benchmark of excellence (e.g. 10% leakages).

JRC to revise this BEMP based on the development of the related BEMP in the electrical and electronic equipment manufacturing document and in the car manufacturing document.

6. Reduction of standby energy of metal working machines (BEMP 2.2.10)

There was a general agreement among participants on the concept of this BEMP. More in detail, the discussions highlighted that:

Description:

- Add the dimension of understanding from a baseline analysis of the overall energy consumption of the factory which processes/machines are mostly responsible for the baseline energy consumption and tackle their stand-by energy consumption in priority.

Examples :

- Add the Schaeffler example of labelling the machines according to whether they should be switched off (green) or not (red).

Indicator:

- Percentage of the machines having a switch-me-off / do-not-switch-me-off label.

Cross-Media effects:

- Switching on and off the machines is not always positive for the environment, because it can affect the life time of the machines. For electric motors, however, variable speed drive motors could be a good solution as they allow that.

Actions: **Lennart S.** to send info and pictures of the labels used at Schaeffler.

7. New proposed BEMPs on optimisation of utilities

- Investigate the aspects of use of on-site renewable energy generation, energy storage, rain-water collection etc. as potential further BEMP(s) within the utility chapter.

IX. BEMPs manufacturing processes

A. Manufacturing processes – generally applicable techniques

1. Application of solid low-friction coating on tools and components (BEMP 2.3.1) and Application of wear- and corrosion-resistant coatings for lifetime extension of tools and equipment (BEMP 2.3.2)

There was agreement among participants on the relevance of coating of tools and end-products/components, but not on the current content of the two BEMPs. Coating of tools is common practice because needed for quality and efficiency of production. Moreover, so far the environmental benefits are not prominent enough. However, these are usually present on a life-cycle basis (e.g. with coating of end-products).

Participants thus suggested reconsidering the possibility of developing a BEMP on coating. One option to investigate would be merging both BEMPs into one with a different approach: a BEMP on better selection of the coatings and of the application methods with environmental criteria.

More in detail, the discussions highlighted that:

Description:

- The BEMP would focus on fostering awareness, at the time of selecting the tools and their coating, of the properties and types of the coatings. This is relevant for SMEs which usually only rely on their suppliers of tools for selecting the relevant coating.
- The new BEMP could also look at the aspect of coating application on tools and end-products/components.

Environmental aspects:

- Selecting the appropriate coating allows increasing the lifetime of the tools, thus resulting in lower material use.

Driving force for implementation:

- Quality of the products and efficiency of production.

Actions: TWG members: provide more examples and information.

2. Selection of coolant as environmental and performance criterion (BEMP 2.3.3)

Participants agreed that this BEMP needs to be edited in several areas. More in detail, the discussions highlighted that:

Description:

- Check if cryogenic cooling is BEMP, because of the additional energy needed. More data are needed to support the environmental benefits as well as the economic feasibility.
- Minimum lubrication should be edited out of the BEMP, because it is not considered BEMP, as it is only applicable for a small number of cooling processes.

Economic:

- Needs to be developed further.

Actions: Georgios to send a paper on advantages and disadvantages of cryogenic cooling.

3. New proposed BEMPs

- Investigate the feasibility of a BEMP on reducing emissions from existing/old machines. A number of good machines in companies are not brand new; these could be retrofitted in order to reduce their emissions (e.g. closing the machines).
- Investigate the feasibility of a BEMP on avoiding over-dimensioning of filters/extractors on machines.
- Investigate the feasibility of a BEMP on the use of coolants for multiple operations (e.g. oil for turning and grinding operations), although this may be possible only in specific cases.
- **Lennart S.** to send information on coolants for multiple operations and on retrofitting old machines.

B. Shaping processes

1. Incremental Sheet metal Forming (ISF) as alternative for mould making (BEMP 2.3.4)

There was a general agreement among participants on the concept of this BEMP. It was highlighted that the indicators can be further developed.

2. Additive manufacturing of complex equipment - flow optimization for optimal heat transfer and temperature control (BEMP 2.3.5)

The BEMP needs to be revised. The BEMP could investigate the selection of the most appropriate manufacturing processes considering the environmental impact. More in detail, the discussions highlighted that:

Description:

- The selection of the best manufacturing technique should be based on the type of product and its specific characteristics.
- Depending on the sector, additive manufacturing is a consolidated technique or an emerging technique.
- Additive manufacturing processes is much more than 3-D printing (e.g. laser cladding).
- The quality of the products is not always proven. Good examples are necessary.
- Information on trade-offs and limitations is needed.
- E.g. the example on heat exchangers is only possible in case there are no contamination problems (because much more difficult or even impossible to clean appropriately).
- Additive manufacturing has a large potential for the repair industry. There are examples in the aerospace and wind turbine industries.

Indicators:

- A life cycle approach is necessary. In case of lighter materials for vehicles or airplanes, the indirect environmental benefits due to less fuel consumption are much higher than the

direct environmental impact during the manufacturing processes. The same may be true for better heat transfer in optimised heat exchangers.

Cross-media effects:

- Potential toxicity of powders used in additive manufacturing.

Actions:

Louis to send information on LCA and additive manufacturing (examples on the repair industry for aerospace and windmill industry)

Wim to send information on new studies on the environmental impact of the technique.

German and **Mark** to provide information for the development of this BEMP.

3. Multi-directional forging: a resource efficient metal forming alternative (BEMP 2.3.6)

The BEMP was in general accepted. Because of the limited experience of the members of the technical working group with this topic, discussions did not go in depth. It was recommended to review the wording used in the text since 'burr' is not the correct word, 'flash' should be used instead.

Actions: TWG members to go back to their network for any further input for this BEMP.

4. New proposed BEMPs on shaping processes

No new BEMPs in this area were proposed by the TWG.

C. Removing processes

1. Hybrid machining as a method to reduce energy consumption (BEMP 2.3.7)

There was a general agreement among participants on the concept of this BEMP. More in detail, the discussions highlighted that:

Description:

- Review the terminology: 'transformative processes' is not the correct wording, more appropriate 'removing processes'.
- Maintenance costs and trade-offs (such as lower flexibility) could limit the applicability of this BEMP: this could be elaborated more.

Environmental benefits:

- More data/examples are needed, to prove the benefits.

2. Machining of near-net-shape feedstock (BEMP 2.3.8)

There was a general agreement among participants on the concept of this BEMP, but a deeper look to the cross-media effects and environmental benefits is needed. More in detail, the discussions highlighted that:

Description:

- Several techniques are mentioned in this BEMP (gel casting, casting, cold forming, Direct Metal Laser Sintering (DMLS), injection moulding). Applicability and environmental benefits are different for the different techniques.
- In general, these technologies are only relevant for large series, only for high cost materials and for some types of components. For instance, not applicable for full dense parts.

Environmental benefits:

- The environmental benefits are in the downstream processes, as this technology reduces or eliminates the need for post-processes. Sometimes no finishing needed.

Driving forces for implementation:

- Cost, speed (comparing to traditional machining, i.e. turning of materials)

Cross-Media effects:

- You need an additional process (polymer binder in metal injection moulding) that could result in extra energy use.
- The binder / polymer to combine the parts can have environmental impacts; a life cycle approach is needed.

Actions:

TWG members to provide information concerning LCA, additional steps for eliminating binders.

Lennart S to provide input on an example on cold forming.

3. EXTRA BEMP presented by JRC: Metal chip recycling and lubricoolant recuperation through briquetting

The main features of an additional BEMP, not included in the background report, were discussed. This is a BEMP suggested by the TWG for the car manufacturing document but that would fit better in this document.

There was a general agreement among participants on the concept of this BEMP, although some additional improvements are needed. More in detail, the discussions highlighted that:

Description:

- Terminology should be improved: e.g. "chips" (from turning) and "swarf" (from grinding);
- The big savings come from the avoided purchase of oil from recovering it from the grinding sludge; a difference between water and oil based coolant must be made. This BEMP should focus on oil based coolants.
- It is important to sort the different waste metal streams corresponding to different alloys. A difference between grades of aluminium chips allows recycling above cast aluminium grade (see also new proposed BEMP below).
- Cover both in-house and outsourced briquetting.

Environmental benefits:

- Compacting aluminium chips results in lower oxidation losses when the aluminium is recycled => positive downstream impact.

Economics:

- Payback can be less than 2 years when purchase of grinding oil costing 2 euros/litre is avoided.

Indicator:

- Percentage of oil content in swarfs and chips (as indicator) is currently used in the sector.

Actions

Lennart S to propose a benchmark and provide information on the oil content in grinding swarf or turning chips as indicator.

4. New proposed BEMPs on removing processes

- Valorisation of the waste
 - Not mixing different grades waste aluminium alloys
 - Keeping different types of aluminium separate (and e.g. monitoring iron content), a high value recycling is possible. If not, all aluminium chips will end in the casting industry (low value).
 - Meltless recycling of swarf/chips.
- Increase the material removal rate in machining.

Action Wim to provide data.

D. Treatment processes

1. Reduce the energy for paint booth HVAC with predictive control (BEMP 2.3.9)

There was a general agreement among participants on the concept of this BEMP. The applicability for SMEs needs to be further investigated in order to clarify the relevance of this technique for them.

Actions:

TWG members: to go back to their network for more case studies, more specific for SME's.
Orsolya will share data for the implementation of the technology in her company when possible.

2. Selection and optimisation of thermal processes for curing wet-chemical coatings on metal products (BEMP 2.3.10)

This BEMP needs to be substantially reviewed. The text (incl. the title) could be developed as guidance (referencing the relevant BREFs) on how to select the right coating and the right curing process to improve the environmental performance. More in detail, the discussions highlighted that:

Description:

- The current text of the BEMP focuses on organic coatings and dry (powder) coating; e.g. it is not relevant for metal or ceramic coatings.
- The BEMP must first focus on the selection of the type of coating (depending on the material to be coated and depending on the use of the materials afterwards). In a second step the BEMP must focus on the selection of the best coating process for the selected material.

- Cross-link to other BEMPs i.e. the BEMP on proper selection of coatings for tools (see section IX.A.1).
- Consider including the aspect of recycling of coating powders, taking inspiration from the company Dokota which collect the used coating powders to employ them for the production of other materials.
- Consider redeveloping the BEMP with a more holistic approach: a BEMP guiding SMEs through the content of the relevant BREFs.

Cross media effects:

- Waste from powder coating (the background report contains an example on this under section 2.2.3).
- Anodizing processes use also energy and chemicals.

Actions:

JRC: double check the potential overlapping of this technique with the content of the BREF.

TWG members: to provide information concerning applicability.

