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Delegations will find attached document D056938/01 - Annex 1.

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ANNEX 1

ANNEX

to the

Commission Decision

on the sectoral reference document on best environmental management practices, sector-specific environmental performance indicators and benchmarks of excellence for the electrical and electronic equipment manufacturing sector under Regulation (EC) No 1221/2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS)

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ANNEX

1. INTRODUCTION

This Sectoral Reference Document (SRD) is based on a detailed scientific and policy report[1] ("Best Practice Report") developed by the European Commission's Joint Research Centre (JRC).

Relevant legal background

The Community eco-management and audit scheme (EMAS) was introduced in 1993, for voluntary participation by organisations, by Council Regulation (EEC) No 1836/93[2]. Subsequently, EMAS has undergone two major revisions:

– Regulation (EC) No 761/2001 of the European Parliament and of the Council[3];

– Regulation (EC) No 1221/2009 of the European Parliament and of the Council[4].

An important new element of the latest revision, which came into force on 11 January 2010, is Article 46 on the development of SRDs. The SRDs have to include best environmental management practices (BEMPs), environmental performance indicators for the specific sectors and, where appropriate, benchmarks of excellence and rating systems identifying performance levels.

How to understand and use this document

The eco-management and audit scheme (EMAS) is a scheme for voluntary participation by organisations committed to continuous environmental improvement. Within this framework, this SRD provides sector-specific guidance to the electrical and electronic equipment manufacturing sector and points out a number of options for improvement as well as best practices.

The document was written by the European Commission using input from stakeholders. A Technical Working Group, comprising experts and stakeholders of the sector, led by the JRC, discussed and ultimately agreed on the best environmental management practices, sector-specific environmental performance indicators and benchmarks of excellence described in this document; these benchmarks in particular were deemed to be representative of the levels of environmental performance that are achieved by the best performing organisations in the sector.

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1 The scientific and policy report is publicly available on the JRC website at the following address: http://susproc.jrc.ec.europa.eu/activities/emas/documents/BEMP_EEE_Manufacturing.pdf. The conclusions on best environmental management practices and their applicability as well as the identified specific environmental performance indicators and the benchmarks of excellence contained in this Sectoral Reference Document are based on the findings documented in the scientific and policy report. All the background information and technical details can be found there.

2 Council Regulation (EEC) No 1836/93 of 29 June 1993 allowing voluntary participation by companies in the industrial sector in a Community eco-management and audit scheme (*OJ L 168, 10.7.1993, p. 1*).

3 Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisations in a Community eco-management and audit scheme (EMAS) (*OJ L 114, 24.4.2001, p. 1*).

4 Regulation (EC) No 1221/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS), repealing Regulation (EC) No 761/2001 and Commission Decisions 2001/681/EC and 2006/193/EC (*OJ L 342, 22.12.2009, p. 1*).

The SRD aims to help and support all organisations that intend to improve their environmental performance by providing ideas and inspiration as well as practical and technical guidance.

The SRD is primarily addressed to organisations that are already registered with EMAS; secondly to organisations that are considering registering with EMAS in the future; and thirdly to all organisations that wish to learn more about best environmental management practices in order to improve their environmental performance. Consequently, the objective of this document is to support all organisations in the electrical and electronic equipment manufacturing sector to focus on relevant environmental aspects, both direct and indirect, and to find information on best environmental management practices, as well as appropriate sector-specific environmental performance indicators to measure their environmental performance, and benchmarks of excellence.

<u>How SRDs should be taken into account by EMAS-registered organisations:</u>

Pursuant to Regulation (EC) No 1221/2009, EMAS-registered organisations are to take SRDs into account at two different levels:

1. When developing and implementing their environmental management system in light of the environmental reviews *(Article 4(1)(b)):*

   Organisations should use relevant elements of the SRD when defining and reviewing their environmental targets and objectives in accordance with the relevant environmental aspects identified in the environmental review and policy, as well as when deciding on the actions to implement to improve their environmental performance.

2. When preparing the environmental statement *(Article 4(1)(d) and Article 4(4)):*

   (a) Organisations should consider the relevant sector-specific environmental performance indicators in the SRD when choosing the indicators[5] to use for their reporting of environmental performance.

   When choosing the set of indicators for reporting, they should take into account the indicators proposed in the corresponding SRD and their relevance with regards to the significant environmental aspects identified by the organisation in its environmental review. Indicators need only be taken into account where relevant to those environmental aspects that are judged as being most significant in the environmental review.

   (b) When reporting on environmental performance and on other factors regarding environmental performance, organisations should mention in the environmental statement how the relevant best environmental management practices and, if available, benchmarks of excellence have been taken into account.

[5] According to Annex IV (B.e.) of the EMAS Regulation, the environmental statement shall contain "*a summary of the data available on the performance of the organisation against its environmental objectives and targets with respect to its significant environmental impacts. Reporting shall be on the core indicators and on <u>other relevant existing environmental performance indicators</u> as set out in Section C*". Annex IV - Section C states that "*each organisation shall also report annually on its performance relating to the more specific environmental aspects as identified in its environmental statement and, where available, take account of sectoral reference documents as referred to in Article 46.*"

They should describe how relevant best environmental management practices and benchmarks of excellence (which provide an indication of the environmental performance level that is achieved by best performers) were used to identify measures and actions, and possibly to set priorities, to (further) improve their environmental performance. However, implementing best environmental management practices or meeting the identified benchmarks of excellence is not mandatory, because the voluntary character of EMAS leaves the assessment of the feasibility of the benchmarks and of the implementation of the best practices, in terms of costs and benefits, to the organisations themselves.

Similarly to environmental performance indicators, the relevance and applicability of the best environmental management practices and benchmarks of excellence should be assessed by the organisation according to the significant environmental aspects identified by the organisation in its environmental review, as well as technical and financial aspects.

Elements of SRDs (indicators, BEMPs or benchmarks of excellence) not considered relevant with regards to the significant environmental aspects identified by the organisation in its environmental review should not be reported or described in the environmental statement.

EMAS participation is an ongoing process. Every time an organisation plans to improve its environmental performance (and reviews its environmental performance) it shall consult the SRD on specific topics to find inspiration about which issues to tackle next in a step-wise approach.

EMAS environmental verifiers shall check if and how the SRD was taken into account by the organisation when preparing its environmental statement (Article 18(5)(d) of Regulation (EC) No 1221/2009).

When undertaking an audit, accredited environmental verifiers will need evidence from the organisation of how the relevant elements of the SRD have been selected in light of the environmental review and taken into account. They shall not check compliance with the described benchmarks of excellence, but they shall verify evidence on how the SRD was used as a guide to identify indicators and proper voluntary measures that the organisation can implement to improve its environmental performance.

Given the voluntary nature of EMAS and SRD, no disproportionate burdens should be put on the organisations to provide such evidence. In particular, verifiers shall not require an individual justification for each of the best practices, sector-specific environmental performance indicators and benchmarks of excellence which are mentioned in the SRD and not considered relevant by the organisation in light of its environmental review. Nevertheless, they could suggest relevant additional elements for the organisation to take into account in the future as further evidence of its commitment to continuous performance improvement.

