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Energy Management and Sustainable Manufacturing (EMSM) Project in factories of industrial organizations — A Methodology — Requirements

Projekt für Energiemanagement und nachhaltige Produktion (EMSM) in Fabriken von Industrieunternehmen — Eine Methodik — Anforderungen

Projet de gestion de l'énergie et de fabrication durable (EMSM) dans les usines des organisations industrielles — Une méthodologie — Exigences

ICS:

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| CCMC will prepare and attach the official title page. |

Contents Page

[Foreword 3](#_Toc188437055)

[Introduction 5](#_Toc188437056)

[1 Scope 7](#_Toc188437057)

[2 Normative references 7](#_Toc188437058)

[3 Terms and definitions 7](#_Toc188437059)

[4 Requirements for the methodology for the implementation of an Energy Management and Sustainable Manufacturing (EMSM) Project 10](#_Toc188437060)

[4.1 Definition of improvement measures to be implemented 10](#_Toc188437061)

[4.2 Technical study or preliminary project of the improvement measures to be implemented 10](#_Toc188437062)

[4.3 Key Performance Indicators for the EMSM Project 11](#_Toc188437063)

[4.3.1 General 11](#_Toc188437064)

[4.3.2 Energy indicators 12](#_Toc188437065)

[4.3.3 Environmental indicators 14](#_Toc188437066)

[4.3.4 Management and use of resources 14](#_Toc188437067)

[4.4 Measurement and Verification Plan 18](#_Toc188437068)

[4.5 Improvement analysis 18](#_Toc188437069)

[4.6 Economic Approach of the EMSM Project 19](#_Toc188437070)

[4.7 Energy Management and Sustainable Manufacturing (EMSM) Design Document 19](#_Toc188437071)

[Annex A (informative) Previous audit and baseline of a factory 20](#_Toc188437072)

[Bibliography 22](#_Toc188437073)

Foreword

This CEN Workshop Agreement (CWA XXXX:YYYY) has been developed in accordance with the CEN‑CENELEC Guide 29 "CEN/CENELEC Workshop Agreements – A rapid way to standardization" and with the relevant provisions of CEN/CENELEC Internal Regulations – Part 2. It was approved by the CEN Workshop “A Methodology for the implementation of an Energy Management and Sustainable Manufacturing (EMSM) Project in factories”, the secretariat of which is held by Asociación Española de Normalización, UNE, consisting of representatives of interested parties on YYYY-MM-DD, the constitution of which was supported by CEN following the public call for participation made on YYYY-MM-DD. However, this CEN Workshop Agreement does not necessarily include all relevant stakeholders.

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Introduction

Efficient management and the use of limited resources have always been one of society’s goals.

Supplying resources in a safe, reliable, economical and environmentally friendly manner requires using them efficiently. This efficient use drive increase efficiency of industrial process and in turn can increase the sectorial competitiveness.

Current energy and environmental policy pursue three main objectives: to ensure security of supply (through energy savings and diversification of sources), to increase the competitiveness of economies, to promote sustainability and to fight climate change.

This CEN Workshop Agreement pretends to contribute to these objectives. It takes as a basis the work done in ECOFACT Project, which is a project through the European Horizon 2020 Research and Innovation Programme under Grant Agreement Nº 958373.

ECOFACT aims at enabling manufacturing industries to optimize the energy performance (3.11) of their production systems in line with their relevant production constraints (time and resources), while at the same time introducing a novel green marketing approach through the concept of energy and environmental signature of the manufactured products from a life-cycle perspective.

Within the Project a range of Key Performance Indicators (KPI) have been identified and will be used as a tool. A Key Performance Indicator is a parameter or a value derived from parameters, which provides information about performance. As such, indicators are essential for measuring and monitoring sustainable performance in manufacturing to improving Europe's competitiveness on world markets with better use of raw materials, natural resources and renewable energies.

Therefore, a selection of indicators has been made to lay the foundations for an evaluation of the fulfilment of the objectives.