3. New proposed BEMPs

- BEMP on waste water treatment (e.g. evaporation processes)
 - JRC will check this against the scope of the relevant BREFs
 - **Lennart S.** to provide references on these technologies

X. BEMPs concurrent engineering and product design

1. Remanufacturing of high value components (BEMP 2.4.1)

There was a general agreement among participants on the concept of this BEMP, although it needs some editing and extra data (as well as clarifying the definition of remanufacturing and perhaps mention also refurbishment). More in detail, the discussions highlighted that:

Description:

- Broaden the BEMP and consider adding new dimensions:
 - The development of remanufacturing manuals, publication of data and information storage for products manufactured...
 - circular economy business models (e.g. offering of remanufacturing services for your products) beyond "design for remanufacturing".
- Terminology:
 - insert a good definition of remanufacturing and mention refurbishment if relevant.
- Mention examples for railway and aerospace (landing gear).
- Consider making a reference in the document to the new British standard for circular economy (BS8001).
- A new BEMP could be the inclusion of indicators on the products that tell the user when it needs refurbishment.

Applicability:

- There are some barriers: the classification and regulation for new products is very strict and remanufacturing is not always possible.

- Data management on the specification of the different parts and products is needed (e.g. storage of data).
- The number of pieces (the scale) must be high enough to start up a remanufacturing line.
- In some cases remanufacturing is not the most environmentally friendly option (e.g. if high energy use in use phase and new products are lighter and thus more energy efficient).

Indicators

- Need to be improved.

Actions:

Mark to send information on Rype Office and an example on plain bearings (Babbitt).

Rachel to send a definition of remanufacturing and information on the BS standard, as well as relevant examples from the H2020 remanufacturing network.

Lennart S to send information on case studies

2. Co-design and open innovation with downstream partners to reduce environmental impact during product life cycle (BEMP 2.4.2)

Participants agreed that this BEMP needs to be reconsidered and that its concept can be included in the overarching BEMP that needs to be developed.

3. New proposed BEMPs

- A new BEMP which presents and references the relevant BREFs for this sector
 - It is important that the environmental aspects covered by the BREFs be also mentioned in this document. Indeed, those are often very important aspects for this sector and we should avoid that they are overlooked by companies (especially SMEs or companies with facilities below the IED size threshold).
 - Two options were discussed: an overarching BEMP making reference to the relevant BREF documents, or several BEMPs (one per chapter?) linking to specific sections of the appropriated BREF documents.
 - The TWG members stated that the second option would be preferred because it would be more user-friendly for the user of the document.
 - JRC will check with the BREF colleagues whether this is a feasible option (knowing that BREFs undergo periodical revision and that we should ensure that the links are done at a level where that stay relevant).

AOB

Participants asked about the dissemination of the final best practice report and SRD. DG ENV is starting with a pilot project on the tourism sector of a dissemination tool/interface that would facilitate the access to the information in the best practice report and SRD by SMEs.

Participants also discussed how these documents will be used (e.g. which professionals do we target within the companies?). The idea is to write something that can be interesting and provide inspiration to the environmental manager, which has a good overview but may not be expert in individual processes.

Inputs from the TWG will be useful to provide guidance on how to best structure the document and present the information so that it is the most useful to the target group, as well as on the best dissemination channels.

Additionally, some participants asked to fix as soon as possible the date for the second TWG meeting which is planned to take place around September 2017.

Finally, the JRC highlighted that all information and inputs can be sent to: jrc-ipts-emas@ec.europa.eu. (if possible before January 2017).

Annex A. - Programme

KICK-OFF MEETING OF THE TECHNICAL WORKING GROUP FOR THE EMAS SECTORAL REFERENCE DOCUMENT ON BEST ENVIRONMENTAL MANAGEMENT PRACTICES FOR THE FABRICATED METAL PRODUCTS SECTOR

BRUSSELS, 21 – 22 SEPTEMBER 2016

AGENDA – DAY 1

Wednesday 21 st September – Venue: Albert Borschette Conference Centre, Rue Froissart 36, Brussels (room 0B)		
Arrival and registration of participants		09:15 – 10:00
Opening and welcome		10:00 – 10:15
Introduction of experts		10:15 - 10:45
Purpose and goals of the meeting		10:45 - 11:00
Introduction of the sectoral reference documents on best environmental management practice (BEMP) and lessons learnt so far		11:00 - 11:30
Overview of the fabricated metal products sector and its environmental aspects		11:30 - 12:00
Definition of the scope of the sectoral reference document		12:00 - 12:45
Lunch break		12:45 - 14:00
Techniques used in the fabricated metal products sector to improve supporting processes - management, procurement and supply chain management		14:00 - 15:00
Techniques used in the fabricated metal products sector to improve supporting processes - optimisation of utilities		15:00 – 16:30
Coffee break		16:30 - 17:00
Techniques used in the fabricated metal products sector to improve manufacturing processes - all manufacturing processes		17:00 - 17:45
Wrap-up and close of the day		17:45 - 18:00

**KICK-OFF MEETING OF THE TECHNICAL WORKING GROUP FOR THE EMAS SECTORAL REFERENCE
DOCUMENT ON BEST ENVIRONMENTAL MANAGEMENT PRACTICES FOR THE FABRICATED METAL
PRODUCTS SECTOR**

BRUSSELS, 21 - 22 SEPTEMBER 2016

AGENDA – DAY 2

Thursday 22 nd September 2016 – Venue: Albert Borschette Conference Centre, Rue Froissart 36, Brussels (room 0B)		
Opening of the day		09:00 - 09:15
Techniques used in the fabricated metal products sector to improve manufacturing processes - forming and removing processes		09:15 - 10:30
Coffee Break		10:30 - 11:00
Techniques used in the fabricated metal products sector to improve manufacturing processes - finishing processes		11:00 - 12:30
Lunch break		12:30 – 14:00
Techniques used in the fabricated metal products sector for concurrent engineering and product design		14:00 – 14:45
Summary of the working group discussions		14:45 - 15:45
Wrap-up and close of workshop		15:45 - 16:30

Annex B – Participants

An	DERDEN	VITO
Arkaitz	ANDEREZ AMORROSTA	Gonvarri Steel Services
Belen	SÁNCHEZ	Gestamp
Felipe	MARTÍNEZ RODRÍGUEZ	European Aluminium
Georgios	SKORDARIS	Aristotle University of Thessaloniki
German	ESTEBAN MUÑIZ	European Commission - DG RTD
Heidi	VAN WAES	Agoria
Ioannis	ANTONOPOULOS	European Commission - JRC
Kostas	LIAPIS	Alumil S.A.
Lennart	HERMANS	CDP
Lennart	SCHLEICHER	Schäffler AG
Liesbet	VAN DEN ABEELE	VITO
Louis	BRIMACOMBE	IOM3 - Institute of Materials, Minerals and Mining
Malte	ZIMMER	CETS - European Committee for Surface Treatment
Marco	DRI	European Commission - JRC
Mark	JOLLY	Cranfield University
Michael	BENNET	European Commission - DG GROW
Nicholas	ORYINO	EFCEM - European Federation of Catering Equipment Manufacturers
Orsolya	MALLÁR-VARGA	Metaplast Gear Technology Kkt.
Paolo	CANFORA	European Commission - JRC
Peter	FISCHER	Peter Fischer Managementberatung
Pierre	GAUDILLAT	European Commission - JRC
Rachel	WAUGH	Oakdene Hollins
Radostina	PETROVA	European Commission - DG RTD
Sébastien	PAQUOT	European Commission - DG ENV
Siebe	JANSSENS	VITO
Sigrid	LINHER	ORGALIME
Silvia	VECCHIONE	ACEA - European Automobile Manufacturers' Association
Stefan	HOERMANN	Global Nature Fund
Thomas	VANDENHAUTE	Sirris
Wim	DEWULF	KU Leuven

Annex C – Slides



Purposes and goals of the kick-off meeting



Marco Dri

jrc-ipts-emas@ec.europa.eu

European Commission
Joint Research Centre (JRC)
Industrial Leadership and Circular Economy Unit



Environmental Management System (EMS)

An EMS:

- is a tool that provides organisations with a method to systematically manage and improve the environmental aspects of their (production) processes.
- It helps organisations to achieve their environmental obligations and performance goals.



2



EMAS

EU Eco-Management and Audit Scheme (EMAS) is established by EU regulation (EC) No 1221/2009




EMAS Performance. Credibility. Transparency

EMAS is:

- Open for companies and other organisations;
- A voluntary management tool to evaluate, report and improve the environmental performance;



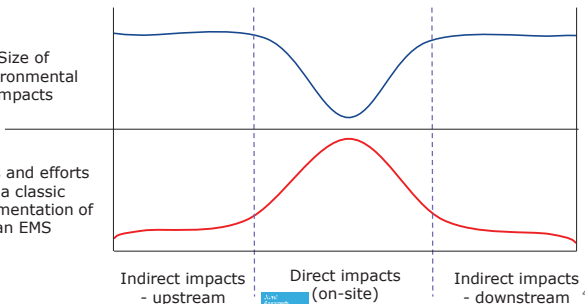
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Need to focus on the most relevant environmental impacts

Size of environmental impacts

Focus and efforts in a classic implementation of an EMS



4

European Commission



According to the EMAS Regulation, the European Commission shall develop EMAS Sectoral Reference Documents on Best Environmental Management Practices (BEMPs)

BEMPs help your organisation to improve its environmental performance and are a key element of the **EMAS** framework.

European Commission

GO GREEN WITH BEST ENVIRONMENTAL MANAGEMENT PRACTICES!




BEMP
Best practices to reduce environmental impacts
Already in Use by Best Environmental Performers

→ Practical Guidance + Environmental Performance Indicators + Benchmarks of Excellence

European Commission

BEMPs for 11 sectors

The European Commission cooperates with experts and stakeholders from different sectors to identify BEMPs. As a result of this cooperation, Sectoral Reference Documents for 11 sectors are currently under development.



WORKING GROUPS
JRC & DG Environment in close cooperation with:

- Research centres and universities
- Industry associations
- Companies
- EMAS verifiers
- Member States
- EMAS organisations
- Environmental NGOs
- Technology providers

7

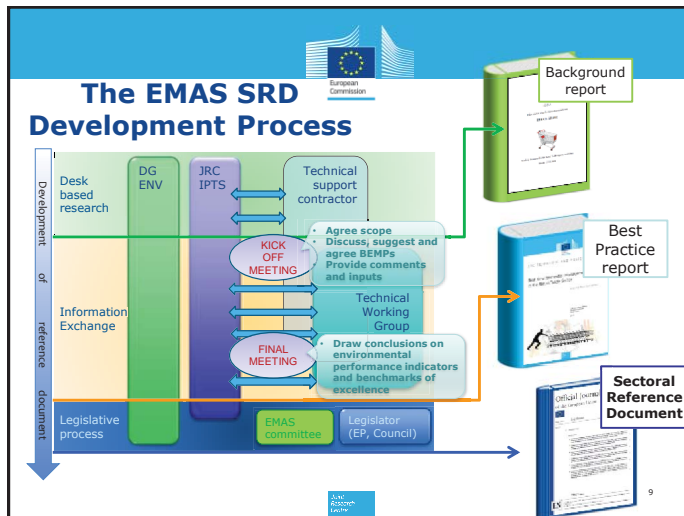
European Commission

Methodology for developing the SRDs

Each SRD is developed according to the following logical steps:

- Define the scope of the document and identify relevant actors;
- Target processes associated with the greatest environmental impact;
- Identify relevant environmental performance indicators for each process;
- Identify frontrunner actors for particular processes;
- Describe best environmental practices with reference to frontrunner application;
- Derive "benchmarks of excellence" from front-runner performance;
- Clearly state applicability.