Structure of the Sectoral Reference Document

This document consists of four chapters. Chapter 1 introduces EMAS' legal background and describes how to use this document, while Chapter 2 defines the scope of this SRD. Chapter 3 briefly describes the different best environmental management practices (BEMPs)[6] together with information on their applicability. When specific

[6] A detailed description of each of the best practices, with practical guidance on how to implement them, is available in the "Best Practice Report" published by the JRC and available on-line at:

environmental performance indicators and benchmarks of excellence could be formulated for a particular BEMP, these are also given. However, defining benchmarks of excellence was not possible for all BEMPs either because of the limited availability of data or because the specific conditions of each company and/or plant (type of electrical and electronic equipment manufactured ranging from large household appliances to small and microelectronic equipment and including both business-to-business and business-to-consumers, diversity of manufacturing processes carried out in each manufacturing facility, etc.) vary to such an extent that a benchmark of excellence would not be meaningful. Even when benchmarks of excellence are given, these are not meant as targets for all companies to reach or metrics to compare the environmental performance across companies of the sector, but rather as a measure of what is possible to help individual companies assess the progress they made and motivate them to improve further. Finally, Chapter 4 presents a comprehensive table with a selection of the most relevant environmental performance indicators, associated explanations and related benchmarks of excellence.

http://susproc.jrc.ec.europa.eu/activities/emas/documents/BEMP_EEE_Manufacturing.pdf. Organisations are invited to consult it if interested in learning more about some of the best practices described in this SRD.

2. SCOPE

This reference document addresses the environmental performance of the Electrical and Electronic Equipment (EEE) manufacturing sector. The target group of this document are companies belonging to the EEE manufacturing sector, i.e. to the following NACE codes (according to the statistical classification of economic activities established by Regulation (EC) No 1893/2006[7]):

– 26 - Manufacture of computer, electronic and optical products;

– 27 - Manufacture of electrical equipment;

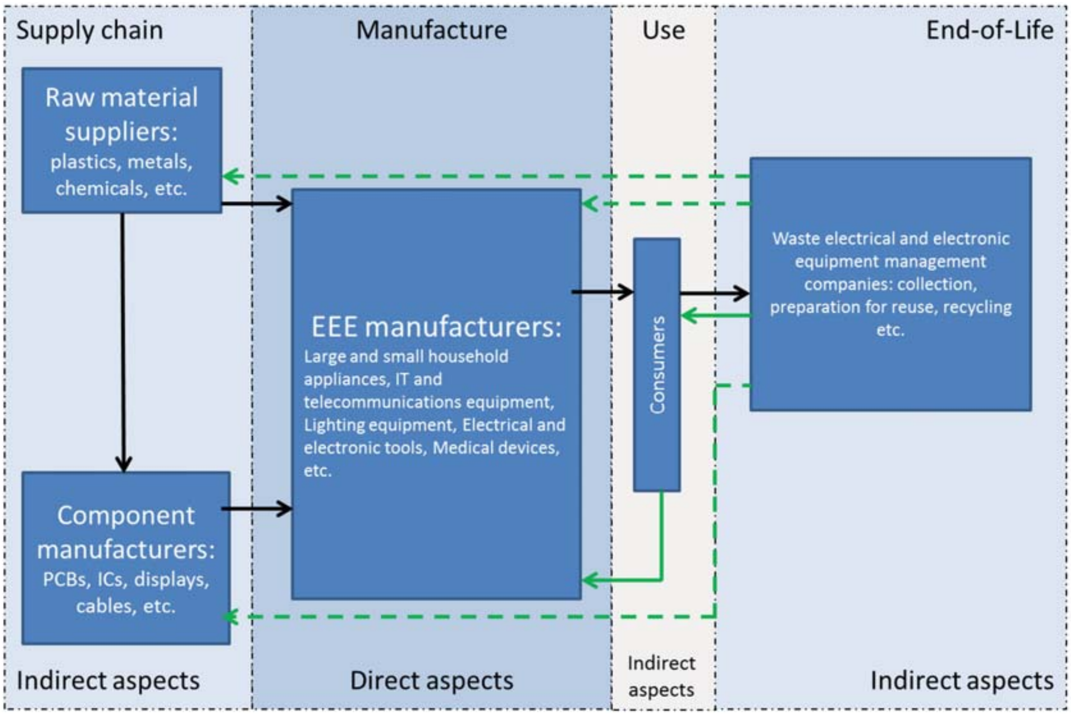
– 28.12, 28.13 - Manufacture of fluid power equipment and of other pumps and compressors;

– 28.22 - Manufacture of lifting and handling equipment;

– 28.23 - Manufacture of office machinery and equipment.

This reference document covers actions that EEE manufacturers can implement to achieve improvements in the environmental performance over the whole EEE value chain, as presented in Figure 2-1. In the figure, the arrows show the key material flows among the different actors in the value chain, while the terms "direct" and "indirect" are used to distinguish the activities where a manufacturer has full control ("direct environmental aspects") to those resulting from the interaction with third parties but which can be influenced to a reasonable degree by the EEE manufacturer ("indirect environmental aspects").

Figure 2-1: Overview of key material flows of the electrical and electronic equipment (EEE) manufacturing value chain



7 Regulation (EC) No 1893/2006 of the European Parliament and of the Council of 20 December 2006 establishing the statistical classification of economic activities NACE Revision 2 and amending Council Regulation (EEC) No 3037/90 as well as certain EC Regulations on specific statistical domains (OJ L 393, 30.12.2006, p. 1).

This reference document is divided into three main sections (Table 2-1) which cover, from the perspective of the manufacturers, the main environmental aspects along the value chain of the electrical and electronic equipment.

Table 2-1: Structure of the reference document for the electrical and electronic equipment manufacturing sector and main environmental aspects addressed

Section		Description	Main environmental aspects addressed
3.1	BEMPs for manufacturing processes	This section covers the activities related to core electrical and electronic equipment manufacturing operations.	Component manufacturing and assembly Final product assembly Plant utilities Site management
3.2	BEMPs for supply chain management	This section deals with the management of the supply chain by electrical and electronic equipment manufacturers. It focuses on the operations that companies in the sector can put in place to sustainably source materials, substitute hazardous substances and reduce the biodiversity impacts of their supply chain.	Sourcing of materials and components Communication with and management of suppliers Product design
3.3	BEMPs fostering a more circular economy	This section deals with management and strategic practices that electrical and electronic equipment manufacturers can implement to foster a more circular economy, such as changing design practices, remanufacturing products, or developing more sustainable business models.	Product design / Development of business models End-of-life management

The environmental aspects presented in Table 2-2 were selected as the most commonly relevant in the sector. However, the environmental aspects to be managed by specific companies need to be assessed on a case-by-case basis.