These indicators have been selected from different sources of information ranging from academic and industry reports or sectoral analysis to standards that include the energy, environmental, and resource management. The most important and most widely applicable ones have been chosen from the work done in ECOFACT Project Some others have been taken form the work done in E2COMATION Project and the contributions from the WS participants..

The chosen Key Performance Indicators (KPIs) comply with the SMАRTER principle; that is, they are specific, measurable, achievable, realistic, and time-bound. They are:

* Specific: representative of the operations.
* Measurable: through using adequate variables.
* Achievable: the measurement defined in the KPI can be implemented. In addition, collecting data for the KPI is not complicated or expensive.
* Realistic: give more information about the organization’s performance to achieve its strategy.
* Time-bound: measure performance within a specific time frame.
* Effective: capable to represent main drivers in sustainability impact of industrial operations.
* Reproducible: able to be significant in other context.

In this document, the following verbal forms are used:

* “shall” indicates a requirement;
* “should” indicates a recommendation;
* “may” indicates permission;
* “can” indicates a possibility or a capability.

Information marked as “NOTE” or included in informative annexes is for guidance in understanding or clarifying the associated requirements.

# Scope

This document specifies the requirements for a methodology (3.19) for the implementation of an Energy Management and Sustainable Manufacturing (EMSM) Project (3.22) in factories of industrial organizations.

NOTE It could be useful to benefit from the outcome of an energy/environmental/industrial auditor technological audit that might have previously been conducted in the factory organization, the baselines generated in the audit could be used as a reference for the Project.

This document is applicable to any EMSM Project implemented by any industrial organization, regardless its activity.

# Normative references

No standards necessary to comply with this document have been identified.

Standards identified for guidance can be consulted in the bibliography chapter.

# Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

* ISO Online browsing platform: available at [http://www.iso.org/obp/](http://www.iso.org/obp/ui)
* IEC Electropedia: available at <http://www.electropedia.org/>

3.1

baseline

quantitative reference(s) providing a basis for comparison of performance

3.2

boundary

physical or organizational limits

NOTE An example of boundary could be a machine, a group of machines or the entire facility.

3.3

data normalization

modification of data to account for changes to enable comparison of activity performance under equivalent conditions

3.4

Digital Twin Platform (DTP)

web application which acts as Energy and Resource Management System for factory organization managers and operators combining industrial digital twin models of production lines and machines with simulation and optimization tools into a single web environment

3.5

Dynamic Life Cycle Assessment (Dynamic LCA)

LCA considering time-dependent variations in environmental impacts of a product or process over its entire lifecycle

3.6

energy

electricity, fuels, steam, heat, compressed air and other like media

[ISO 50001] [47]

3.7

energy consumption

quantity of energy (3.6) applied

[ISO 50001] [47]

3.8

energy efficiency

ratio or other quantitative relationship between an output of performance, service, goods, commodities, or energy, and an input of energy

[ISO 50001] [47]

3.9

Energy Management and Sustainable Manufacturing (EMSM) Project

a project implemented in an organization for the improvement of its energy and sustainable manufacturing performance (3.24)

3.10

Energy Management and Sustainable Manufacturing (EMSM) Project´s scope

the set of activities, which an organization addresses for the improvement of its energy and sustainable manufacturing performance (3.24) in a given period of time

3.11

energy performance

measurable result(s) related to energy efficiency (3.8), energy use (3.12) and energy consumption (3.7)

[based on ISO 50001] [47]

3.12

energy use

manner or kind of application of energy

[ISO 50001] [47]

3.13

environmental impact

change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization’s environmental aspects

[ISO 14001] [46]

3.14

Industrial Energy Disaggregation by Product

application of specific rules, requirements and guidelines (product category rules) for the obtention of separated information for each product regarding energy

3.15

Key Performance Indicator (KPI)

parameter, or a value derived from parameters, which provides information about performance

[SOURCE: ISO 24523:2017, 3.13, modified ] [49]

3.16

manufacturing environmental aspect

element of a manufacturing activity that interacts or can interact with the environment

3.17

material-flow simulation

mass and energy balances simulation

NOTE Usually is conducted by equipment.