8



Purposes and goals of the meeting

- to know each other
- to exchange views
- to discuss the development of the Sectoral Reference Document (organisation of the information exchange)
- to discuss the timing

Purposes and goals of the meeting

To discuss:

- Scope of the document for the Fabricated Metal Products sector
- Environmental aspects of the Fabricated Metal Products sector
- Proposals for best environmental management practices
- First ideas about environmental performance indicators

Thank you!

**Paolo Canfora
Marco Dri
Ioannis Antonopoulos
Pierre Gaudillat**

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<http://susproc.jrc.ec.europa.eu/activities/emas/index.html>


European Commission


Introduction to the sectoral reference documents and lessons learnt



Pierre Gaudillat

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European Commission
Joint Research Centre (JRC)
Industrial Leadership and Circular Economy Unit




European Commission

Main elements of the sectoral reference documents


The sectoral reference documents comprise 3 main elements:

- Best environmental management practices (BEMPs)
 - Food waste minimisation by retailers
- Environmental performance indicators
 - Kg waste generation per m² of sales area
- Benchmarks of excellence
 - Zero food waste sent to landfill or incineration plant

An example from:

2

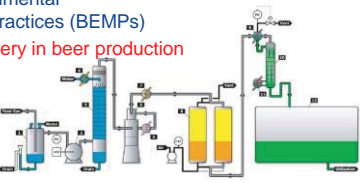


European Commission

Main elements of the sectoral reference documents

The sectoral reference documents comprise 3 main elements:

- Best environmental management practices (BEMPs)
 - CO₂ recovery in beer production
- Environmental performance indicators
 - kg CO₂ recovered / hL beer produced
- Benchmarks of excellence
 - 50% of CO₂ produced by fermentation recovered

An example from:

3


European Commission

Best Environmental Management Practices (BEMPs)

What is BEMP:

- those techniques, measures or actions that allow organisations of a given sector to **minimise their impact on the environment**
- direct** and **indirect** aspects
- technical/technological** as well as **management /organisational** type
- fully implemented** by best performers
- technically feasible** and **economically viable**



4

Best Environmental Management Practices (BEMPs)

What is not BEMP:

BEMP is what goes well beyond common practice

but is already fully implemented

and widely applicable

- Obsolete techniques
- Common practice
- Good practice
- Emerging techniques
 - are available and innovative
 - not yet proved their economic feasibility
 - not yet implemented at full scale

5

Best Environmental Management Practices (BEMPs)

Description of BEMPs (requires detailed technical information):

- Description
- Achieved environmental benefit
- Appropriate environmental indicator
- Cross-media effects
- Operational data
- Applicability
- Economics
- Driving force for implementation
- Reference organisations
- Reference literature

Structure similar to Best Available Technique Reference Documents (BREFs) according to Industrial Emission Directive

6

Environmental Performance Indicators and Benchmarks of Excellence

- **Environmental performance indicators**
 - "specific expression that allows measurement of an organisation's environmental performance" (EMAS Regulation)
- **Benchmarks of excellence**
 - exemplary environmental performance

already in use

environmentally meaningful

can be a proxy

very ambitious

achieved by frontrunners

not a target but a measure of what is possible

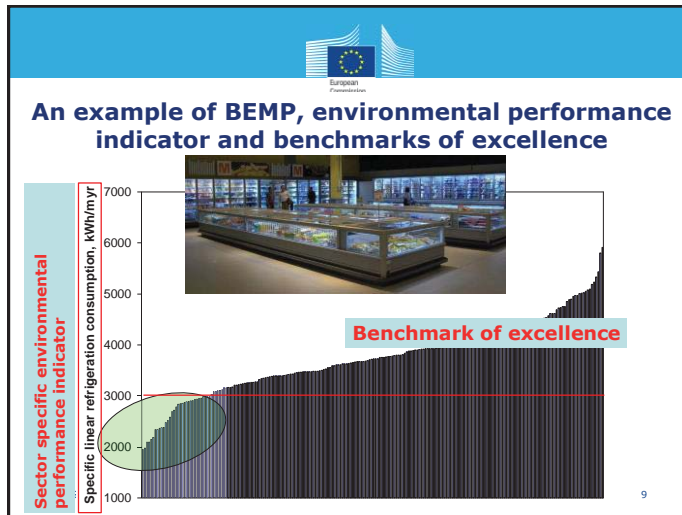
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How to identify BEMPs

The frontrunner approach



8



- 
European Commission
- ### Use of the EMAS SRDs
- **EMAS registered organisations:** According to the EMAS regulation "Where sectoral reference documents [...] are available for the specific sector, the assessment of the organisation's environmental performance shall take into account the relevant document" (Regulation EC 1221/2009 Article 4.1(d)).
 - Information on (likely) most relevant environmental aspects.
 - Inspiration on what measures can be implemented next for continuous environmental performance improvement.
 - Recommended environmental performance indicators.
 - Value beyond EMAS: Reference documents for all organisations in the sectors covered which intend to improve their environmental performance
- 12



Lessons learnt

Environmental performance indicators and benchmarks

- In many cases, clear conclusions on environmental indicators and also on benchmarks of excellence could be drawn.
- Quantitative distribution not always available but other effective methods for benchmarking can be used.
- A key role of the technical working group is to validate the findings, and to draw conclusions on environmental performance indicators and benchmarks of excellence



13



Lessons learnt

Technical Working Group:

- allows access to a wider network
- constructive and supportive but very different contribution intensities
- composition may change from kick-off to final meeting

Feedback framework

- comments were submitted in an informal way (no template)
- using a template may discourage to send comments



14



Interaction between EMAS and other policy instruments



* Ensure a high level of protection of human health and the environment from the risks that can be posed by chemicals
 ** Restricts (with exceptions) the use of hazardous materials in the manufacture of various types of electronic and electrical equipment



Thank you!



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10/10/2016



Technical working group meeting - Best Environmental Management Practice for the Fabricated Metal Products Manufacturing Sector

Kick off Meeting, 21-22 September 2016 – Brussels (BE)

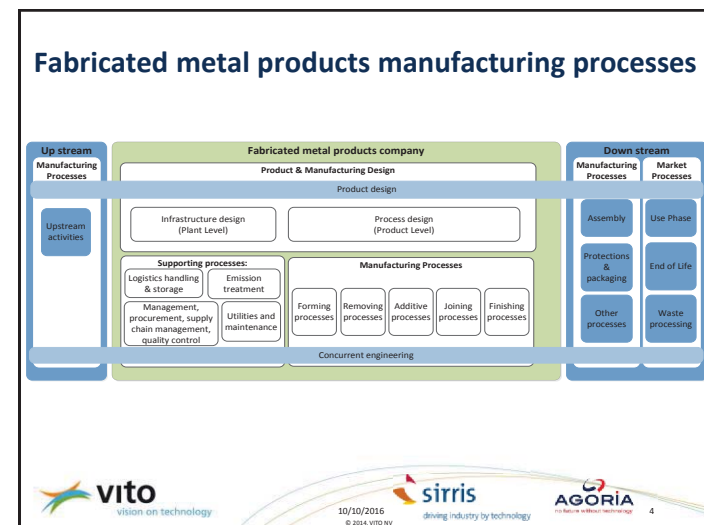
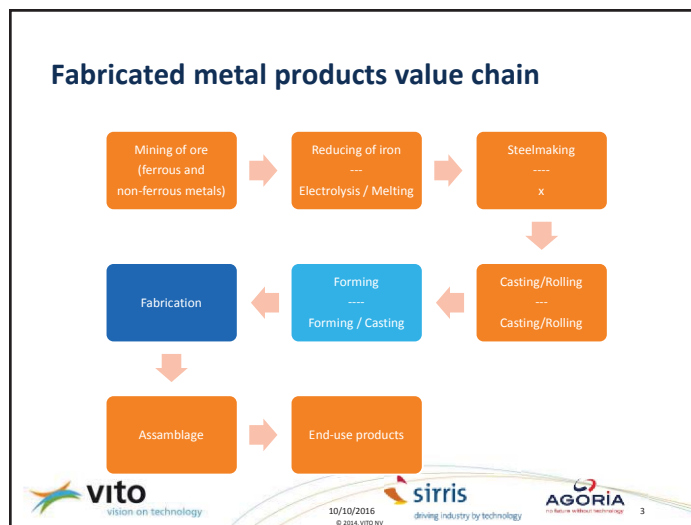



Liesbet Van den Abeele

Overview of the fabricated metal products manufacturing sector and its environmental aspects

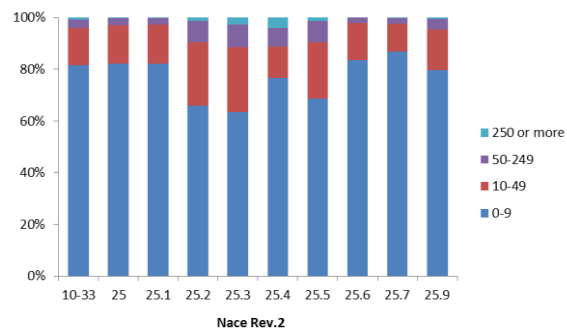
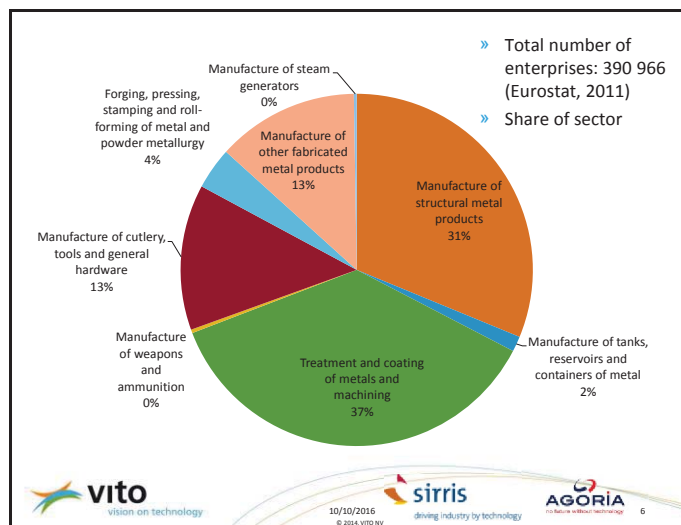




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Fabricated metal products sector – Nace 25

NACE code	Description
25	Manufacture of fabricated metal products, except machinery and equipment
25.1	Manufacture of structural metal products (e.g. doors and windows)
25.2	Manufacture of tanks, reservoirs and containers of metal (e.g. radiators, boilers, tanks, etc.)
25.3	Manufacture of steam generators, except central heating hot water boilers
25.4	Manufacture of weapons and ammunition
25.5	Forging, pressing, stamping and roll-forming of metal; powder metallurgy
25.6	Treatment and coating of metals; machining
25.7	Manufacture of cutlery, tools and general hardware
25.9	Manufacture of other fabricated metal products (e.g. drums and containers, metal packaging, wire products, chains, screws, etc.)