Table 2-2: Most relevant environmental aspects and related main environmental pressures addressed in this document

Most relevant environmental aspects	Related main environmental pressures
Component manufacturing and assembly	Resource efficiency Water Waste Emissions to air Soil Energy and climate change Hazardous substances Biodiversity
Final product assembly	Energy and climate change
Plant utilities	Resource efficiency Water Waste Emissions to air Energy and climate change Biodiversity
Site management	Water Waste

Most relevant environmental aspects	**Related main environmental pressures**
	Emissions to air Soil Energy and climate change Biodiversity
Sourcing of materials and components	Resource efficiency Energy and climate change Biodiversity
Communication with and management of suppliers	Resource efficiency Energy and climate change Hazardous substances
Product design / Development of business model	Resource efficiency Water Waste Emissions to air Energy and climate change Hazardous substances
End-of-life management	Resource efficiency Waste

3. BEST ENVIRONMENTAL MANAGEMENT PRACTICES, SECTOR ENVIRONMENTAL PERFORMANCE INDICATORS AND BENCHMARKS OF EXCELLENCE FOR THE ELECTRICAL AND ELECTRONIC EQUIPMENT MANUFACTURING SECTOR

3.1. BEMPs for manufacturing processes

This section is relevant for the EEE manufacturers.

3.1.1. Energy-efficient cleanroom technology

BEMP is to minimise the energy use of the cleanrooms. This can be achieved by implementing the following measures:

– Defining the capacity of the cleanroom facility correctly and dimensioning its equipment accordingly. Downsizing to the minimum required is the target for all equipment, except cooling towers and passive components (pipes and ducts) which can be upsized to save energy. Their upsizing improves the chiller performance and allows the use of smaller fans and pumps.

– Reducing the pressure difference between the cleanroom and its surroundings and adapting the air volume to the demand in order to reduce the electricity use of the fans.

– Allowing wider operating ranges for the cleanroom space temperature and relative humidity. Wider operating ranges lead to lower energy use for cooling, preheating and dehumidification of the supply airflow.

– Setting a lower face velocity[8] by combining larger air handling units with smaller fans that allow the air circulation to be maintained at a lower velocity.

– Determining the lowest possible Air Change Rate (ACR) by reducing the heat load and the actual particle generation within the cleanroom.

– Exploiting all opportunities to reduce the heat load generated within the cleanroom and recover the waste heat from process equipment. The recovered waste heat can be used, for instance, to reheat supply air.

– Using highly efficient components, such as Variable-Frequency Drive (VFD) fan motors, pumps and chillers to allow a better response to the varying load of the cleanroom.

– Avoiding over-purification of the water required for the cleanroom operations by respecting the specifications of the required cleanroom classification, without excessively large safety margins.

Applicability

The BEMP is broadly applicable to all EEE manufacturers that operate cleanrooms.

For newly built cleanroom facilities, the ACR can be lower than the ACR range recommended according to its classification, but efforts are necessary to ensure and adjust the quality requirements of the cleanroom. For existing cleanroom facilities, particle count-based control and continuous monitoring can be applied to reduce ACR values.

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[8] Face velocity is the speed at which air passes over the filters or heating/cooling coils in an air handler unit.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i1) Energy use in the cleanroom for printed circuit board manufacturing (kWh/m² of processed printed circuit board) (i2) Energy use in the cleanroom for semiconductors and/or integrated circuits manufacturing (kWh/cm² of silicon wafers) (i3) Air Change Rate (number/hour) (i4) COP (Coefficient of Performance) of the cooling equipment installed (kWh cooling energy produced / kWh energy used) (i5) Water conductivity (µS/cm)	N/A

3.1.2. Energy-efficient cooling technology

BEMP is to reduce the need for cooling and improve the energy efficiency of the cooling systems used in production processes and production halls. This can be achieved by applying the following measures:

– Assessing and optimising the required temperature level for each of the processes and rooms/spaces with a cooling demand.

– Using cooling cascades by splitting the existing cooling circuit into two or more temperature levels.

– Implementing free cooling techniques. Different relevant technological options include direct cooling with flow-through colder outside air, free dry cooling where a water cycle is cooled with outside air and free wet cooling (cooling tower).

– Using a heat recovery ventilation system to cool and dehumidify the incoming ambient air.

– Using absorption cooling technology as an alternative to compression chillers. Recovered waste heat can be used to provide the thermal compression of the refrigerant.

Applicability

Measures to improve the energy efficiency of cooling are broadly applicable to EEE manufacturing companies.

To be able to implement free cooling, the temperature level of the return flow of the cooling system must be above the outdoor temperature and enough space must be available in the outdoor area of the production site.

Absorption cooling is applicable where a source of waste heat or renewable heat is continuously available at the production site or in its surroundings.

The economic feasibility of the proposed measures depends substantially on the existence of a year-round cooling load.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence

(i6) Coefficient of Performance (COP) for individual cooling equipment (kW of cooling power provided / kW of power used) (i7) Coefficient of System Performance (COSP) including the energy required to run the supplementary equipment of the cooling system, e.g. pumps (kW of cooling power provided / kW of power used) (i8) Use of cooling cascades (Y/N) (i9) Use of free cooling (Y/N) (i10) Use of heat recovery ventilators (Y/N) (i11) Use of absorption chillers (Y/N) (i12) Energy use of the cooling system per unit of turnover (kWh/EUR)	N/A

3.1.3. Energy-efficient soldering

BEMP is to improve the energy efficiency of reflow soldering operations.

For existing soldering equipment, BEMP is to do the following:

– Maximise the throughput of the existing reflow soldering equipment in order to reduce the specific electricity demand per square metre of manufactured printed circuit boards. This is achieved through the optimisation of the speed of the conveyor of the soldering line while maintaining an acceptable process window.

– Install retrofit insulation to the soldering equipment.

For new soldering equipment, BEMP is to do the following:

– Select equipment with i. an improved power management system (e.g. available standby or dormant state), ii. a flexible cooling system which allows switching between an internal and external cooling unit and enables waste heat recovery and iii. an improved consumption monitoring and control system for liquid nitrogen.

– Use of direct-current (DC) fan motors instead of alternating-current (AC) in order to regulate the speed of the different motors separately.

For both existing systems and new soldering equipment, BEMP is to:

– avoid the use of liquid nitrogen for less delicate applications, such as low-complexity assemblies.

Applicability

This BEMP is applicable to EEE manufacturers with reflow soldering operations, and especially relevant for the production of printed circuit boards (PCB).

The measures for new soldering equipment are applicable when the decision is taken to install a new reflow soldering line. The return on investment depends considerably on increased yield, performance, and maintenance requirements rather than energy savings.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence

(i13) Total energy demand per surface unit of printed circuit board processed (kWh of electricity / m^2 of PCB) (i14) Nitrogen consumption per surface unit of printed circuit board processed (kg of nitrogen / m^2 of PCB)	N/A

3.1.4. On-site copper recycling in process chemicals

BEMP is to recover copper from the etching process agents used in printed circuit board manufacturing by electrolysis. This allows the recovery of high-quality copper, the reduction of the amount of etching agent used and the reuse of water.