3.18

measurement

process to determine a value

[ISO 50001] [47]

3.19

methodology

collection of standards, procedures and supporting methods that define the complete approach to the development of a project

3.20

monitoring

determining the status of a system, a process or an activity

3.21

process parameter

specified value for a process variable

3.22

project

temporary endeavor to achieve one or more defined objectives

3.23

sensitivity analysis

systematic procedures for estimating the effects of the choices made regarding methods and data on the outcome of a study

[SOURCE: ISO 14040:2006, 3.31][39]

3.24

sustainable manufacturing performance

measurable result(s) related to social, environmental and economic effects due to manufacturing activities

# Requirements for the methodology for the implementation of an Energy Management and Sustainable Manufacturing (EMSM) Project

## Definition of improvement measures to be implemented

The organization shall define, in first place, the improvement measures to be implemented within a specific boundary (3.2) and their physical and temporal scope as well as the resources to achieve them.

When several of the identified improvements affect the same system (concatenation of improvements), they must be considered together to evaluate possible cross-effects.

When defining measurements (3.18) to be taken the impact that those measures may have in maintenance, operation and end of useful life of the facilities must be considered.

## Technical study or preliminary project of the improvement measures to be implemented

A technical study or preliminary project for the implementation of the proposed improvements shall be available, according to the needs.

NOTE Technical studies or preliminary projects may include, when appropriate:

* Descriptive report;
* Installation schematics;
* Purchase specifications;
* Standards to be followed;
* Supplier guaranties;
* Budgets;
* Benefit/cost ratio;
* Conditions and deadlines for execution;
* Responsibilities and obligations;
* Consideration of possible necessary licenses.

## Key Performance Indicators for the EMSM Project

### General

The organization shall define their own KPIs (3.15) for measuring the improvements of the EMSM Project.

KPIs in 4.3.2, 4.3.3 and 4.3.4 are only a proposal. They can be taken as a basis.

They could also arise from audit/ baselines (3.1) previously obtained from technical approaches (see annex A).

New KPIs referring to other industrial aspects and effects can be introduced when necessary.

NOTE 1 Reference period and demonstrating period may be different for different factories.

NOTE 2 Previous baselines may be operating in quality, environmental or energy management systems supported by ISO standards implemented in the factories of industrial organizations and be useful for identifying consolidated KPIs in factories. Besides, integrating simulation and optimization tools into a Digital Twin Platform (3.4) could enhance and improve the management in terms of energy (3.6), resources and costs.

NOTE 3 A Digital Twin Platform can be used, as an optional tool, to ensure a user-friendly monitoring (3.20) of field data KPIs, guaranteeing access to real-time data streams and historical datasets. Within the digital twins, advanced 3 D models of industrial plants and machinery, energy and resource IIoT devices are grouped by the parameter they monitor or type of meter.

As an example, a list of DTP parameters could be the following, among others:

* electrical energy;
* thermal energy;
* natural gas;
* compressed air;
* water;
* hot water;
* operating hours;
* operating percentages;
* control valve percentage;
* current;
* pressure;
* temperature;
* air meter data;
* air calometer data;
* chemical data.

Depending on the industrial scenario, the DTP could also offer one or more simulation and optimization tools:

* Energy flexibility: as a production optimizer it could schedule the weekly production of a line, reducing item changeover times (as a consequence less energy is used, while CO2 emissions are reduced); as an energy optimizer it could schedule the thermal and electrical energy production, minimizing the energy bill and better managing the factory’s energy assets;
* Predictive Maintenance (PdM): could reduce maintenance costs estimating the Remaining Useful Lifetime of relevant equipment;
* Industrial Energy Disaggregation by Product (3.14): could forecast resource consumptions disaggregated by product;
* material-flow simulation (3.17): could generates a production forecast with the related energy consumption;
* production planning and scheduling: could minimize environmental impacts (3.13) through a simulated, improved production scheduling;
* Energy simulator: it could stimulate the behaviour of complex industrial processes (such as must cooling systems).