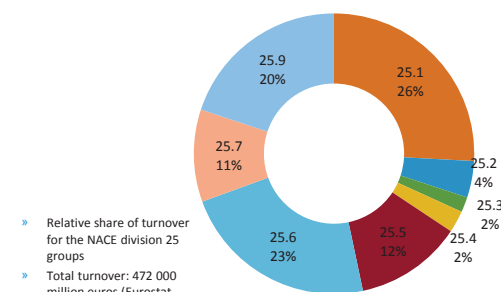
» Share of enterprise size classes

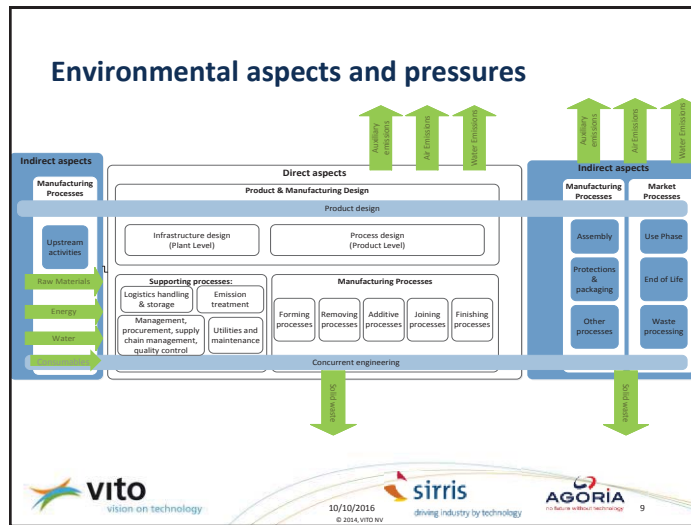
» Nace 10-33: Total manufacturing

» Nace 25: Fabricated metal products manufacturing

• Lot of small enterprises with less than 10 persons employed (82%)

Turnover





Direct environmental aspects and pressures

Legend

+ small impact

++ medium impact

+++ large impact

+ impact not applicable

/

Direct aspects

Infrastructure design

Process Design

Supporting processes

Manufacturing Processes

- Management, procurement, supply chain management, quality control

Logistics, handling and storage

Emission Treatment: water treatment - air treatment

Utilities and maintenance: process heating & cooling - compressed air - HVAC building

Forming Processes: - forging - bending

Removing Processes: - turning, milling - EDM processes - cutting, punching, laser

Additive processes: - 3D printing

Joining Processes: - welding - brazing

Finishing Processes: - heat treatment - surface treatment - electrochemical - laser operations

Packaging

	Resource use	Direct aspects														
		Infrastructure design							Process Design							
		Supporting processes							Manufacturing Processes							
		- Management, procurement, supply chain management, quality control	Logistics, handling and storage	Emission Treatment: water treatment - air treatment	Utilities and maintenance: process heating & cooling - compressed air - HVAC building	Forming Processes: - forging - bending	Removing Processes: - turning, milling - EDM processes - cutting, punching, laser	Additive processes: - 3D printing	Joining Processes: - welding - brazing	Finishing Processes: - heat treatment - surface treatment - electrochemical - laser operations	Packaging					
	Raw Materials	+++	+	/	/	++	+++	++	++	++	++	++	++	++	++	++
	Energy	++	+	++	+++	++	++	++	++	++	++	++	++	++	++	++
	Water	+	/	/	+	+	+	+	+	+	+	+	+	+	+	+
	Consumables	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Water	/	/	+++	+	+	+	+	+	+	+	+	+	+	+	+
	Air	/	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Odour	/	/	+	+	+	+	+	+	+	+	+	+	+	+	+
	Other (noise,)	/	+	+	++	++	++	++	++	++	++	++	++	++	++	++
	Non hazardous	+	/	++	/	+	++	+	+	++	+	+	+	+	++	++
	Hazardous	/	/	+	/	/	/	/	/	/	/	/	/	/	+++	++
	Liquid waste	/	/	/	/	/	/	/	/	/	/	/	/	/	+++	++

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Direct environmental aspects and pressures

Legend
+ small impact
++ medium impact
+++ large impact
+ impact not applicable

	Direct aspects	
	Infrastructure design	Process Design
	Supporting processes	Manufacturing Processes
	Management, procurement, supply chain management and quality control <ul style="list-style-type: none"> - In general low impact on the environment - High potential in influencing the environmental impact <ul style="list-style-type: none"> - On resources used - On waste generated / reused 	
Resource use		
Raw Materials	+++	++
Energy	++	++
Water	+	+
Consumables	++	++
Emissions		
Water	/	/
Air	/	+
Odour	/	+
Other (noise,)	/	+
Waste		
Non hazardous	+	++
Hazardous	/	++
Liquid waste	/	++

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Direct environmental aspects and pressures

Legend
+ small impact
++ medium impact
+++ large impact
+ impact not applicable

	Direct aspects	
	Infrastructure design	Process Design
	Supporting processes	Manufacturing Processes
	Logistics, handling and storage <ul style="list-style-type: none"> - Low impact - Out of the scope of this study 	
Resource use		
Raw Materials	+	++
Energy	+	++
Water	/	+
Consumables	+	++
Emissions		
Water	/	/
Air	+	+
Odour	/	++
Other (noise,)	+	++
Waste		
Non hazardous	/	++
Hazardous	/	++
Liquid waste	/	++

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Direct environmental aspects and pressures

Legend		Direct aspects									
		Infrastructure design					Process Design				
		Supporting processes					Manufacturing Processes				
+	small impact										
++	medium impact										
+++	large impact										
+	large impact										
/	not applicable										
Additive processes											
3D printing are only used in specific subsectors. They have an impact on											
<ul style="list-style-type: none"> - Raw material used - Energy 											
- In some cases they can be an environmental friendly alternative											
Resource use	Raw Materials						++				
	Energy						++				
	Water						/				
	Consumables						/				
Emissions	Water						/				
	Air						/				
	Odour						/				
	Other (noise,)						+				
Waste	Non hazardous						+				
	Hazardous						/				
	Liquid waste						/				

Direct environmental aspects and pressures

Legend		Direct aspects									
		Infrastructure design					Process Design				
		Supporting processes					Manufacturing Processes				
+	small impact										
++	medium impact										
+++	large impact										
+	large impact										
/	not applicable										
Joining Processes (e.g. welding, brazing, gluing, pressing) have an impact on											
<ul style="list-style-type: none"> - Resources used <ul style="list-style-type: none"> - Raw material - Energy - Consumables (welding electrodes, shielding gases, glues) - Emission <ul style="list-style-type: none"> - Odour - Dust 											
Resource use	Raw Materials						+				
	Energy						++				
	Water						/				
	Consumables						++				
Emissions	Water						/				
	Air						++				
	Odour						++				
	Other (noise,)						+				
Waste	Non hazardous						+				
	Hazardous						/				
	Liquid waste						/				

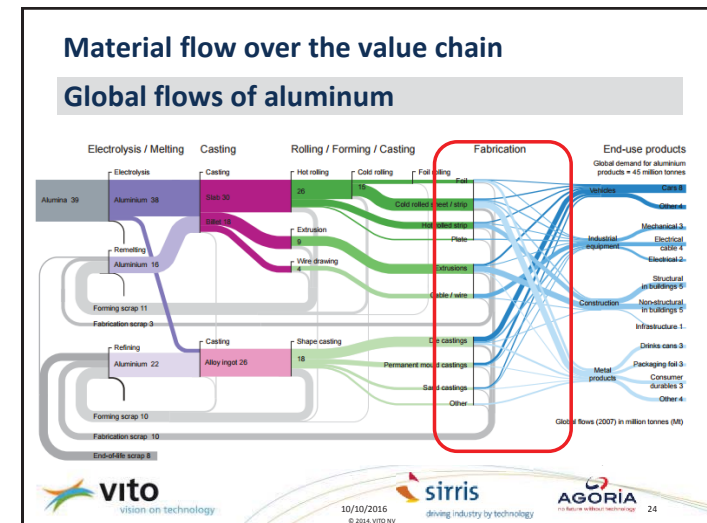
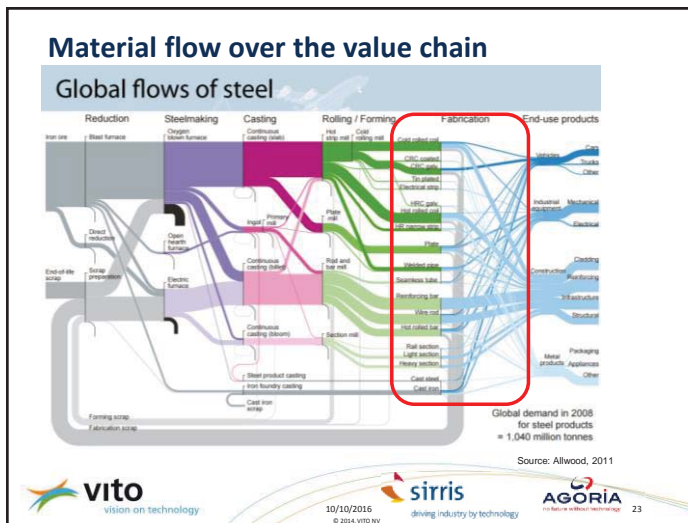
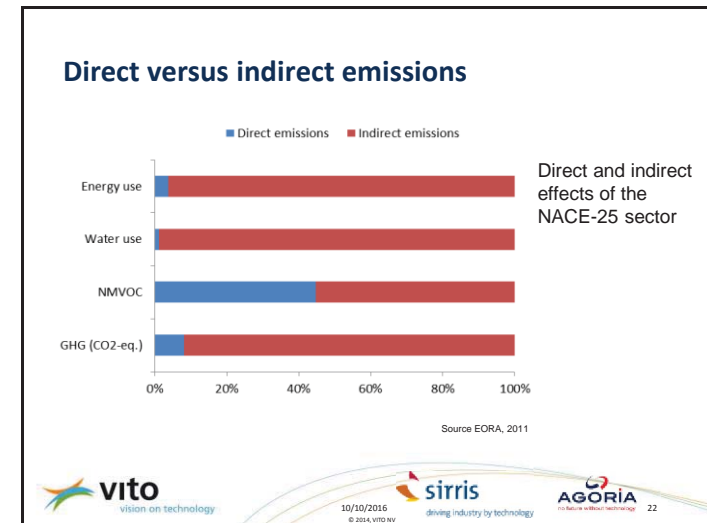
Direct environmental aspects and pressures