Applicability

The BEMP is applicable to printed circuit board production facilities. However, the economic feasibility depends greatly on the production levels, and thus on the amount of high-quality copper that can be recovered (e.g. over 60 t of copper per year). A further limitation is the space needed for the on-site recycling system, which ranges between 50 m² and 80 m² depending on the arrangement of the installation and the volume of the buffer tanks. However, this does not necessarily need to be right next to the etching process.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**
(i15) On-site copper recycling system in place (Y/N) (i16) Amount of copper recycled from etching process agents (t/year)	N/A

3.1.5. Cascade rinsing systems

BEMP is to minimise water use in EEE printed circuit board (PCB) manufacturing companies by installing multiple cascade rinsing systems with four or more stages.

In addition, BEMP is optimising water use, e.g. by setting the water intake in rinsing baths according to process-specific quality requirements and by reuse of rinsing bath water for different process steps.

Applicability

The BEMP is broadly applicable to printed circuit board manufacturing companies. The optimisation measures and the installation of multiple cascade rinsing systems with at least four stages are applicable both in existing facilities and in new builds. In the case of cascade rinsing systems with four or more stages, the available space may pose some limitations.

Five-stage cascade rinsing systems specifically are most applicable for systems with a high machine throughput or highly concentrated electrolytes and the following additional limiting factors need to be considered:

– highly concentrated rinse water leads to a greater use of chemicals and more time being needed for sedimentation in deionisation for waste water treatment;

– heating of the rinsing bath water due to increased numbers of pumps, which increases pressure by germ contamination;

– germ contamination needs to be mitigated by implementing proper water disinfection techniques.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i17) Total water consumption in the fabrication plant (l/m^2 of PCB manufactured) (i18) Share of cascade rinsing systems with four or five stages out of the total number of rinsing facilities (%) (i19) Water consumption in cascade rinsing systems with four or five stages compared with the water consumption in three-stage cascade rinsing systems (%) (i20) Five-stage cascade rinsing system in place (Y/N)	(b1) At least 50% of the rinsing facilities are equipped with a cascade rinsing system with four or more stages

3.1.6. Minimisation of perfluorocompound emissions

BEMP is to minimise the emissions of perfluorocompounds (PFC) in semiconductor fabrication facilities by the following measures:

– Substituting PFC gases with a high specific global warming potential with others with a lower global warming potential, e.g. replacement of C_2F_6 by C_3F_8 for Chemical Vapour Deposition (CVD) chamber cleaning.

– Optimising the CVD chamber cleaning process to increase the conversion factor of the PFC gases used, in order to avoid unused PFC gases being emitted after the chamber cleaning process. This requires the monitoring of emissions and the adjustment of operational parameters, such as chamber pressure and temperature, plasma power, cleaning gas flow rates and gas ratios in the event that PFC gas mixtures are used.

– Operating remote plasma cleaning technology that replaces the use of PFC gases in situ (e.g. C_2F_6 and CF_4) with remote NF_3. In this process, NF_3 is dissociated by the plasma before entering the process chamber and is thus used more efficiently with very little NF_3 being emitted from the process chamber after cleaning.

– Installing point-of-use (POU) abatement techniques, such as: a burner-scrubber, installed after the vacuum pump, or a small plasma source, installed before the vacuum pump, used to abate PFC emissions from plasma etching.

Applicability

The BEMP is broadly applicable to semiconductor fabrication facilities using PFC gases. However, the specific measures that can be implemented in a facility need to be assessed on a case-by-case basis.

Process optimisation is broadly applicable and can be an effective measure both in existing facilities and in new-build CVD chambers. It is the only measure which also saves costs, since it can allow lower gas consumption and better throughput.

Substitution of PFC gases is often technically unfeasible, especially for plasma etching.

Remote plasma cleaning technology using NF_3 is broadly applicable to fabrication facilities. However, its implementation may require replacing processing equipment. It is thus more feasible when a new production facility is being built or obsolete processing equipment needs to be renewed.

Concerning point-of-use abatement techniques, burner-scrubber systems are more common than point-of-use plasma abatement. The limitations to the applicability of scrubber systems are space, existing infrastructure and costs. For the plasma abatement devices, one of the main limitations is their low flow treatment capacity.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**
(i21) Normalised Emission Rate for perfluorocompounds emissions (kg CO_2eq/cm²) (i22) Minimisation of PFC emissions by applying one of the following techniques (Y/N): – substitution of PFC gases with a high specific global warming potential with others with lower global warming potential – application of process optimisation focused on CVD chamber cleaning – installation of remote plasma cleaning technology – use of POU abatement techniques	(b2) The Normalised Emission Rate for PFC emissions in new-build semiconductor fabrication facilities or facilities having undergone major renovation is lower than 0.22 kg CO_2eq/cm^2

3.1.7. Rational and efficient use of compressed air

BEMP is for electrical and electronic equipment manufacturers to reduce their energy consumption associated with the use of compressed air in the manufacturing processes by the following measures:

- Mapping and assessing the use of compressed air. When part of the compressed air is used in inefficient applications or in an inappropriate manner, other technological solutions may be more fit for purpose or more efficient. In case a switch from pneumatic tools to electricity-driven tools for a certain application is considered, a proper assessment, considering not just energy consumption but all environmental aspects as well as the specific needs of the application, needs to be carried out.
- Optimising the compressed air system by:
  - identifying and eliminating leaks, using suitable control technology, such as ultrasound measuring instruments for air leaks that are hidden or difficult to access;
  - better matching of the supply and demand of compressed air within the manufacturing facility, i.e. matching the air pressure, volume and quality to the needs of the various end-use devices and, when appropriate, producing the compressed air closer to the consumption centres by choosing decentralised units rather than a large centralised compressor catering for all uses;

– producing the compressed air at a lower pressure by decreasing the pressure losses in the distribution network and, when needed, adding pressure boosters only for devices that require higher pressure than most applications;

– designing the compressed air system based on the annual load duration curve, in order to ensure supply with the minimum energy use over base, peak and minimal loads;

– selecting highly efficient components for the compressed air system, such as highly efficient compressors, variable-frequency drives and air dryers with integrated cold storage;

– once all of the above is optimised, recovering the heat from the compressor(s) through the installation of a plate heat exchanger within the oil circuit of the compressors; the recovered heat can be employed in a variety of applications, such as the drying of products, regeneration of the desiccant dryer, space heating, cooling thanks to the operation of an absorption chiller or converting the recovered heat into mechanical energy using Organic Rankine Cycle (ORC) machines.

Applicability

The measures described in this BEMP are broadly applicable to all EEE companies that use compressed air.

