Environmental Management Accounting
Procedures and Principles

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Abstract
The UN CSD aims to promote Environmental Management Accounting (EMA) by publications, pilot projects and an international platform. The objective of workbook 1 is to define principles and procedures for EMA. The intended users of these EMA metrics are national governments interested in establishing national EMA guidelines appropriate to their own countries' context and organizations seeking to install EMA systems for better controlling and benchmarking purposes.

Workbook 1 will soon be available at the UN CSD for download at their webpage. The following summary provides some of the core definitions and generic assessment tables.

What is EMA – Environmental Management Accounting?

EMA **metrics for internal decision-making** include both: **physical metrics** for material and energy consumption, flows, and final disposal, and **monetarised metrics** for costs, savings, and revenues related to activities with a potential environmental impact.

The core part of **environmental information systems** are **material flow balances** in physical units of material, water and energy flows within a defined system boundary. This can be on the corporate level, but also one step further done to cost centers and production processes or even down to machinery's and products. Then, it becomes the task of process technicians and not so much accountants to tackle and trace the necessary data.

INPUT	System boundaries	OUTPUT
	Nations	
Materials ⇒	Regions	⇒ Products
Energy ⇒	Corporations	⇒ Waste
Water ⇒	Processes	⇒ Emissions
	Products	

Figure1: System boundaries for mass balances

EMA, Environmental management accounting represents a **combined approach** which provides for the transition of data from financial accounting and cost accounting to increase material efficiency, reduce environmental impact and risk and reduce costs of environmental protection. EMA is performed by private or public corporations, but not nations and has a financial as well as physical component.

Key application fields for the use of EMA data are

- Assessment of annual environmental costs/ expenditures
- Product Pricing
- Budgeting
- Investment appraisal, calculating investment options

- Calculating costs and savings of environmental projects
- Design and implementation of environmental management systems
- Environmental performance evaluation, indicators and benchmarking
- Setting quantified performance targets
- Cleaner production and Ecodesign projects
- External disclosure of environmental expenditures, investments and liabilities
- External environmental or sustainability reporting
- Other reporting of environmental data to statistical agencies and local authorities

EMA has been defined in the 2nd and 3rd meeting of the expert working group on "Improving the role of government in the promotion of EMA" of the UN Division for Sustainable Development to cover the issues in the two middle columns of figure 2.

ACCOUNTING IN FINANCIAL UNITS		**ACCOUNTING IN PHYSICAL UNITS**	
CONVENTIONAL ACCOUNTING	**ENVIRONMENTAL MANAGEMENT ACCOUNTING**		**OTHER ASSESSMENT TOOLS**
	FEMA FINANCIAL EMA	**PEMA PHYSICAL EMA**	
DATA ON CORPORATE LEVEL			
CONVENTIONAL BOOK KEEPING	**TRACING OF ENVIRONMENTAL PART FROM BOOK KEEPING AND COST ACCOUNTING**	**MATERIAL FLOW BALANCES ON CORPORATE LEVEL FOR MASS, ENERGY AND WATER FLOWS**	PRODUCTION PLANNING SYSTEMS, STOCK ACCOUNTING SYSTEMS
DATA ON PROCESS/COST CENTER AND PRODUCT/COST CARRIER LEVEL			
COST ACCOUNTING	**ACTIVITY BASED COSTING, MATERIAL FLOW COST ACCOUN-TING**	**MATERIAL FLOW BALANCES ON PROCESS AND PRODUCT LEVEL**	OTHER ENVIRONMENTAL ASSESSMENTS, MEASURES AND EVALUATION TOOLS
BUSINESS APPLICATION			
INTERNAL USE FOR STATISTICS, INDICATORS, CALCULATING SAVINGS, BUDGETING AND INVESTMENT APPRAISAL	**INTERNAL USE FOR STATISTICS, INDICATORS, CALCULATING SAVINGS, BUDGETING AND INVESTMENT APP-RAISAL OF ENVI-RONMENTAL COSTS**	**INTERNAL USE FOR ENVIRONMENTAL MANAGEMENT SYSTEMS AND PERFORMANCE EVALUATION, BENCHMARKING**	OTHER INTERNAL USE FOR CLEANER PRODUCTION PROJECTS AND ECODESIGN
EXTERNAL FINANCIAL REPORTING	EXTERNAL DISCLOSURE OF ENVIRONMENTAL EXPENDITURES, INVESTMENTS	EXTERNAL REPORTING (EMAS-STATEMENT, CORPORATE	OTHER EXTERNAL REPORTING TO STATISTICAL AGENCIES, LOCAL

	AND LIABILITIES	ENVIRONMENTAL REPORT, SUSTAINABILITY REPORT)	GOVERNMENTS ETC.
NATIONAL APPLICATION			
NATIONAL INCOME ACCOUNTING BY STATISTICAL AGENCY	NATIONAL ACCOUNTING ON INVESTMENTS AND ANNUAL ENVIRON-MENTAL COSTS OF INDUSTRY, EXTERNALITIES COSTING	NATIONAL RESSOURCE ACCOUNTING (MASS BALANCES FOR COUNTRIES, REGIONS AND SECTORS)	

Figure 2: What is EMA ?

What are environmental costs?