Legend		Direct aspects									
		Infrastructure design					Process Design				
		Supporting processes					Manufacturing Processes				
+	small impact										
++	medium impact										
+++	large impact										
+	large impact										
/	not applicable										
Finishing processes like heat treatment, surface treatment, laser operations (e.g. polishing, engraving) have different impacts:											
<ul style="list-style-type: none"> - Water uses and emissions to water (surface treatment); - Emissions to air (dust, LVOC, ...) - Hazardous waste and liquid streams (heavy metals, organic compounds). 											
Resource use	Raw Materials						+				
	Energy						++				
	Water						+++				
	Consumable						++				
Emissions	Water						+++				
	Air						++				
	Odour						++				
	Other (noise,)						++				
Waste	Non hazardous						+				
	Hazardous						+++				
	Liquid waste						+++				

Direct environmental aspects and pressures

Legend		Direct aspects									
		Infrastructure design					Process Design				
		Supporting processes					Manufacturing Processes				
+	small impact										
++	medium impact										
+++	large impact										
/	not applicable										
Packaging processes											
<ul style="list-style-type: none"> - Impact on <ul style="list-style-type: none"> - raw material use - Non hazardous waste - Out of the scope of this study 											
Resource use	Raw Materials						+				
	Energy						+				
	Water						+				
	Consumables						+				
Emissions	Water						+				
	Air						+				
	Odour						+				
	Other (noise,)						+				
Waste	Non hazardous						+				
	Hazardous						+				
	Liquid waste						+				

Indirect environmental aspects and pressures					
Product Life Cycle					
Concurrent Engineering and Product Design					
Indirect aspects	Direct aspects			Indirect aspects	Direct & Indirect aspects
upstream	NACE 25 Product & Manufacturing Design			down stream	value chain
Design Process	Supporting processes	Manufacturing Processes	Manufacturing Processes	Design Process	Market processes
- raw material production	- Management, procurement, supply chain management, quality control	- Forming	- Assembly	- Material selection	- Use Phase
- production equipment	- Logistics handling and storage	- Removing	- Product finishing	- Protection & Packaging	- Refurbishment
	- Emission treatment	- Additive	- Logistics	- Disassembly	- Material recycling
	- Utilities and maintenance	- Joining			
		- Finishing			
		- Packaging			
Resources					
Raw Materials	+++	See previous table	+	+++	/
Energy	++		+++	++	/
Water	+		/	+	/
Consumables	+		+	++	/
Emissions					
Water	+	See previous table	/	/	/
Air	+		+	/	/
Odour	/		/	/	/
Other (noise, vibration, etc.)	+		+	/	+
Waste					
Non hazardous	++	See previous table	++	+	++
Hazardous	+		/	/	+
Liquid waste	+		+	/	/



An Derden

Definition of the scope of the sectoral reference document - EU legislation, policy instruments and existing best practice guidance on environmental aspects in the sector

Out of scope of proposed BEMPs

- » Processes and environmental aspect of companies in NACE 25 covered by
 - » BREFs, directly or indirectly linked to the manufacture of fabricated metal products
 - » EU legislation, policy instruments and best practice guidance

GENERAL

Industrial Emissions Directive = IED (2010/EU/75)

- » 7 old Directives
 - » IPPC Directive 2008/1/EG
 - » Large combustion plants 2001/80/EG
 - » Waste Incineration 2000/76/EG
 - » Solvent Directive 1999/13/EG
 - » TiO_2 (3) 78/176/EEG, 82/883/EEG, 92/112/EEG

IPPC = Integrated Pollution Prevention & Control
BAT as reference point for permit conditions



Integration and
revision

- » 1 new Directive
 - » IED (2010/EU/75)



ACTIVITIES

Applicability: activities mentioned in Annex I

2. Production and processing of metals

- BREF NFM** Metal ore (including sulphide ore) roasting or sintering
- BREF FMP** Production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour
- BREF FMP** Processing of ferrous metals:
 - operation of hot-rolling mills with a capacity exceeding 20 tonnes of crude steel per hour;
 - operation of smitheries with hammers the energy of which exceeds 50 kilojoule per hammer, where the calorific power used exceeds 20 MW;
 - application of protective fused metal coats with an input exceeding 2 tonnes of crude steel per hour.
- BREF FMP** Operation of ferrous metal foundries with a production capacity exceeding 20 tonnes per day
- BREF NFM** Processing of non-ferrous metals:
 - production of non-ferrous crude metals from ore, concentrates or secondary raw materials by metallurgical, chemical or electrolytic processes;
 - melting, including the alloyage, of non-ferrous metals, including recovered products and operation of non-ferrous metal foundries, with a melting capacity exceeding 4 tonnes per day for lead and cadmium or 20 tonnes per day for all other metals.
- BREF STM** Surface treatment of metals or plastic materials using an electrolytic or chemical process where the volume of the treatment vats exceeds 30 m³

ACTIVITIES

Applicability: activities mentioned in Annex I

6. Other activities

BREF STS Surface treatment of substances, objects or products using organic solvents, in particular for dressing, printing, coating, degreasing, waterproofing, sizing, painting, cleaning or impregnating, with an organic solvent consumption capacity of more than 150 kg per hour or more than 200 tonnes per year

» but also

BREF ENE **BREF ICS** **BREF LCP** **BREF WT** **BREF WI** **BREF SF**

» BREF Surface Treatment of Metals and Plastics (STM) & BREF Surface Treatment using Organic Solvents (STS) most direct linked to the Fabricated Metal Products value chain

ENVIRONMENTAL PARAMETERS

Examples of direct environmental parameters covered in the BREFs (directly or indirectly) linked to the manufacture of Fabricated Metal Products

BREF	environmental issues covered in the BREFs	Parameters
Industrial processes & related operations leading to BAT-AELs	emission into water air emissions	metals, surfactants (NPE and PFOS), complexing agents (cyanides and EDTA), chlorides, sulphates, phosphates, nitrates and anions NOx, HCl, HF, acid particulates, hexavalent chromium mist, ammonia, dust and solvents
Industrial processes & related operations NOT leading to BAT-AELs	energy consumables water raw materials waste	energy consumption use of chemicals for cleaning water consumption usage of raw materials occurrence of solid and liquid wastes

OTHER EU LEGISLATION

Energy

» 2012/27/EU13: Energy efficiency directive

Water

» 2000/60/EC14: Water framework directive

Consumables

» 1907/2006/EC: Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

Emissions to water

» 2000/60/EC: Water framework directive
» 2008/105/EC: Directive on environmental quality standards
» 2006/118/EC: Directive on the protection of groundwater against pollution and deterioration

Emissions to air

» 2001/379/EC: Council Decision Long Range Transboundary Air Pollution on Heavy Metals
» 2001/81/EC: Directive on national emission ceilings for certain atmospheric pollutants
» 2003/87/EC: European emission trading system (ETS) - greenhouse gas emission
»

OTHER EU LEGISLATION

Noise

» 2000/14/EC : Directive on noise emission in the environment by equipment for use outdoors

Waste

» 2008/98/EC: Waste Framework Directive
» 2012/19/EU: Directive on waste electrical and electronic equipment (WEEE)
» 2002/95/EC : Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (ROHS)
» 94/62/EC: Directive on packaging and packaging waste
» 850/2004/EC: Regulation on persistent organic pollutants
» 333/2011/EC: Regulation establishing criteria determining when certain types of scrap metal cease to be waste under Directive 2008/98/EC

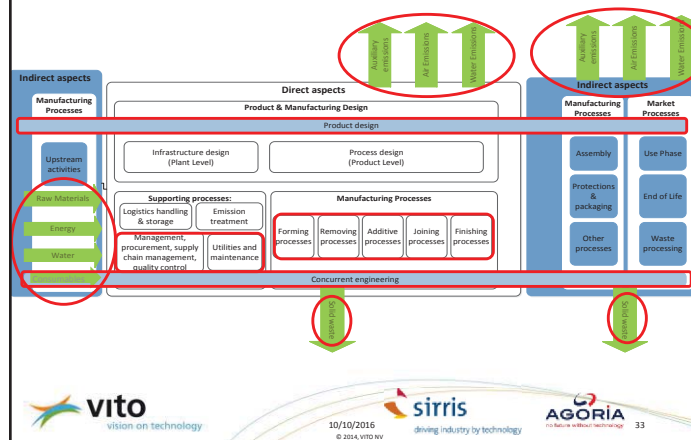
Raw Material

» /

Odour

» /

Proposal of scope for the BEMPs



Proposal of scope for the BEMPs – Activity level

- » Supporting processes:
 - » Management, procurement, supply chain management, quality control
 - » Utilities and maintenance
- » Manufacturing processes
 - » Forming processes
 - » Removing processes
 - » Additive processes
 - » Joining processes
 - » Finishing processes
- » Organisational level
 - » Product design
 - » Concurrent engineering

Proposal of scope for the BEMPs – environmental impact

- » Resources used
 - » Material
 - » Energy
 - » Water
 - » Consumables
- » Emissions to
 - » Water
 - » Air
 - » Odour, noise and vibrations
- » Waste
 - » Non-hazardous waste
 - » Hazardous waste
 - » Liquid waste

PROPOSED SCOPE

- » Does the TWG agree with our proposal of scope?
- » Are there any other ideas?

Overview of the proposed BEMPs

Overview of the proposed BEMPs

- **Supporting processes** (Section 2.2 of the background report)
 - Management, procurement and supply chain management (4 BEMPs)
 - Optimisation of utilities (6 BEMPs)
- **Manufacturing processes** (Section 2.3 of the background report)
 - Manufacturing processes – generally applicable techniques (3 BEMPs)
 - Forming processes (3 BEMPs)
 - Removing processes (2 BEMPs)
 - Finishing processes (2 BEMPs)
- **Concurrent engineering and product design** (Section 2.4 of the background report) (2 BEMPs)

For each BEMP identified,
we will present the
following elements:

Description

- Brief description of the proposed BEMP

Environmental benefits

- Environmental benefits of the proposed BEMP

Proposed indicators

- Main environmental indicators to monitor the implementation of the proposed BEMP

Proposed BEMPs part 1
Thomas Vandenhoute

Management, procurement and supply chain management

2.2 Proposed best environmental management practices for supporting processes

Management, procurement and supply chain management

- 2.2.1 Extend the lean principles with measure for energy and material consumption
- 2.2.2 Measures for stock reduction - while keeping customer demand flexibility
- 2.2.3 Cross-sectoral and value chain collaboration (by communication and integration)
- 2.2.4 Chemical leasing & Chemical management services

2.2.1 Extend the lean principles with measures for energy and material consumption

» Description

- » Overproduction
- » Waste of inventory
- » Waste of transportation
- » Waste of waiting
- » Production of defects
- » Waste of over-processing
- » Waste of unnecessary motion



2.2.1 Extend the lean principles with measures for energy and material consumption

» Environmental benefits

- » Various environmental benefits
 - » reduction of resource (materials) use
 - » Reduction of energy use and CO₂-emissions
 - » Significant reductions of waste

» Proposed indicators

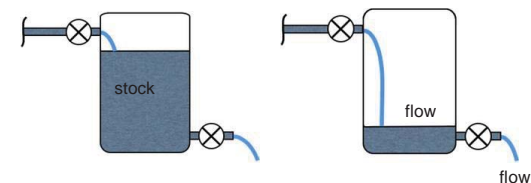
- » kg raw material used per produced unit
- » total energy use per produced unit
- » kg waste produced per year or per product

2.2.2 Measures for stock reduction - while keeping customer demand flexibility

» Description



Quick Response Manufacturing reduces the stock directly proportionally to the lead time.