Regarding the heat recovery, a continuous demand for process heat is necessary in order to realise the corresponding energy and cost savings.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**
(i23) Electricity use of the compressed air system per unit of volume at the point of end use (kWh/m³) (i24) Air Leakage Index[9] (No)	(b3) The electricity use of the compressed air system is lower than 0.11 kWh/m^3 of compressed air delivered, for large installations operating at a gauge pressure of 6.5 bar, with volume flow normalised at 1013 mbar and 20°C, and pressure deviations not exceeding 0.2 bar. (b4) After all air consumers are switched off, the network pressure remains stable and the compressors (on standby) do not switch to load condition.

9 The Air Leakage Index is calculated, when all air consumers are switched off, as the sum for each of the compressors of the time it runs multiplied by the capacity of that compressor, divided by the total standby time and the total rated capacity of the compressors in the system $(Air\ Leakage\ Index = \frac{\sum_i t_{i(cr)} * C_{i(cr)}}{t_{(sb)} * C_{(tot)}})$

3.1.8. Protection and enhancement of biodiversity

BEMP is to devise, implement and periodically review an action plan for protecting and enhancing biodiversity at the production facilities and in nearby areas. Examples of actions that can be included in the action plan are:

– planting trees or reintroducing native species into a degraded natural environment;

– surveying flora and fauna, with the aim of documenting and monitoring the state of biodiversity at a specific site;

– allowing open land within a facility to “revert to nature";

– developing biotopes to create new habitats;

– involving staff, their relatives and local communities in biodiversity projects.

Applicability

The BEMP is broadly applicable to all electrical and electronic equipment manufacturers.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i25) Land use – area of land within the production site and its assessed natural value (e.g. brown fields, areas adjacent to protected areas, areas of high biodiversity value) (m^2) (i26) Area of protected or restored natural habitats within the production site, or outside but managed or protected by the manufacturer (m^2) (i27) Implementation of a site biodiversity action plan in all production facilities (Y/N)	(b5) A biodiversity action plan is implemented in all production facilities to protect and enhance the state of biodiversity (flora and fauna) at the specific site

3.1.9. Use of renewable energy

BEMP is for electrical and electronic equipment manufacturing companies to use renewable energy for their processes thanks to:

– purchase of verified additional renewable electricity or own generation of electricity from renewable energy sources;

– own production of heat from renewable energy sources.

Applicability

This BEMP is broadly applicable to all companies in the sector.

Use of renewable electricity (self-generated or purchased) is possible in all cases.

Integration of heat from renewable sources in EEE manufacturing processes is, in contrast, more difficult due to their complexity, the need for high temperatures, and, in some cases, incompatibility between the heat demand and the seasonality of the renewable heat offer.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i28) Share of electricity from renewable sources (self-generated or purchased with verified additionality) out of the total electricity use (%) (i29) Share of heat from renewable sources out of the total heat use (%)	N/A

3.1.10. Optimised waste management within manufacturing facilities

BEMP is for electrical and electronic equipment manufacturers to develop and implement a waste management strategy that prioritises other treatment options besides disposal for all the waste generated at the manufacturing facilities and follows the waste hierarchy[10]. This strategy needs to encompass both non-hazardous and hazardous waste fractions, set ambitious targets for improvement and monitor them, and also explore possibilities to implement the approach of industrial symbiosis.

Applicability

This BEMP is broadly applicable to all EEE manufacturing companies.

A limiting factor for the effective implementation of industrial symbiosis is the need for communication and coordination among different companies, i.e. lack of knowledge of and insight into other companies' activities and thus potential exploitation routes for waste and by-products.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i30) Development and implementation of an effective waste management strategy (Y/N) (i31) Share of sites with a waste management strategy (%) (i32) Recycling rate of the waste generated at manufacturing plants (%) (i33) Waste disposal diversion rate of the waste generated at manufacturing plants (%) (i34) For a specific product or product	(b6) The company has a waste management strategy in place in all sites (b7) The company achieves a waste disposal diversion rate of 93% on average across all manufacturing plants

[10] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312, 22.11.2008, p. 3), known as the Waste Framework Directive, introduces an order of preference for action to reduce and manage waste. This is known as the waste hierarchy. It set the highest priority on waste prevention, followed by waste reuse, then recycling and then (energy) recovery of waste fractions that cannot be prevented, reused or recycled. Finally, waste disposal is only to be considered when none of the previous routes are possible.

range, waste generation per metric ton of product or other suitable functional unit (kg/t)	

3.2. BEMPs for supply chain management

This section is relevant for EEE manufacturers and deals with practices related to their supply chain.

3.2.1. Assessment tools for cost-effective and environmentally sound substitution of hazardous substances

BEMP is to use reference tools to identify and assess hazardous substances in purchased materials in order to substitute them. Manufacturers will use input data from suppliers, provided ideally as full material declarations or declarations of conformity, to track substances. The assessment then focusses on three key steps:

– clarification of whether the substance under discussion is a substance of very high concern (based on the REACH Candidate List) or a RoHS restricted substance[11], in which case substitution has high priority;

– classification of the substance under discussion taken from the safety data sheet and confirmed by comparison with a database of hazardous substances;

– use of an assessment tool in addition to the above, for specific substances, such as certain phthalates and halogenated flame retardants, to investigate the best alternatives.

Applicability

This BEMP is, in principle, applicable to all companies of the sector. However, SMEs may lack the leverage to demand full material declarations from many suppliers, in which case they can request supplier declarations of conformity complemented by laboratory testing.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**
(i35) Share of suppliers that provide a full material declaration (% of supply chain expenditure) (i36) Share of suppliers that issue a supplier declaration of conformity for a company-specific list of restrictions, complemented by a certification (preferably third-party) based on laboratory testing (% of supply chain expenditure) (i37) Disclosure (e.g. on website and in annual sustainability reports) of the two previous indicators (Y/N)	(b8) Mandatory requirements for all major suppliers (in terms of % of supply chain expenditure) to provide a full material declaration are in place

[11] Some of which can still be used by virtue of RoHS exemptions

3.2.2. Disclosure and setting of targets for supply chain greenhouse gases emissions

BEMP is to assess, according to recognised standards, and regularly disclose all the direct and the most relevant indirect greenhouse gas (GHG) emissions (all scope 1 and scope 2 as well as the most relevant scope 3 emissions[12]). Based on the assessment, BEMP is to set targets for the reduction of those direct and indirect GHG emissions as well as to demonstrate and regularly publish actual absolute and/or relative GHG emission reductions.

Applicability

This BEMP is applicable to all companies of the sector. However, there are some limitations in the calculation of scope 3 emissions, due to the complexity of the value chains of EEE.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i38) Periodical (e.g. annual) publication of GHG emissions calculated with a recognised standard method (Y/N)	(b9) GHG emissions (including scope 1, 2 and the most relevant scope 3) are calculated with a recognised standard method and periodically published
(i39) Categories of scope 3 emissions included in the assessment	(b10) Absolute or relative GHG emission reduction targets are disclosed publicly
(i40) Periodical (e.g. annual) disclosure of demonstrated actual absolute and/or relative GHG emission reductions (Y/N)	(b11) Absolute and/or relative actual GHG emission reductions are demonstrated and periodically published

3.2.3. Application of Life Cycle Assessment

BEMP is to make use of Life Cycle Assessments (LCA) as a decision support instrument in the context of: strategic planning (macro-level), design and planning of products, facilities, and processes (micro-level) and monitoring the environmental performance of the company (accounting). Conducting LCA on product ranges to support environmental improvements is the most relevant area of application in the industry and allows the setting of LCA-based improvement targets for product ranges.