NOTE 4

Further software functionalities than an EMSM Project may offer could include:

* Dynamic Life Cycle Assessment (3.5);
* Sustainable Production Planning;
* Energy Aware Optimization Planning and Scheduling.

Indicators shall consider three categories: Energy, Environment and Management and Use of resources.

### Energy indicators

| KPI Name | KPI Definition | Units | Calculation Method |
| --- | --- | --- | --- |
| Energy consumption | Energy consumption per carrier (electricity, thermal... –gas, diesel, etc. –) and reference unit | kWh/reference unit | When available, measured data should be used for the different energy carriers. Otherwise, the energy consumption (3.7) value should be calculated based on the data available. |
| Energy savings | The reduction in energy consumption achieved through efficiency measures, process optimizations, or the implementation of advanced technologies compared to a baseline scenario | kWh/reference unit | Difference between baseline and real energy consumption adjustments |
| RES self- generation | The production of energy by renewable energy sources, for direct consumption by the same facility or system generating it | kWh or kWh/reference unit | When available, measured data should be used for the different energy carriers. Otherwise, the energy consumption value should be calculated based on the data available. |
| RES share | The proportion of total energy consumption or production that is supplied by renewable energy sources | % | Renewable Energy Sources (RES) contribution to the total energy consumption |
| Load factor | The ratio of the actual energy consumed over a given period to the maximum possible energy that could have been consumed or at full capacity during the same period. | % | Average demand/peak demand |
| Average demand | The mean value of energy demand over a specified time period, calculated as the total energy consumed divided by the length of the time period | kWh | When available, measured data should be used for the different energy carriers. Otherwise, the energy consumption value should be calculated based on the data available. |
| Non Production Period (NPP) energy consumption | Energy consumption per carrier (electricity, thermal –gas, etc. –) and functional unit in non-production period of a production facility | kW | Measured and calculated energy consumption during NPP (kWh) / NPP (hours) |

NOTE 1 In relation to the evaluation of energy in factories, an aspect that should be assessed is energy consumption.

NOTE 2 Depending on the availability of energy meters, the measurement can be provided on a general, line-by-line, or per-process basis.

NOTE 3 Measurement may also consider different types of energy, distinguishing, for example, by different sources: electricity, natural gas, diesel, etc. It would be ideal to distinguish by uses and/or systems and/or processes and/or areas.

NOTE 4 Energy costs are considered within 4.3.4, Management and Use of Resources Indicators.

NOTE 5 Manufacturing environmental aspects (3.16) of the different types (sources) of energy used in the industry are considered within the environmental KPIs, covering the entire life cycle of a product.

NOTE 6 A reference unit in the context of this document can be a quantity of final product, a quantity of raw material, i.e. waste used as an input for the process, a quantity of energy produced/consumed or others.

### Environmental indicators

| KPI Name | KPI Definition | Unit | Calculation Method |
| --- | --- | --- | --- |
| Total environmental performance | Overall environmental performance | Dimensionless  (Pt) | EF 3.1 single score (European Commission, 2022) [9] |
| Total environmental costs | EUR | Environmental Prices (CE Delft,  2018) [10] |
| Global Warming Potential 100 years | Greenhouse gas emissions | kg CO2 eq. | Baseline model of 100 years of the  IPCC (based on IPCC 2013) (Myhre et al, 2013) |
| \*Water consumption | The total amount of water consumed during the entire life cycle of the product | M3 World eq. | Available WAter REmaining (AWARE) as recommended by UNEP, 2016  (Boulay et al 2018) [11] [12] [13] |
| Energy consumption | Cumulative Energy Demand | MJ | Cumulative Energy Demand (CED)  (Hischier et al, 2010) [8] |
| Resource consumption | Resource use, minerals and metals | kg Sb eq. | CML 2002 (Guinée et al., 2002) and van Oers et al. 2002. [14] |
| Resource use, fossils | MJ | CML 2002 (Guinée et al., 2002) and van Oers et al. 2002. [14] |
| \* Water consumption is included here from the perspective of the water footprint which includes upstream processes. Note the difference with the in-situ use of water as a resource at the manufacturing site. | | | |