2.2.2 Measures for stock reduction - while keeping customer demand flexibility

» Environmental benefits

- » Reducing defects due to faster detection has several environmental benefits:
 - » decrease of the number of products that must be scrapped
 - » less raw materials and energy used (due to fewer products)
- » Shifting to right sized equipment means that production equipment is sized to work best for the specific product mix being produced, as opposed to the equipment that would meet the largest possible projected production volume.
 - » Right sized equipment is typically less material and energy-intensive (per unit of production) than conventional, large-scale equipment
- » Less floor space for equal levels of production (and heating / lighting of space)

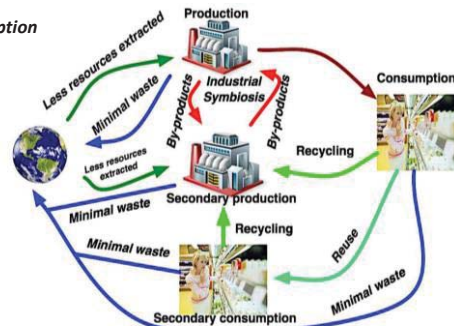
2.2.2 Measures for stock reduction - while keeping customer demand flexibility

» Proposed indicators

- » the product lead time
- » Additional indicators could be:
 - » kg WIP per product range or Focused Target Market Segment (FTMS)
 - » kg of products not meeting the quality requirements (non-conforming products) per total amount of products produced
 - » m² floor space for storage

2.2.3 Cross-sectoral and value chain collaboration (by communication and integration)

» Description



2.2.3 Cross-sectoral and value chain collaboration (by communication and integration)

» Example



2.2.3 Cross-sectoral and value chain collaboration (by communication and integration)

» Environmental benefits

- » Cross-sectoral and value chain collaboration between organisations can foster **optimal use of resources** (e.g. materials, equipment, capacity, etc.) **and energy** and lead to **more rational waste management**
- » Due to this optimisation significant reduction of CO₂ emissions can be achieved throughout the entire value chain



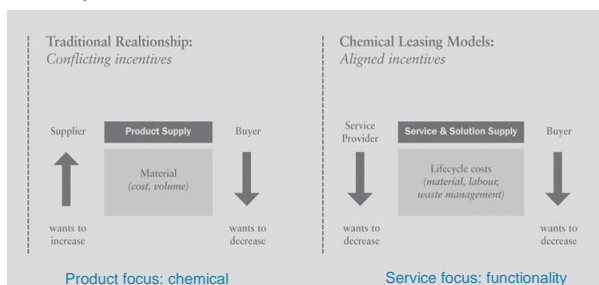
2.2.3 Cross-sectoral and value chain collaboration (by communication and integration)

» Proposed indicators

- » Participation in industrial symbiosis networks and exchange of material/energy etc. - Y/N
- » The amount of waste and sidestreams valorised outside the company
- » Use of by-products or other energy sources from other industries within the industrial symbiosis network in processes of the Fabricated Metal Products manufacturing company:
 - » scrap or other by-products – Y/N
 - » steam – Y/N
 - » renewable energy – Y/N

2.2.4 Chemical leasing & Chemical management services

» Description



2.2.4 Chemical leasing & Chemical management services

» Description



2.2.4 Chemical leasing & Chemical management services

» *Environmental benefits*

- » Reduction in the amount of chemicals used and disposed of
- » Reduction of the quantity and frequency of deliveries and associated packaging waste (pallets, shrink wrap, etc.)
- » Stimulation of substitution of hazardous chemicals
- » Reduction of customer's chemical waste
- » Avoidance of underutilised chemicals, especially in SMEs
- » Reduction of energy used, due to fewer cleaning cycles, reduced storage of chemicals
- » Reduction of the water use, due to fewer cleaning cycles

2.2.4 Chemical leasing & Chemical management services

» *Proposed indicators*

- » Use of solvents or chemicals, typically expressed as amount of chemicals used (kg) per part cleaned or amount of chemicals used (kg) per m² cleaned
- » Emission of VOC, typically expressed as amount of VOC (g) per part cleaned and related health and safety risks
- » Energy use for processes related to the use of solvents or chemicals, typically expressed as number of parts cleaned per kW

PROPOSED BEMPS – SUPPORTING PROCESSES

Management, procurement and supply chain management

- 2.2.1 Extend the lean principles with measure for energy and material consumption
- 2.2.2 Measures for stock reduction - while keeping customer demand flexibility
- 2.2.3 Cross-sectoral and value chain collaboration (by communication and integration)
- 2.2.4 Chemical leasing & Chemical management services

» Any other BEMP proposals?

Proposed BEMPs part 2
Liesbet Van den Abeele
An Derden

Optimisation of utilities

2.2 Proposed best environmental management practices for the supporting processes

Optimisation of utilities

- 2.2.5 Energy management
- 2.2.6 Efficient ventilation
- 2.2.7 Optimal lighting
- 2.2.8 Energy and water savings of cooling circuits
- 2.2.9 Efficient use of compressed air systems
- 2.2.10 Reduction of standby energy of metal working machines

2.2.5 Energy management

» Description

- » Cross-cutting proposed BEMP
 - » Focus on the overall energy efficiency of the plant, rather than on an individual process or solution

» Key elements

- » top management is committed to the energy policy, strategy and action plan in place and regularly reviewed
- » Organisational structure: energy management is fully integrated into the senior management structure with clear accountability for energy consumption
- » Appropriate and comprehensive staff training on energy management, matching the identified needs
- » Extensive communication of energy issues within and outside the organisation
- » Investments: funds routinely committed to energy efficiency
- » Procurement: consider energy consumption in all procurement

2.2.5 Energy management

» Environmental benefits

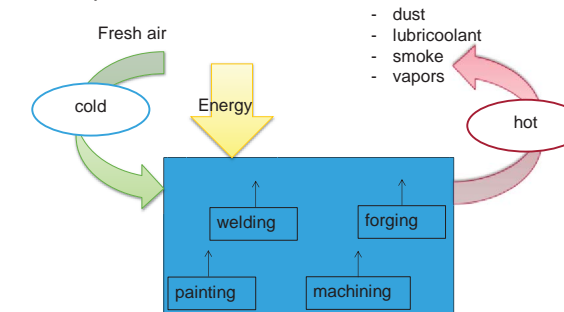
- » Energy savings

» Proposed indicators

- » Energy use (kWh_e and kWh_t /year; / month, / week)
- » Monitoring system for energy use in place – Y/N

2.2.6 Efficient ventilation

» Description



2.2.6 Efficient ventilation

- » Define the **actual** (and future) **needs** for ventilation
 - » Understand the building and its air flows
 - » Make an overview of sources of heat, humidity and pollutants (dust, fumes, etc.) in the building
 - » Reduce / Isolate emission sources where possible
- » **Audit**, to compare the defined needs with the current installation
- » (Re)design the ventilation
 - » Using variable speed drive motors for ventilation
 - » Optimizing position and orientation of blowers
 - » Controlling the air volume in function of the ventilation needs
 - » On-demand systems

2.2.6 Efficient ventilation

- » **Environmental benefits**
 - » Reduction of energy use
 - » Noise reduction due to lower fan speeds and lower extraction volumes

2.2.6 Efficient ventilation

- » **Proposed indicators**
 - » Type of ventilation system: demand driven – Y/N
 - » Use of energy per m³ building (installed kWh or m³/hour): dimensioning of installed ventilation capacity.
 - » The effective air volume extracted from the building
 - » Extracted air per hour (m³/h) or per shift
 - » Extracted air per produced batch of material X, Y, Z produced (m³)

2.2.7 Optimal lighting

- » **Description**
 - » Perform a **lighting study**, to define the actual (and future) needs of light
 - » Perform an **audit**, to compare the defined needs with the current installation
 - » Develop and **implement** a lighting plan delivering the optimal solution (light system, fitting, lamps, etc.; daylight, movement depending lighting control, etc.)

2.2.7 Optimal lighting

- » **Environmental benefits**
 - » Reduction of the electricity consumption
 - » This leads to an overall reduction of the indirect greenhouse gases (CO₂) emissions
- » **Cross-media effects**
 - » In case of insufficient lighting, the overall result can be improved lighting, without energy savings
- » **Proposed indicator**
 - » Electricity consumption (e.g. in kWh/m² lighted floor per year)

2.2.8 Energy and water savings of cooling circuits

- » **Define** the actual (and future) needs for cooling, reducing the demand where possible – e.g. for machine shops:
 - » Change fixed pumping capacity by demand driven pumps
 - » Optimize spray nozzles for grinding and reduce the cutting fluid pressure
 - » Reduce the temperature specifications where possible
- » **Audit**, to compare the defined needs with the current cooling installation
- » **(Re)design** cooling installation, taking into account
 - » Designing the system on machine level (instead of plant level)
 - » Select the optimal cooling tower for the company (energy efficiency, water saving, noise reduction)
 - » If possible, avoid open water cooling systems

2.2.8 Energy and water savings of cooling circuits

- » **Environmental benefits**
 - » Reduction of energy and water use
 - » By using less water, the water treatment volume can also be reduced. Especially in open cooling systems, the water volume to be treated (softening, filtering) is reduced considerably.
 - » The noise level of the system can be reduced significantly, benefiting employees as well as other actors like neighbours, wildlife, etc.

2.2.8 Energy and water savings of cooling circuits

- » **Proposed indicators**
 - » Energy consumption (kWh/year for cooling)
 - » Water consumption (m³/year for cooling)
 - » Sound level (dBA)

2.2.9 Efficient use of compressed air systems

- » **Description**
- » Mapping where and how the compressed air is used – for inefficient applications identify if other solutions are better fit for purpose:
 - » low-pressure uses of compressed air should be looked at with a critical eye to see if alternatives are possible and environmentally beneficial:
 - » Explosion hazards? Extreme temperatures? Need for cleanliness? Weight of the tool?
- » Optimization of the compressed air system configuration, e.g.
 - » Compressors with variable speed drivers
 - » Control of the compressed air system
 - » Air quality in function of the needs
 - » Optimising the air intake: quality, temperature
 - » Consider heat recovery

2.2.9 Efficient use of compressed air systems

- » Appropriate maintenance for compressed air systems:
 - » Leak reduction
 - » Implementation of preventive maintenance plan
 - » Appropriate removal of condensate
 - » Replace tools in time
 - » Lubricate properly

2.2.9 Efficient use of compressed air systems

- » **Environmental benefits**
 - » Reduction of the energy use
- » **Proposed indicators**
 - » Energy use per output (expressed in terms of kWh/kg, kWh per number of produced parts, etc).
 - » Compressed air production equipment power consumption (per system) in kWh, per day, per month, per year, etc.
 - » Compressed air flow (per system, division, etc.) in standard cubic meter per minute.

