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Environmental management — Material flow cost accounting — Guidance for practical implementation in SMEs

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 207, *Environmental management*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Achieving the Sustainable Development Goals (SDGs) established by the United Nations in 2015 has become a high priority for society. In particular, Goal 12 requires both governments and private sectors to ensure sustainable consumption and production patterns. Companies of all sizes need to achieve improvements in material and energy efficiency for sustainable production.

A number of International Standards provide guidance on material flow cost accounting (MFCA), which is an approach to assess material efficiency within an organization (see ISO 14051) and to enhance material efficiency in cooperation with supply-chain partners (see ISO 14052). While organizations are encouraged to implement MFCA based on ISO 14051, depending on levels of operations, they may prefer a more simplified approach to MFCA. To address this need, this document provides guidance for organizations to initiate a phased implementation of MFCA. This approach focuses on the most relevant production process to enhance material efficiency along with cost reductions, possibly leading to additional business opportunities (e.g. a green supply chain).

This document can be used independently of ISO 14051 and ISO 14052. However, the basic philosophy of MFCA as well as the terms and definitions are the same as in ISO 14051. In addition, this document has been designed to help organizations to identify new business opportunities regarding material and energy efficiency. Large organizations can also use this document as a starting point for their implementation of MFCA in a specific department or process.

This document provides:

— common terminologies;

— principles;

— a calculation approach, analysis and improvement;

— an application of the MFCA implementation result.

Annex A gives a case example of an MFCA implementation in organizations.

Environmental management — Material flow cost accounting — Guidance for practical implementation in SMEs

1 Scope

This document gives practical guidelines for the phased implementation of material flow cost accounting (MFCA) that organizations, including small and medium-sized enterprises (SMEs), can adopt to enhance their environmental performance and material efficiency.

The phased approach provides flexibility that allows organizations to develop their MFCA activities at their own pace, according to their own circumstances. The resulting information can act as a motivator for organizations to seek opportunities to simultaneously generate financial and environmental benefits by reducing material losses and energy consumption.

This document is applicable to any organization, regardless of its level of development, the nature of its activities, or the location at which these activities occur.

This document provides basic calculation procedures to analyse saving potentials by avoiding material losses. Detailed calculation procedures or information on techniques for improving material or energy efficiency are out of the scope of this document.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purpose 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 https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
energy cost
cost for electricity, fuels, steam, heat, compressed air and other like media

Note 1 to entry: Energy cost can be either included under material cost or quantified separately, at the discretion of the organization.

[SOURCE: ISO 14051:2011, 3.4]

3.2
energy use
application of energy

EXAMPLE Ventilation; lighting; heating; cooling; transportation; data storage; production process.

Note 1 to entry: Energy use is sometimes referred to as “energy end-use”.

[SOURCE: ISO 50001:2018, 3.5.4]

3.3
material
substance that enters and/or leaves a process

Note 1 to entry: Materials can be divided into two categories:

— materials that are intended to become part of products, e.g. raw materials, auxiliary materials, intermediate products;

— materials that do not become part of products, e.g. cleaning solvents and chemical catalysts, which often are referred to as operating materials.

Note 2 to entry: Some types of materials can be classified into either category, depending on their use. Water is one such material. In some cases, water can become part of a product (e.g. bottled water), while in other cases it can be used as an operating material (e.g. water used in an equipment washing process).

Note 3 to entry: Energy carriers like fuels or steam can be identified as materials, at the discretion of the organization.

[SOURCE: ISO 14051:2011, 3.10, modified]

3.4
material flow cost accounting summary sheet
MFCA summary sheet
spreadsheet that reflects the *MFCA* (3.6) information for a production process that is treated as a single process

3.5
material cost
cost for a substance that enters and/or leaves a process

Note 1 to entry: Material cost can be calculated in various ways, e.g. standard cost, average cost, and purchase cost. The choice between cost calculation methods is at the discretion of the organization.

[SOURCE: ISO 14051:2011, 3.12, modified]

3.6
material flow cost accounting
MFCA
tool for quantifying the flows and stocks of *materials* (3.3) in processes or production lines in both physical and monetary units

[SOURCE: ISO 14051:2011, 3.15]

3.7
material loss
all material outputs generated in a process, except for intended products

Note 1 to entry: Material losses include air emissions, wastewater and solid waste, even if these material outputs can be reworked, recycled or reused internally, or have market value.

Note 2 to entry: By-products can be considered as either material losses or products, at the discretion of the organization.

[SOURCE: ISO 14051:2011, 3.16, modified]

3.8
system cost
cost incurred in the course of in-house handling of the *material* (3.3) flows, except for *material cost* (3.5), *energy cost* (3.1) and *waste management cost* (3.9)

EXAMPLE Cost of labour; cost of depreciation and maintenance; cost of transport.

[SOURCE: ISO 14051:2011, 3.21]

3.9
waste management cost
cost of handling *material losses* (3.6) generated in a process

[SOURCE: ISO 14051:2011, 3.22, modified — The notes to entry have been deleted.]

4 Principles

4.1 Understand the basic material flow and energy use

The material flows related to products and energy use, including material losses in the most relevant production process, are identified and quantified as physical data.