Applicability

This BEMP is broadly applicable to all electrical and electronic equipment manufacturing companies, especially to large companies.

[12] According to the GHG Protocol, scope 1 emissions are all the direct GHG emissions of a company, i.e. GHG emissions that are released by owned or controlled facilities or vehicles. Scope 2 emissions are indirect GHG emissions from consumption of purchased electricity, heat, cold or steam, i.e. emissions that were released elsewhere to produce the energy consumed within company boundaries. Scope 3 denotes all other indirect emissions from product (good or service) or material flows entering or leaving the company boundaries.

Internal resources and the complexity of LCA are potential limiting factors for the conducting of LCA for small and medium-sized enterprises. However, simplified LCA tools and ready-made databases help mitigate the difficulties.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i41) Inclusion of LCA according to the ISO standards 14040 and 14044 in the environmental strategy of the company and use of LCA when taking major decisions for developing new and redesigned products (Y/N) (i42) Percentage of product ranges for which LCA-based improvement targets have been met (weighted by number of product models or by sales)	(b12) LCA is carried out according to the international standards ISO 14040 and ISO 14044 (b13) The company carries out LCA for new and redesigned products and the results are systematically used as a basis for product development choices

3.2.4. Protection and enhancement of biodiversity along the electrical and electronic equipment supply chain

BEMP is to develop and implement a programme for managing the biodiversity impacts related to supply chain products and supply chain activities.

Based on a mapping of products and materials provided by the supply chain and of their relevant impacts on biodiversity, procurement guidelines and requirements can be formulated, targeting changes in relation to products and components with a greater potential to impact biodiversity.

Applicability

The BEMP is applicable to all electrical and electronic equipment manufacturing companies.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i43) Implementation of a periodic assessment of biodiversity impacts of products and materials provided by the supply chain (Y/N) (i44) Formulation of procurement guidelines and requirements for the most relevant products and materials identified in the biodiversity assessment (Y/N) (i45) For each of the groups of products (e.g. wood and paper products) for which procurement requirements have been developed by the company: • share of products qualifying as priority procurement (%)	(b14) The company implements a programme for a periodic assessment of biodiversity impacts of products and materials provided by the supply chain and the results of the assessment are used to formulate procurement guidelines and requirements on the most relevant products and materials.

• share of products qualifying as acceptable procurement (%) • share of products qualifying as procurement to be avoided (%) (i46) The share (by purchase volume) of suppliers that have provided initial reporting as to their potential impacts on biodiversity (%) (i47) The share (by purchase volume) of suppliers that have developed a biodiversity management plan (%) (i48) The share (by purchase volume) of suppliers that are implementing their biodiversity management plan (i.e. making progress towards achieving set targets) (%)	

3.3. BEMPs fostering a more circular economy

This section is relevant for electrical and electronic equipment manufacturing companies and deals with management and strategic practices that foster a more circular economy.

3.3.1. Strategic guidance on designing products for the circular economy

BEMP is to have an approach in place that ensures that the consideration of all the different environmental aspects, and specifically a move towards the circular economy, is systematically integrated into the design process of products. Such an approach is based on:

– setting goals for the improvement of the environmental performance of the products, either at the company level (general goals for all products) or at the level of a specific product; objectives need to be clear, well defined and communicated at the company level so that there is an awareness of employees at all levels; circular economy related goals can be set, depending on the product, on durability, reparability, upgradability and recyclability, which are all largely dictated by design.

– integrating into the design process inputs and feedback from the different units tied to the product manufacture, use and end-of-life, as well as, in some cases, from external stakeholders;

– creating a feeling of a collective effort throughout the company towards the development of the various design specifications for the new products.

This is implemented by one or both of the following approaches:

– setting an internal environmental standard for the design of new products at the company level, with defined general goals and compulsory requirements, which are continuously enhanced based on feedback from different units within the organisation; when starting the design of each specific product, these are then converted into design specifications for the specific product;

– establishing an interdisciplinary design committee or steering group for the design of each product, involving representatives from all the different relevant units directly tied to the various stages in the actual product design process.

Applicability

The BEMP is applicable to all electrical and electronic equipment manufacturing companies

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i49) Setting of circular economy objectives for new products (Y/N) (i50) Number of different units across the company having contributed to design processes (No) (i51) Share of products or components (by number or revenue) for which design cycles or redesign cycles have been embarked upon that explicitly address the different approaches of circular economy (%) (i52) Environmental benefits achieved over their whole life cycle by the products sold during the year that were designed or redesigned taking into account circular economy objectives ($kgCO_{2e}$ for carbon emissions, kg material saved for resource efficiency, etc.)	(b15) The company has put in place circular economy objectives for new products and an effective product design process to ensure these are achieved

3.3.2. Integrated product service offering

BEMP is for EEE manufacturers to provide Integrated Product Service Offerings (IPSO) both in business to businesses and business to consumers, shifting from designing and selling physical products to providing a product service system that leads to an improved functional and environmental performance. For instance, IPSO create incentives for manufacturers to ensure their products are durable or offer the opportunity to take back products to redeploy them or refurbish them for further use.

Applicability

The IPSO model is especially applicable to EEE with a high capital cost and a long useful life.
The applicability in the field of electrical household appliances with limited purchasing costs, a low bill of materials or a significant size/weight is limited (e.g. take-back is not feasible if the economical/technical value is too low compared to transportation costs).

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i53) Implementation of the IPSO model ensuring that it delivers environmental benefits (Y/N)	(b16) The company adopts IPSO in its business ensuring that it leads to a continuous improvement of the environmental performance of the product

(i54) Take-back rates of products installed at customer premises within the IPSO per product category (%) (i55) Share of reused devices out of the total number of devices installed within the IPSO (%)	service offered (b17) 100% take-back rate for post-consumer devices from leasing contracts and 30% refurbishment rate

3.3.3. Remanufacturing or high-quality refurbishment of used products

BEMP is to prevent waste by remanufacturing or refurbishing used electrical and electronic equipment and bringing them into the market for reuse. The remanufactured or refurbished products achieve at least the same quality levels they had when they were first placed on the market and are sold with the appropriate warranty.

Applicability

This practice is particularly suitable for mid- or high-capital-intensive equipment.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**
(i56) Use of LCA to demonstrate that the remanufacturing or refurbishment activities have environmental net benefits, including in light of energy efficiency gains of new product models (Y/N)	(b18) LCA is used to demonstrate that the remanufacturing or refurbishment activities have environmental net benefits, including in light of energy efficiency gains of new product models

3.3.4. Increase of the content of recycled plastics in electrical and electronic equipment

BEMP is to increase the use of recycled plastics for the manufacture of electrical and electronic equipment, where applicable according to the required material properties. This can be achieved by closed-loop recycling of plastic production scrap, closed-loop recycling of post-consumer plastics from own products as well as purchasing recycled plastics made from post-consumer plastic waste (open-loop recycling).