2.2.10 Reduction of standby energy of metal working machines

- » **Description**
 - » Proposed Cross-cutting BEMP:
 - » focus on the overall energy efficiency of the plant (coolant circulation, compressed air, auxiliary components: eg. electronics & fans)
 - » Key elements
 - » lowering standby power demand
 - » by selectively switching off non-required activities
 - » guidance list turned off components/functions @ specific moments
 - » programmed in a CNC controller
 - » limiting duration of standby activities
 - » by optimised production planning
 - » ↑ machine tool utilisation
 - » (temporary) switching off non-required machine tools

Examples:
shutting down non-essential functions
automatic activation before shift start

2.2.10 Reduction of standby energy of metal working machines

» *Environmental benefits*

- » reduction of energy consumption
 - » *Example CO₂ cutting laser:*
 - » up to 66% of power standby requirements
 - » by de-activation of non-essential subunits & ensure quick machine reactivation
- » pumps, electrical servo engines and other electrical components
 - » increased lifetime
 - » reduces maintenance costs
 - » lowered amount of spare parts needed in stock

cross media effects:

- » energy peak during start up
- » impairment of the energy balance
- » careful planning of the energy saving effects is a prerequisite

PROPOSED BEMPS – SUPPORTING PROCESSES

Optimisation of utilities

- 2.2.5 Energy management
- 2.2.6 Efficient ventilation
- 2.2.7 Optimal lighting
- 2.2.8 Energy and water savings of cooling circuits
- 2.2.9 Efficient use of compressed air systems
- 2.2.10 Reduction of standby energy of metal working machines

» Any other BEMP proposals?

Proposed BEMPs part 3

Thomas Vandenhaute

An Derden

Manufacturing processes – generally applicable techniques

2.3 Proposed best environmental management practices for the manufacturing processes

Generally applicable techniques

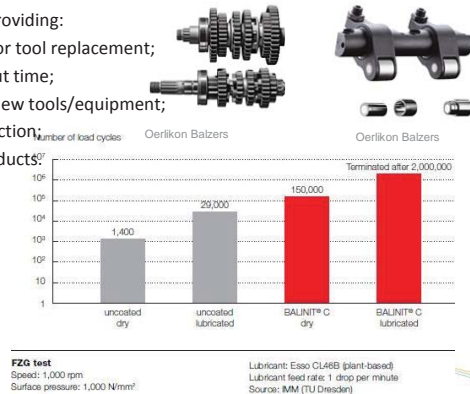
- 2.3.1 Application of solid low-friction coatings on tools and components
- 2.3.2 Application of wear- and corrosion-resistant coatings for lifetime extension of tools and equipment.
- 2.3.3 Selection of coolant as environmental and performance criterion

2.3.1 Application of solid low-friction coatings on tools and components

» Description

» Functional coating providing:

- » Less downtime for tool replacement;
- » Faster throughput time;
- » Cost savings on new tools/equipment;
- » Less scrap production;
- » Added value products;



2.3.1 Application of solid low-friction coatings on tools and components

» Environmental benefits

- » limited or no use of liquid lubricants
- » higher life time of tools and equipment leads to less scrap production and less material use to make new products
- » requires no liquid grease so operators are no longer exposed to (toxic) additives, VOCs, etc., resulting in healthier and cleaner work environment

» Proposed indicators

- » Amount of waste linked to the lubricants use: kg waste for disposal per year; kg waste for recycling per year
- » Amount of scrap production (number of waste products or kg of burr/production run or time magnitude)
- » Increased productivity (number of produced parts/tool).

2.3.2 Application of wear- and corrosion-resistant coatings of tools and equipment

» Description

» Functional coating with:

- » Less downtime for tool replacement;
- » Faster throughput time;
- » Cost savings on new tools/equipment;
- » Less scrap production;
- » Higher quality products;
- » Added value products.



2.3.2 Application of wear- and corrosion-resistant coatings of tools and equipment

» Environmental benefits

- » more efficient and a reduction of resource use, i.e. use of new materials for making new products.
- » Furthermore, due to the extended lifetime, there will be a reduced manufacturing of new products to replace the worn products with all environmental issues involved (carbon emissions, energy consumption, etc.)

» Proposed indicators

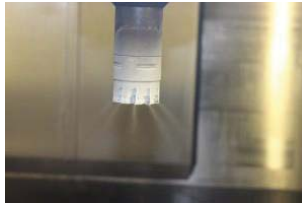
- » Amount of waste linked to the lubricants use: kg waste for disposal per year; kg waste for recycling per year.
- » Amount of scrap production (number of waste products or kg of burr/production run or time magnitude)
- » Increased productivity (number of produced parts/tool).

2.3.3 Selection of coolant as environmental and performance criterion

» Description

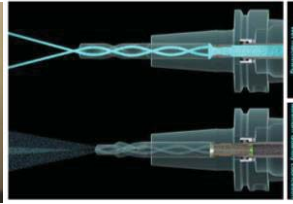
- » two trends in eco-efficient cooling (type of material, coating and tool)

» Cryogenic Cooling



Cryogenic cooling solutions:
liquid CO₂ (-80°C) or
liquid N₂ (-196°C)
Strong cooling capacity (↔ oil/emulsion)

» Minimum Quantity Lubrication (MQL)



Pulsed oil in pressed air
Less thermal shocks & cooling very
consistent & focussed (↔ oil/emulsion)

2.3.3 Selection of coolant as environmental and performance criterion

» Environmental benefits

» Cryogenic cooling

- » reduction of the energy consumption per produced part
- » decreased throughput rate & increased machining efficiency
- » avoidance of excessive waste
- » decreased amount of required tools & longer tool life
- » used coolants (CO₂ and N₂) can evaporate and solve in the air
- » no harmful impact on the operator (↔ oils and emulsions are difficult to recycle and cause harmful emissions)

cross media effects:

- » energy use for production and storage of liquid CO₂ and N₂

» Minimum Quantity Lubrication (MQL)

- » less use of coolant (for example: by a factor 30)

2.3.3 Selection of coolant as environmental and performance criterion

» Proposed indicators

- » emissions of oil emulsions to air and water
(l emulsion/machine hour)
- » CO₂-emissions to air, due to lower energy use
(kWh/production batch)
- » longer lifetime of machinery / tools
(number of tools per production batch)

PROPOSED BEMPS – MANUFACTURING PROCESSES

Generally applicable techniques

- 2.3.1 Application of solid low-friction coatings on tools and components
- 2.3.2 Application of wear- and corrosion-resistant coatings for lifetime extension of tools and equipment
- 2.3.3 Selection of coolant as environmental and performance criterion

» Any other BEMP proposals?

Proposed BEMPs part 4
Thomas Vandenhaute
Liesbet Van den Abeele

Forming processes

2.3 Proposed best environmental management practices for the manufacturing processes

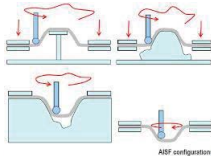
Forming processes

- 2.3.4 Incremental Sheet metal Forming (ISF) as alternative for mould making
- 2.3.5 Additive manufacturing of complex equipment - flow optimization for optimal heat transfer and temperature control
- 2.3.6 Multi-directional forging: a resource efficient metal forming alternative

2.3.4 Incremental Sheet metal Forming (ISF) as alternative for mould making

» Description

- » ISF: a metal sheet is formed incrementally by a progression of localized deformation
 - » No (or inexpensive) moulds required
 - » Time to market
 - » Lower material use
 - » Small series and prototypes



ISF configurations



2.3.4 Incremental Sheet metal Forming (ISF) as alternative for mould making

» Environmental benefits

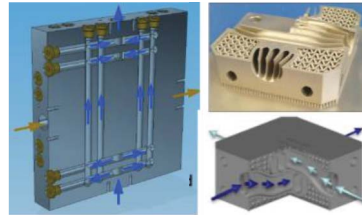
- » Reduction of raw material consumption (up to 10% compared to stamping)
- » Reduction of energy consumption (for example: up to 66% of power standby requirements)

» Proposed indicators

- » Reduction of material use:
 - » This comparison can be either a full LCA or a simplified LCA based on semi-quantitative analysis – Y/N.
 - » Other indicators are, kg material per mould
- » Reduction of energy use: Comparison of case studies on energy consumption between classical process on mould manufacturing and ISF. A possible indicator could be kWh/mould, kWh/product made in this mould.

2.3.5 Additive manufacturing of complex equipment - flow optimization for optimal heat transfer and temperature control

» Description



2.3.5 Additive manufacturing of complex equipment - flow optimization for optimal heat transfer and temperature control

» Environmental benefits

- » Primary effects:
 - » Increased efficiency of material and energy use
 - » Better performance of the heat exchanger
- » Secondary effects:
 - » Weight and volume optimization

2.3.5 Additive manufacturing of complex equipment - flow optimization for optimal heat transfer and temperature control

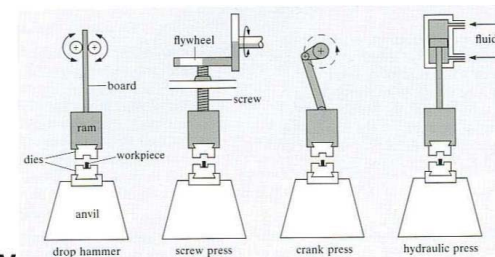
» Proposed indicators

- » Environmental comparison between machining and AM
 - » Raw material use during production (AM vs. traditional manufacturing in %)
 - » Energy use across entire value chain (AM vs. traditional manufacturing in %)

2.3.6 Multi-directional forging: a resource efficient metal forming alternative

» Description

- » Forging is the working of metal into a useful shape by hammering or pressing. Traditional, the hot metal is formed in different steps, where pressure is coming from one direction



2.3.6 Multi-directional forging: a resource efficient metal forming alternative

- » Multi-directional forging
 - » Pressure in different directions
 - » Less burr (burr free)



2.3.6 Multi-directional forging: a resource efficient metal forming alternative

- » **Steps**
 - » Development and simulation of the 'traditional' process steps;
 - » Implementation of the forging sequence and forging tests in industrial environment
 - » Validation of the process sequence and the resulting materials and component properties

2.3.6 Multi-directional forging: a resource efficient metal forming alternative

- » **Environmental benefits**
 - » Reduction of burr
 - » The burr can be reused as material, but this reuse ask extra energy for melting
 - » Reduction of energy use during forging (heating)
 - » Reducing energy during finishing (machining, cooling)
 - » Less material production upstream in the value chain
- » **Proposed indicators**
 - » % of generated burrs per unit
 - » Total energy required for the forging process, in terms of energy per piece

PROPOSED BEMPS – MANUFACTURING PROCESSES

Forming processes

- 2.3.4 Incremental Sheet metal Forming (ISF) as alternative for mould making
- 2.3.5 Additive manufacturing of complex equipment - flow optimization for optimal heat transfer and temperature control
- 2.3.6 Multi-directional forging: a resource efficient metal forming alternative

» Any other BEMP proposals?