### Management and use of resources

#### Generic resource management and use indicators

| KPI Name | KPI Definition | Units | Calculation Method |
| --- | --- | --- | --- |
| Utilization Rate | The ratio between how many units a company produces over a period of time and how many units the company could potentially produce in that same period with optimal use of time and labour | % | (actual level of output) ÷ (maximum level of output) x 100  [17] [18] [22]  (Utilizion efficiency [%]) |
| Throughput | The average number of units being produced over a time period (having in mind raw materials or secondary origin such as waste materials) | Units/time | (units produced) ÷ (time)    [17] [18] [19] [22]  (Through put rate [Quantity  Unit] / Time unit]) |
| Manufacturing Cycle Time | The total amount of time it takes to produce a product. The cycle time metric can be used to measure the time it takes to manufacture a completed product, each individual component of the final product, or even go as far as to include delivery to the end user. Thus, cycle time can be used to analyse overall efficiency of a manufacturing process on the macro scale, as well as determine inefficiencies on a micro scale.  NOTE This KPI can be applied to an individual product or each distinct component involved in manufacturing. In cases where a single production line produces multiple products, the cycle time should be measured and reported separately for each product type to ensure accuracy and prevent double counting. | Time | (Process End Time) – (Process Start Time)  [17] [18] [19] |
| Downtime to Operating Time | The effectiveness of machinery maintenance and the machine itself. | Time | (Downtime) ÷ (Operating Time)  [19] |
| Availability | Availability is a ratio that shows the relation between the actual production time (APT) and the planned busy time (PBT) for a work unit. | % | Actual production time ÷ Planned busy time  [22] |
| Effectiveness | Effectiveness represents the relationship between the planned target cycle and the actual cycle expressed as the planned runtime per item (PRI) multiplied by the produced quantity (PQ) divided by the actual production time (APT). | % | (the planned runtime per item x produced quantity) ÷ actual production time  [22] |

#### Manufacturing Resources

|  |  |  |  |
| --- | --- | --- | --- |
| KPI Name | KPI Definition | Units | Calculation Method |
| Demand  Forecasting | The amount of raw materials they will require to meet future customer demand. | Raw  Materials/t name | (Raw Materials) x  (Production Rate)  [19] |
| Inventory turns | How many times inventory is sold over a specific time period and helps indicate resource effectiveness. Low ratio numbers indicate poor sales and excessive inventory, while high ratio numbers represent strong sales or insufficient inventory | Inventories  sold/time | (Units of Goods Sold) ÷ (Avg.  Inventory)  [19] |
| Worker  efficiency | The worker efficiency considers the relationship between the actual personnel work time (APWT) related to production orders and the actual personnel attendance time (APAT) of the employee. | % | Actual personnel work time ÷ actual personnel attendance time APWT / APAT  [22] |
| Comprehensive energy consumption | Comprehensive energy consumption is the ratio between all the energy consumed in a production cycle and the produced quantity (PQ) | Joule /  (number of units) or amount | e = E/PQ =(∑Mi x Ri + Q)/ PQ where  e: unit energy consumption of an equipment,  E: comprehensive energy consumption  Mi: actual consumption of certain kind of energy  (kilowatt hour)  Ri: conversion coefficient of certain kind of energy  Q: algebraic sum of effective energy exchanges with the environment  [22] |
| Water use strategy and management | The amount of water specifically consumed in situ during the production of a single reference unit. | m3/ reference unit | Total water used at the single facility level divided by the reference units selected  [20] [21] |
| Waste prevention and management | Total amount of waste generated during the production referred to a single reference unit | kg/ reference unit | Total waste generated (i.e. hazardous and non-hazardous) divided by the reference units selected  [20] [21] |

NOTE 1 Energy consumption has been considered as a resource in the production process.