Applicability

This BEMP is suitable for many polymers that are used in electrical and electronic equipment manufacturing. Recycled plastics can replace virgin plastics in those cases where the required material specifications can be met.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**
(i57) Share of recycled plastics from pre-consumer waste used for the manufacture of a specific product or product group out of the total plastics used for that product or product group (%) (i58) Share of recycled plastics from post-consumer waste used for the manufacture of a specific product or product group out of the	N/A

total plastics used for that product or product group (%) (i59) Total amount of recycled plastics from pre-consumer waste used in manufacturing (tonnes) (i60) Total amount of recycled plastics from post-consumer waste used in manufacturing (tonnes) (i61) Sales of products manufactured with recycled plastics out of total product sales (%)	

4. RECOMMENDED SECTOR-SPECIFIC KEY ENVIRONMENTAL PERFORMANCE INDICATORS

The following table lists a selection of key environmental performance indicators for the electrical and electronic equipment manufacturing sector, together with the related benchmarks and reference to the relevant BEMPs. These are a subset of all the indicators mentioned in Section 3.

Table 4.1: Key environmental performance indicators and benchmarks of excellence for the electrical and electronic equipment manufacturing sector

Indicator	**Common units**	**Main target group**	**Short description**	**Recommended minimum level of monitoring**	**Related EMAS core indicator**[13]	**Benchmark of excellence**	**Related BEMP**[14]
BEMPs for manufacturing processes							
Energy use in the cleanroom for printed circuit board manufacturing	kWh/m^2	Electrical and electronic equipment manufacturers	Energy used in the cleanroom for the manufacturing of printed circuit boards per surface unit of printed circuit board processed	Facility	Energy efficiency	N/A	3.1.1
Energy use in the cleanroom for semiconductors and/or integrated circuits manufacturing	kWh/cm^2	Electrical and electronic equipment manufacturers	Energy used in the cleanroom for the manufacturing of the semiconductors and integrated circuits per surface unit of semiconductors and/or integrated circuits processed	Facility	Energy efficiency	N/A	3.1.1

13 EMAS core indicators are listed in Annex IV to Regulation (EC) No 1221/2009 (Section C.2).

14 The numbers refer to the sections in this document.

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[13]	Benchmark of excellence	Related BEMP[14]
Air Change Rate (ACR)	Number/hour	Electrical and electronic equipment manufacturers	Frequency of the replacement of the air within the cleanroom	Facility	Energy efficiency	N/A	3.1.1
Coefficient of System Performance (COSP)	kW of cooling power provided / kW of power used	Electrical and electronic equipment manufacturers	Ratio between the useful cooling power provided by a cooling system and the electrical power used by the cooling system. The power used by the supplementary equipment (e.g. pumps) is included in the denominator of this ratio.	Site	Energy efficiency	N/A	3.1.2
Total energy demand per surface unit of printed circuit board processed	kWh/m^2 of printed circuit board	Electrical and electronic equipment manufacturers	Amount of energy required for the processing of printed circuit boards divided by the surface of printed circuit boards processed	Facility	Energy efficiency	N/A	3.1.3
Nitrogen consumption per surface unit of printed circuit	kg of nitrogen/ m^2 of manufactured printed circuit	Electrical and electronic equipment	Amount of nitrogen consumed in the soldering process divided by	Facility	Material efficiency	N/A	3.1.3

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[13]	Benchmark of excellence	Related BEMP[14]
board processed	board	manufacturers	the total surface of the printed circuit boards manufactured				
Amount of copper recycled from etching process agents	t/year	Electrical and electronic equipment manufacturers	Weight of on-site copper recycled from etching process agents over a year	Site	Material efficiency	N/A	3.1.4
Total water consumption in the fabrication plant	l/m^2 of manufactured printed circuit board	Electrical and electronic equipment manufacturers	Total volume of water consumed in the fabrication plant divided by the surface of the printed circuit boards manufactured	Site	Water	At least 50% of the rinsing facilities are equipped with a cascade rinsing system with four or more stages	3.1.5
Normalised Emission Rate for perfluorocompounds emissions	kg CO_2eq/cm^2	Electrical and electronic equipment manufacturers	Global warming potential caused by the PFC emissions of a manufacturing site divided by the surface of the wafers produced	Site	Emissions	The Normalised Emission Rate for PFC emissions in new-build semiconductor fabrication facilities or facilities having undergone major renovation is lower than 0.22 kg CO_2eq/cm2	3.1.6

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[13]	Benchmark of excellence	Related BEMP[14]
Electricity use of the compressed air system per unit of volume at the point of end use	kWh/m^3	Electrical and electronic equipment manufacturers	Electricity use of the compressed air system (including the energy use of the compressors, dryers and secondary drives) per standard cubic metre of compressed air delivered, at a stated pressure level	Site	Energy efficiency	The electricity use of the compressed air system is lower than 0.11 kWh/m^3 of delivered compressed air, for large installations working at a gauge pressure of 6.5 bar, with volume flow normalised at 1013 mbar and 20°C, and pressure deviations not exceeding 0.2 bar	3.1.7
Air Leakage Index	Number	Electrical and electronic equipment manufacturers	The Air Leakage Index is calculated when all air consumers are switched off as the sum for each of the compressors of the time it runs multiplied by the capacity of that compressor, divided by the total standby time and the total rated capacity of the compressors in the	Site	Energy efficiency	After all air consumers are switched off, the network pressure remains stable and the compressors (on standby) do not switch to load condition	3.1.7

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[13]	Benchmark of excellence	Related BEMP[14]
			system, and it is expressed as: Air Leakage Inde[x] where: $t_{i(cr)}$ is the time (min) during which a compressor runs when all air consumers are switched off (standby of the compressed air system); $C_{i(cr)}$ is the capacity (Nl/min) of the compressor that switches on for the time $t_{i(cr)}$ while all air consumers are switched off; $t_{(sb)}$ is the total time (min) during which the installed compressed air equipment is in standby mode; $C_{(tot)}$ is sum of the rated capacity (Nl/min) of all the				

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[13]	Benchmark of excellence	Related BEMP[14]
			compressors in the compressed air system.				
Implementation of a site biodiversity action plan in all production facilities	Y/N	Electrical and electronic equipment manufacturers	This indicator refers to whether all production facilities have in place a biodiversity action plan for the site	Site	Biodiversity	A biodiversity action plan is implemented in all production facilities to protect and enhance the state of biodiversity (flora and fauna) at the specific site	3.1.8
Share of electricity from renewable sources (self-generated or purchased with verified additionality) out of the total electricity use	%	Electrical and electronic equipment manufacturers	Electricity from renewable sources either self-generated or purchased divided by the total electricity use within the site. As per purchased renewable electricity, it is only accounted for in this indicator if verified as additional (i.e. not already accounted for by another	Site	Energy efficiency	N/A	3.1.9