4.2 Ensure the reliability of physical data

Physical data on material flows and energy use are collected in consistent measurement units.

NOTE Refer to ISO 14033 *Quantitative Environmental Information*.

4.3 Estimate and attribute costs to material losses and energy use

The costs associated with material losses and energy use are estimated, and these costs are attributed to the material losses and energy use.

4.4 Link physical and monetary data

Decision-making on environmental and management issues within organizations is supported by linking physical data with associated cost.

5 Cost calculations in a phased approach

5.1 General

Data on material flows and energy use should be translated into monetary units to support decision-making according to the cost calculations. This process consists of one preparation-phase, four calculation-phases and one analytical phase. Organizations can incrementally implement MFCA as indicated in 5.2 to 5.7.

5.2 Preparation phase — Identification of the most relevant production process in the organization

The organization should identify its most relevant production process. If there is a single production process in the organization, all of the material losses and energy use should be examined. If multiple processes are present, the organization can select either the most relevant production process or multiple processes as one single production unit for calculation.

A selection approach for the most relevant production process should be divided into two steps:

a) assess the magnitude of the different material losses and energy use;

b) select the process with a high raw material unit cost, large volume of material losses and defective products, etc. as the most relevant production process.

If the organization wants to assess several relevant processes, adoption of ISO 14051 is recommended.

5.3 Calculation phase 1 — Quantification of material flows in physical units

The amounts of material inputs and outputs should be quantified in physical units such as mass, length, number of pieces or volume, depending on the type of materials. Outputs are divided into products and material losses.

5.4 Calculation phase 2 — Calculation of material costs and waste management costs

Cost calculations should be started with material costs. This includes costs related to the materials used in the most relevant production process which may include raw materials, auxiliary materials, operating materials and intermediate products. The costs of all material inputs are assigned to products and material losses according to the physical quantity. In addition, waste management costs are calculated.

5.5 Calculation phase 3 — Calculation of energy costs

The calculation of energy costs is at the discretion of the organization. When it is determined to be necessary, energy costs should be calculated and allocated to products and material losses according to the physical data quantified in calculation phase 1.

5.6 Calculation phase 4 — Calculation of system costs

The calculation of system costs is at the discretion of the organization. When it is determined to be necessary, system costs should be calculated and allocated to products and material losses according to the physical data quantified in calculation phase 1.

5.7 Analytical phase — Analysis of material loss costs

Along with the phases above, an analysis of cost impacts should be conducted. Material loss costs could be understood as saving potentials for organizations. Material costs assigned to material losses are usually the most important target to be reduced. Additionally, energy costs and system costs can indicate further saving potentials. If multiple processes have been combined as one, it should be ensured that the system costs are actually correlated with the material losses.

6 Calculation methods in a phased approach and development of an improvement plan

6.1 General

This clause explains the calculation methods and gives examples of the templates in which the cost calculations should be made.

6.2 MFCA summary sheet

The MFCA summary sheet is a general template that can be used for MFCA in a phased manner. The template contains information on target materials, products and material losses as illustrated in Table 1. Calculated costs at each phase are summarized in the MFCA summary sheet.

Table 1 — MFCA summary sheet

Fundamental Data	
Selected Production Process(es)	XYZ
Production Period or Lot Size	1 lot
Planned Production Volume	500 pieces

	Input			Output			
				Product		Material Loss	
Target Materials	**Unit Price ($/kg)**	**Input (kg)**	**Cost ($)**	**Output (kg)**	**Cost ($)**	**Output (kg)**	**Cost ($)**
Material A	–	–	–	–	–	–	–
Material B	–	–	–	–	–	–	–
Material C	–	–	–	–	–	–	–
Sub Total of Materials		–	–	–	–	–	–
Waste Management for Material Losses	**Unit Cost ($/kg)**		**Cost ($)**			**Output (kg)**	**Cost ($)**
–	–		–			–	–
–	–		–			–	–
–	–		–			–	–
Sub Total of Waste Management			–			–	–
Energy	**Unit Price ($)**	**Input**	**Cost ($)**	**Allocation Ratio**	**Cost ($)**	**Allocation Ratio**	**Cost ($)**
–	–	–	–				
–	–	–	–				
Sub Total of Energy				–	–	–	–
System Costs	**Unit Cost ($)**	**Input**	**Cost ($)**	**Allocation Ratio**	**Cost ($)**	**Allocation Ratio**	**Cost ($)**
–			–		–		
–			–		–		
–			–		–		
Sub Total of System Costs			–	–	–	–	–
Total Cost			–		–		–
			Ratio on Total Costs		–		–

This is a simplified example for a table, more complete and comprehensive tables are provided in ISO 14051.

6.3 Example template for the preparation phase

The organization selects the most relevant production process and material inputs. In this example, XYZ production process and the material inputs “Material A”, “Material B” and “Material C” are assumed to be the most relevant for the organization.

For its implementation of MFCA, the organization decided to collect one lot data, which produces 500 pieces of product as planned. The organization entered the data into an MFCA summary sheet, as shown in Table 2. In the following tables, added information is shaded.