NOTE 2 A reference unit in the context of this document can be a quantity of final product, a quantity of raw material, i.e. waste used as an input for the process, a quantity of energy produced/consumed or others.

#### Manufacturing quality

| KPI Name | KPI Definition | Units | Calculation Method |
| --- | --- | --- | --- |
| Yield | The percentage of units that are produced the correct way and to the unit specifications the first time through the production line without rework | % | (Units manufactured properly) ÷ (total number of units that went through the company’s production line) x 100  [18] |
| Scrap Rate | The percentage of material used that is not able to be used due to being defective or errors in the production process | % | (Amount of material that has been scrapped) ÷ (total number of material used) x 100  [18] |
| Overall  Equipment  Effectiveness  (OEE) | The percentage of manufacturing time that is truly productive. An OEE score of 100% means you are manufacturing only Good  Parts, as fast as possible, with no Stop Time  NOTE In the language of OEE that means 100% Quality (only Good Parts), 100% Performance (as fast as possible), and 100%  Availability (no Stop Time). | % | (Availability x Performance x  Quality)  [19] |
| Quality ratio | The quality ratio is the relationship between the good quantity (GQ) and the produced quantity (PQ) | % | Good quantity ÷ produced quantity GQ / PQ  [22] |

NOTE Production performance analysis is an important operational activity because it is part of product quality assurance. It includes analysis of production information, resource and equipment utilization, equipment performance, procedural efficiencies, and production variability.

#### Manufacturing costs

|  |  |  |  |
| --- | --- | --- | --- |
| KPI Name | KPI Definition | Units | Calculation Method |
| Total Manufacturing Cost (TMC) Per Reference Unit | The total costs of resources involved in producing products including material, labour and overhead | €  €/reference  unit | (Direct materials + Direct labour + Manufacturing overheads) ÷ reference units*.*  [18] |
| Energy Cost Per Reference Unit | The total cost per carrier of energy spent over a period of time and divides it by the number of units produced in that time frame. | €  €/unit | (Total Energy Cost) ÷  (Reference units Produced)  [19] |

NOTE 1 By transforming financial and accounting data into KPIs, the industry can make sound business decisions.

NOTE 2 A reference unit in the context of this document can be a quantity of final product, a quantity of raw material, i.e. waste used as an input for the process, a quantity of energy produced/consumed or others.

## Measurement and Verification Plan

The organization shall define and implement a measurement and verification plan.

For that, the organization shall:

* Establish the baseline for the KPIs selected in 4.3;
* Prepare the measurement and verification equipment;
* Identify a responsible for carrying out the measurements and calculations;
* Define and calculations and their frequency and implement them;
* Define and use a reporting document.

NOTE 1 The plan can be developed specifically for the Energy Management and Sustainable Manufacturing Project or come from protocols established by prestigious organizations.

NOTE 2 The implementation of the Measurement and Verification Plan will make it possible to know the degree of compliance with the objectives, providing information, where appropriate, of existing discrepancies and allowing the establishment of corrective measures.

## Improvement analysis

The improvement shall be demonstrated comparing the reference period baseline (KPIs data prior to the improvement measures) with the demonstration period baseline (KPIs data after improvement measures). The comparison shall show better results in the energy management and sustainability manufacturing performance for the Project, using data normalization (3.3) for the project, when necessary.

The organization must carry out the corresponding sensitivity analysis (3.23) to show influence that certain changes in the most influential variables of the reference period baseline have on the viability and results of the project.

NOTE The sensitivity analysis permits to foresee the possible economic risks assumed in the project.

See annex A.