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[13]	Benchmark of excellence	Related BEMP[14]
			organisation or in the electricity mix of the grid).				
Share of heat from renewable sources out of the total use of heat	%	Electrical and electronic equipment manufacturers	Heat from renewable sources (e.g. solar thermal, geothermal, biomass) divided by the total use of heat within the site	Site	Energy efficiency	N/A	3.1.9
Waste disposal diversion rate of the waste generated at manufacturing plants	%	Electrical and electronic equipment manufacturers	Weight of waste sent for preparation for reuse, recycling or energy recovery divided by the total amount of waste generated within the manufacturing site. This indicator can be calculated separately for hazardous and for non-hazardous waste and/or for the most important materials of the waste stream, e.g. metal scrap,	Site	Waste	The company achieves a waste disposal diversion rate of 93% on average across all manufacturing plants	3.1.10

Indicator	**Common units**	**Main target group**	**Short description**	**Recommended minimum level of monitoring**	**Related EMAS core indicator[13]**	**Benchmark of excellence**	**Related BEMP[14]**
			polymers.				
Share of sites with a waste management strategy	%	Electrical and electronic equipment manufacturers	This indicator is expressed as the number of sites with a waste management strategy in place, based on the elements presented in the description of this BEMP, divided by the total number of sites of the company. In the event that a company has one site only, it can be expressed as a yes/no indicator for the site.	Site	Waste	The company has a waste management strategy in place in all sites	3.1.10
BEMPs for supply chain management							
Share of suppliers that provide a full material declaration	%	Electrical and electronic equipment manufacturers	This indicator measures the percentage of supply chain expenditure on suppliers that provide a full material	Site	Biodiversity Material efficiency	Mandatory requirements for all major suppliers (in terms of percentage of supply chain expenditure) to provide a full	3.2.1

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[13]	Benchmark of excellence	Related BEMP[14]
			declaration out of the total supply chain expenditure			material declaration are in place	
Periodical (e.g. annual) publication of GHG emissions calculated with a recognised standard method	Y/N	Electrical and electronic equipment manufacturers	This indicator refers to whether the GHG emissions of the company (including scope 1 and 2 and the most relevant for scope 3) are calculated according to a recognised standard method and periodically published	Company	Emissions	GHG emissions (including scope 1, 2 and the most relevant scope 3) are calculated with a recognised standard method and periodically published	3.2.2
Periodical (e.g. annual) disclosure of demonstrated actual absolute and/or relative GHG emission reductions	Y/N	Electrical and electronic equipment manufacturers	This indicator refers to the periodical disclosure of demonstrated actual GHG emission reductions by the company	Company	Emissions	Absolute and/or relative actual GHG emission reductions are demonstrated and periodically published	3.2.2
Inclusion of LCA according to the ISO standards	Y/N	Electrical and electronic equipment	This indicator refers to whether LCA is integrated	Company	Energy efficiency Material efficiency	LCA is carried out according to the international	3.2.3

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[13]	Benchmark of excellence	Related BEMP[14]
14040 and 14044 in the environmental strategy of the company and use of LCA when taking major decisions for developing new and redesigned products		manufacturers	into the environmental strategy of the company and whether its use supports major decisions for developing new or redesigned products		Water Waste Biodiversity Emissions	standards ISO 14040 and ISO 14044. The company carries out LCA for new and redesigned products and the results are systematically used as a basis for product development choices	
Formulation of procurement guidelines and requirements for the most relevant products and materials identified in the biodiversity assessment	Y/N	Electrical and electronic equipment manufacturers	This indicator refers to whether biodiversity procurement guidelines and requirements are developed for the products and materials identified as most relevant in the periodic assessment of biodiversity impacts of products and materials provided	Company	Biodiversity	The company implements a programme for a periodic assessment of biodiversity impacts of products and materials provided by the supply chain and the results of the assessment are used to formulate procurement guidelines and requirements on the most relevant	3.2.4

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[13]	Benchmark of excellence	Related BEMP[14]
			by the supply chain			products and materials	
BEMPs fostering a more circular economy							
Setting of circular economy objectives for new products	Y/N	Electrical and electronic equipment manufacturers	This indicator refers to the presence of circular economy objectives for new products or product groups	Company	Material efficiency	The company has put in place circular economy objectives for new products and an effective product design process to ensure these are achieved	3.3.1
Share of products or components (by number or revenue) for which design cycles or redesign cycles have been embarked upon that explicitly address the different approaches of circular economy	%	Electrical and electronic equipment manufacturers	Number of products or components for which design or redesign cycles that explicitly address the different approaches to the circular economy have been implemented divided by the total number of products or components produced by the	Company	Material efficiency	N/A	3.3.1

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[13]	Benchmark of excellence	Related BEMP[14]
			company				
Implementation of the IPSO model ensuring that it delivers environmental benefits	Y/N	Electrical and electronic equipment manufacturers	This indicator monitors whether an IPSO model that aims at improving the environmental performance of products is in place	Company	Material efficiency	The company adopts IPSO in its business ensuring that it leads to a continuous improvement of the environmental performance of the product service offered	3.3.2
Take-back rates of products installed at customer premises within the IPSO per product category	%	Electrical and electronic equipment manufacturers	This indicator is expressed as the percentage of products installed on customer premises within the IPSO model and taken back by the manufacturer for redeployment or refurbishment for further use	Company	Material efficiency	100% take-back rate for post-consumer devices from leasing contracts and 30% refurbishment rate	3.3.2
Share of reused devices out of the total number of devices installed within the IPSO	%	Electrical and electronic equipment manufacturers	This indicator is expressed as the number of reused devices divided by the total number of devices installed	Company	Material efficiency	N/A	3.3.2

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[13]	Benchmark of excellence	Related BEMP[14]
			within an IPSO model by the company				
Use of LCA to demonstrate that the remanufacturing or refurbishment activities have environmental net benefits, including in light of energy efficiency gains of new product models	Y/N	Electrical and electronic equipment manufacturers	This indicator refers to the use of LCA for demonstrating the actual environmental net benefits of the remanufacturing or refurbishment activities	Company	Material efficiency	LCA is used to demonstrate that the remanufacturing or refurbishment activities have environmental net benefits, including in light of energy efficiency gains of new product models	3.3.3
Total amount of recycled plastics from pre-consumer waste used in manufacturing	Tonnes	Electrical and electronic equipment manufacturers	Weight of recycled plastics from pre-consumer waste used for the manufacturing of electrical and electronic equipment	Site/company	Material efficiency	N/A	3.3.4
Total amount of recycled plastics from post-consumer waste used in manufacturing	Tonnes	Electrical and electronic equipment manufacturers	Weight of recycled plastics from post-consumer waste used for the manufacturing of electrical and	Site/company	Material efficiency	N/A	3.3.4

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[13]	Benchmark of excellence	Related BEMP[14]
			electronic equipment				