Proposed BEMPs part 5
An Derden

Removing processes

2.3 Proposed best environmental management practices for the manufacturing processes

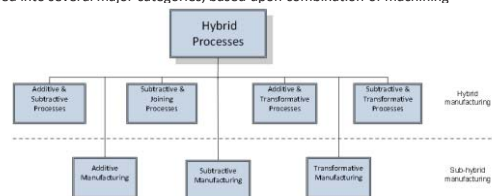
Removing processes

- 2.3.7 Hybrid machining as a method to reduce energy consumption
- 2.3.8 Machining of near-net-shape feedstock

2.3.7 Hybrid machining as a method to reduce energy consumption

» Description

- » manufacturing process which combines two or more established manufacturing processes into a new combined setup
 - » advantages of each discrete process can be exploited synergistically
 - » some adverse effects of constituent processes when they are individually applied can be avoided or reduced
 - » different performance characteristics (productivity, accuracy, surface quality)
- » can be classified into several major categories, based upon combination of machining technologies



2.3.7 Hybrid machining as a method to reduce energy consumption

» Environmental benefits

- » when combining energy efficient technologies (with advanced processes, compared to using solely the advanced processes)
 - » lower lead times due to faster machining processes
 - » lower energy consumption and CO₂ emissions
 - » more efficient use of consumables leading to less hazardous waste and emissions
 - » overall lower operating expenditure (OPEX)

cross media effects:

- » environmental impact due production of hybrid machines (hardware)
- » extra cooling water or compressed air (extra energy)

2.3.7 Hybrid machining as a method to reduce energy consumption

» *Proposed indicator*

- » energy consumption (CO₂ emissions)
(kWh machine consumption per batch) – more efficient overall machining process

2.3.8 Machining of near-net-shape feedstock

» *Description*

- » near-net-shapes = products which initial production is very close to the final geometry, limiting the amount of unwanted finishing operations
- » examples:
 - » gel casting
 - » casting
 - » cold forming
 - » spray forming
 - » Selective Laser Sintering (SLS)
 - » Direct Metal Laser Sintering (DMLS)
 - » injection molding (ceramic, metal and plastic)
- » required knowledge concerning technical and logistical issues



Figure 1: Near net shape machining (Whitesell group, 2015)

2.3.8 Machining of near-net-shape feedstock

» *Environmental benefits*

- » material and consumable savings
 - » lower amount of CO₂ emissions
 - » reduced amount of lost material / material wastes (eg. slags, refractories, electrodes, gases)
 - » lower consumption of electrical power, coolant and pressurized air
- » reduced tool wear

cross media effects:

/

2.3.8 Machining of near-net-shape feedstock

» *Proposed indicators*

- » % of metals which end up in burrs during production of metal piece
- » energy use and CO₂ emissions
(compared to machining conventional feedstocks due to less overall material removal)

Additional BEMP: Metal chip recycling and lubricoolant recuperation through briquetting

Best practice is to press metal swarf from processing into briquettes and recover cutting emulsion.

- » Metal scrap
 - » low-value, contaminated stream
- » Briquetting allows
 - » Valorisation of waste stream (resale value of briquettes)
 - » Reduction of waste fees for emulsion disposal
 - » Reduced costs of cutting emulsion
 - » Reduced logistical costs of swarf storage
 - » Reduced health and safety hazards
- » Environmental benefits
 - » Reduction of virgin material use (metal, lubricoolant)
 - » Reduction of waste generation



Proposed environmental performance indicators

Metrics	Description
Y/N	- Installation of a briquetting system (Y/N)
kg/kg	- kg metal waste generated (per kg product or hours worked etc.)
kg/yr	- kg of metal chips processed as briquettes (annual)
L/yr	- L of cutting emulsion recovered (annual)

PROPOSED BEMPS – MANUFACTURING PROCESSES

Removing processes

- 2.3.7 Hybrid machining as a method to reduce energy consumption
- 2.3.8 Machining of near-net-shape feedstock

» Any other BEMP proposals?

Proposed BEMPs part 6

Finishing processes

2.3 Proposed best environmental management practices for the manufacturing processes

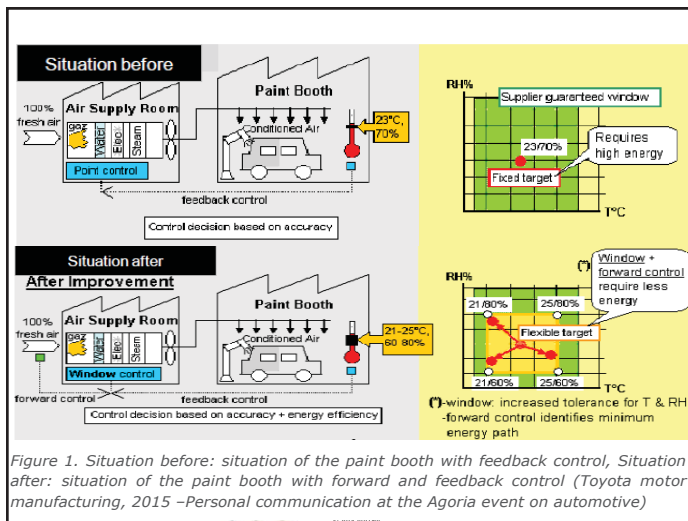
Finishing processes

- 2.3.9 Reduce the energy for paint booth HVAC with predictive control
- 2.3.10 Selection and optimisation of thermal processes for curing wet-chemical coatings on metal products

2.3.9 Reduce the energy for paint booth HVAC with predictive control

» Description

- » further reduction of environmental impact of heating, ventilation and air conditioning (HVAC) by keeping "differences" in temperature or humidity changes constant to achieve constant paint drying speed / paint drying time
- » complex technique which requires
 - deep knowledge of paint quality control
 - maintenance and continuous follow up
 - strong and reliable data capturing and automation
- » implemented in large paint booths using water based paints (automotive companies)



2.3.9 Reduce the energy for paint booth HVAC with predictive control

» Environmental benefits

- » reduced energy need for conditioning (heating and cooling) of air for the paint booth
- » reduced CO₂ emissions and other emissions due to heating and cooling (for example CO₂ emission reduction of 62% over 2 years)
- » reduced VOC emissions (water based paints in case of oil based)

cross media effects:
/

2.3.9 Reduce the energy for paint booth HVAC with predictive control

» *Proposed indicator*

- » Energy use for the paint booth in function of the size of the painted units and the booth, kWh/product painted, kWh/operating time of paint booth or, kWh/per m³ air)
- » Additionally the reduction in energy consumption can be translated into CO₂ emission reduction (which depends on the energy type used).

2.3.10 Selection and optimisation of thermal processes for curing wet-chemical coatings on metal products

» *Description*

- » (Room temperature curing)
- » High temperature curing
- » Infrared curing (IR curing)
- » UV and UV-led curing



Picture:
<http://www.pfonline.com/articles/infrared-curing-evaluating-the-characteristics-of-ir-energy>

2.3.10 Selection and optimization of thermal processes for curing wet-chemical coatings on metal products

» *Environmental benefits*

- » Reduction of energy

» *Proposed indicators*

- » Energy use for the paint booth in function of the size of the painted units and the booth, (kWh/product painted, kWh/operating time of paint booth or, kWh/per m³ air)
- » Additionally the reduction in energy consumption can be translated into CO₂ emission reduction (which depends on the energy type used).

PROPOSED BEMPS – MANUFACTURING PROCESSES

Finishing processes

- 2.3.9 Reduce the energy for paint booth HVAC with predictive control
- 2.3.10 Selection and optimisation of thermal processes for curing wet-chemical coatings on metal products

» Any other BEMP proposals?

Proposed BEMPs part 7
Thomas Vandenhoute

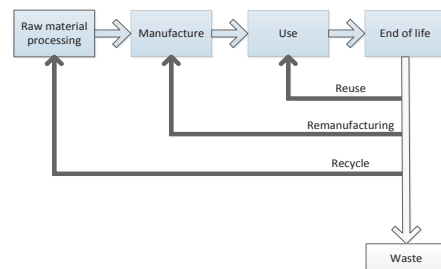
Concurrent engineering and product design

2.4 Proposed best environmental management practices in the areas of concurrent engineering and product design

- 2.4.1 Remanufacturing of high value components
- 2.4.2 Co-design and open innovation with downstream partners to reduce environmental impact during product life cycle

2.4.1 Remanufacturing of high value components

» Description



2.4.1 Remanufacturing of high value components


» Description

- » Collection of products to be processed
- » Disassembly of product
- » Cleaning of parts
- » Inspection and sorting of parts
- » Reconditioning of parts and/or replacement by new parts
- » Product reassembly
- » Final testing


Remanufacturing Step / Product Property	Inspection	Cleaning	Disassembly	Storage	Reprocess	Reassembly	Testing
Ease of Identification	x		x	x			x
Ease of Verification	x						
Ease of Access	x	x	x		x	x	x
Ease of Handling			x	x	x	x	
Ease of Separation			x		x		
Ease of Securing						x	
Ease of Alignment						x	
Ease of Stacking				x			
Wear Resistance		x	x		x	x	

2.4.1 Remanufacturing of high value components


» Examples




Lower cost quality office furniture *Rype Office offering (Rype Office, 2015)*



REFRESHED
Remake or remodel your current furniture at a fraction of the cost of new.



REMADE
Save 50% to 60% on the recommended retail price on quality brand-name furniture because we reuse long-life structural components that are in good condition.



NEW
We help you choose new furniture that is easily remade and so you save because it has a longer lifespan.

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2.4.1 Remanufacturing of high value components

» Examples



Steel waiting for a buyer at the Portal Power plant (Alwood, J.M. et al, 2012 and Portal Power, 2015)

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2.4.1 Remanufacturing of high value components

» Environmental benefits

- » Reduction of material use
- » Reduction of energy use

» Proposed indicators

- » The amount of the remanufactured components per product sold (weight%/products)
- » Percentage of products with remanufactured components (out of total number of products)

2.4.2 Co-design and open innovation with downstream partners to reduce environmental impact during product life cycle

» Description



Closed vs. open innovation (Chesbrough, 2003)

2.4.2 Co-design and open innovation with downstream partners to reduce environmental impact during product life cycle

» *Example*



The CorX® System (Cradle to Cradle Certified Products Registry, 2014)

2.4.2 Co-design and open innovation with downstream partners to reduce environmental impact during product life cycle

» *Environmental benefits*

- » Reduce the overall impact of products, e.g.
 - » reduced weight
 - » reduced waste
 - » facilitated dismantling

2.4.2 Co-design and open innovation with downstream partners to reduce environmental impact during product life cycle

» *Proposed indicators*

- » Management decisions on co-design and open innovation
- » Other indicators:
 - » kg raw material used per produced unit
 - » total energy use per produced unit
 - » kg waste produced per year or per product

PROPOSED BEMPS – CONCURRENT ENGINEERING AND PRODUCT DESIGN

- 2.4.1 Remanufacturing of high value components
- 2.4.2 Co-design and open innovation with downstream partners to reduce environmental impact during product life cycle

» Any other BEMP proposals?