## Economic Approach of the EMSM Project

The organization shall approve an Economic Approach for the EMSM Project in order to demonstrate that the proposed activities are the most appropriate for achieving the economic and financial objectives of maximising benefits and minimizing risk.

The Economic Approach shall:

* contain all the necessary activities for the EMSM Project and the timetable for their implementation, in order to implement the measures and identify the real funding needs;
* include the main milestones of the EMSM, the time frame for achieving them, and interconnections with the rest of the activities and the time planning for their implementation;
* be technically, economically and financially feasible, realistic and credible, so that there are no barriers that prevent the execution of any of its activities;
* contain the financial projections that cover the entire course of the planning, implementation, development and operation, including any replacements and residual values; as well as sensitivity analysis related to the main variables.

NOTE 1 The Economic Approach justifies the expectations of success of the EMSM Project and it is essential to show the technical-economic-financial viability of the EMSM.

NOTE 2 The economical/technical approach may be used internally for the company’[s economic planning](http://es.wikipedia.org/wiki/Planificaci%C3%B3n)  and externally to inform and engage third parties, such as banks, investors and public bodies.

## Energy Management and Sustainable Manufacturing (EMSM) Design Document

Once, the organization has completed its EMSM Project, it must issue a Project Design Document providing information on the factory improvement for the established scope of EMSM Project (3.10), comparing the reference period baseline with the demonstration period baseline.

NOTE Benchmarks allow a fair comparison of factories, regardless of size, and that are applicable to a wide range of facilities. This is achieved by ensuring that only a single benchmarking methodology is required.

Information provided in the Project Design Document should be presented in a way that is verifiable by interested parties, including:

1. Definition of improvement measures.
2. Technical study of the improvement measures to be implemented.
3. Definition of KPI.
4. Measurement and verification plan.
5. Improvement analysis.
6. Economic approach of the EMSM Project.
7. (informative)  
     
   Previous audit and baseline of a factory
   1. General

It can be useful to conduct an energy/environmental/industrial audit in the factory organization prior to the EMSM Project that serves to define one or more baselines. Some of these baselines could be used as a baseline reference for the EMSM Project that the factory organization decides to implement.

* 1. Energy/environmental/industrial audit/survey

An energy/environmental/industrial audit/survey should provide information on the state and performance of facilities, facilities potential improvements, indicators potential improvements, impacts of the potential improvements on operation and maintenance, as well as the associated investments.

The physical and technical scope for the audit/survey to be conducted in the factory organization should be clearly defined.

In general, an energy/environmental/industrial audit in a factory organization should include the following stages:

1. Installation description;
2. Detailed inventory of equipment/processes/facilities/areas;
3. Assessment of the condition of the facilities;
4. Supply analysis;
5. Analysis of environmental impacts;
6. Processes analysis;
7. Analysis of horizontal and service technologies;
8. Data collection and measurement;
9. Energy, environmental and industrial accounting;
10. Mass/Energy/industrial resource balance;
11. Cost analysis of factory organization performance;
12. Analysis of improvement proposals;
13. Development of improvements;
14. Concatenation of improvements;
15. Recommendations and good practices;
16. Drafting of the audit/survey report.

NOTE EN 16247-3:2022 [46] provides useful information for conducting an energy audit within a process.

* 1. Baseline

Baseline(s) in an existing factory organization can be useful to establish performance levels prior to the accomplishment of a modification (Reference Period). This baseline(s) physically exists and is measured before possible changes within a EMSM Project are implemented. The reference model is able to accommodate changes in process parameters (3.21) and conditions so that “adjustments” are made.

On the flexible models of the company’s activities for which the results can be automatically updated based on changes in the input data, KPIs based on high-specificity models are tracked.

An EMSM Project thus can use previously developed relevant information of baselines already established in the factory organization, providing, transparency and rigor to the decision-making process of the improvement measures to implement within an EMSM Project.

It contributes also to generate the necessary confidence for the obtention of lines of aid of public or private financing for these improvements.

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