The main problem of environmental management accounting is that we lack a standard **definition of environmental costs**. Depending on various interests, they include a variety of costs, e.g. disposal costs or investment costs and, sometimes, also external costs (i.e. costs incurred outside the company, mostly to the general public). Of course, this is also true for profits of corporate environmental activities (environmental cost savings). In addition, most of these costs are usually not traced systematically and attributed to the responsible processes and products, but simply summed up in general overhead.

The fact that environmental costs are not fully recorded often leads to **distorted calculations** for improvement options. Environment protection projects, aiming to prevent emissions and waste at the source (avoidance option) by better utilizing raw and auxiliary materials and requiring less (harmful) operating materials are not recognized and implemented. The economic and ecological advantages to be derived from such measures are not used. The people in charge are often not aware that producing waste and emissions is usually more expensive than disposing of them.

Environmental costs comprise both internal and external costs and relate to all costs occurred in relation with environmental damage and protection. **Environmental protection costs** include costs for prevention, disposal, planning, control, shifting actions and damage repair that can occur at companies, governments or people (VDI 2000[1]) . This book only deals with corporate environmental costs. External costs which result from corporate activities but are not internalized via regulations and prices are not considered. It is the role of governments to apply political instruments such as eco-taxes and emission control regulations in order to enforce the 'polluter-pays' principle and thus to integrate external costs into corporate calculations.

[1] VDI, the German Association of Technicians, together with German Industry representatives, have developed a guidance document on the definition of environmental protection costs and other terms of pollution prevention, VDI 2000.

Measures for environmental protection comprise all activities taken for legal compliance, compliance with own commitments or voluntarily. Economic effects are no criteria, but the effect on prevention or reduction of environmental impact. (VDI 2000).

Corporate environmental protection expenditure includes all expenditure for measures for environmental protection of a company or on its behalf to prevent, reduce, control and document environmental aspects, impacts and hazards, as well as disposal, treatment, sanitation and clean up expenditure. The amount of corporate environmental protection expenditure is not directly related to the environmental performance of a company (VDI 2000).

For company internal calculation of environmental costs, expenditure for environmental protection is only one part of the coin. The costs of waste and emissions include much more then the respective pollution prevention or treatment facilities.

The concept of '**waste**' has a double meaning. Waste is a material which has been purchased and paid for but which has not turned into a marketable product. Waste is therefore indicative of production inefficiency. Thus, the costs of wasted materials, capital and labor have to be added to arrive at total corporate environmental costs and a sound basis for further calculations and decisions. Waste in this context is used as general term for solid waste, waste water and air emissions, and thus comprises all **non-product output**.

	Environmental Protection Costs (Emission Treatment and Pollution Prevention)
+	**Costs of wasted material**
+	**Costs of wasted capital and labor**
=	**Total corporate environmental costs**

Figure 3: Total corporate environmental costs

The approach presented has the underlying assumption, that all purchased materials (including water and energy) must by physical necessity leave the company either as product or waste and emission. **Waste is thus a sign of inefficient production**. Therefore when calculating environmental costs, not only disposal fees are regarded, but the wasted material purchase value and the production costs of waste and emissions are added.

Adding the **purchase value of non-material output** (waste, waste water) to the environmental costs, makes the share of "environmental " costs higher in relation to other costs. However, it is not the goal of this paper to show, that environmental protection is expensive. It is also not the most important task to spent a lot of time defining exactly which costs are environmental or which costs are not, or what percentage of something is environmental or not.

The most important task is to make sure that **all relevant, significant costs are considered** when making business decisions. In other words, "environmental" costs are just a subset of the bigger cost universe that is necessary for good decision making. "Environmental" costs are part of an integrated system of material and

money flows throughout a corporation, and not a separate type of cost altogether. Doing environmental management accounting is simply doing better, more comprehensive management accounting, while wearing an “environmental” hat, that opens the eyes for hidden costs. Therefore, the focus of material flow accounting is no longer assessing the total “environmental” costs, but on a **revised calculation of production costs on the basis of material flows**.

The first block of environmental cost categories comprises conventional **waste disposal and emission treatment costs** including related labor and maintenance materials. Insurance and provisions for environmental liabilities also reflect the spirit of treatment instead of prevention. The first section corresponds to the conventional definition of environmental costs comprising all treatment, disposal and clean-up costs of existing waste and emissions.

The second block is termed **prevention and environmental management** and adds the labor costs and external services for good housekeeping as well as the "environmental" share and extra costs of integrated technologies and green purchase, if significant. The main focus of the second block is on annual costs for prevention of waste and emissions, but without calculated cost savings. They include higher pro-rata costs for environment-friendly auxiliary and operating materials, low-emission process technologies and the development of environmentally benign products.

Conventionally, three production factors are distinguished: materials, capital (investments, related annual depreciation and financing cost) and labor. The next two blocks consider the costs of wasted material, capital and labor due to inefficient production, generating waste and emissions.

In the third block, the **wasted material purchase value** is added. All non-product output is assessed by a material flow balance. Wasted materials are evaluated with their material purchase value or materials consumed value in case of stock management.

Lastly, the **production costs of non-product output** are added with the respective production cost charges, which include labor hours, depreciation of machinery and operating materials. In activity based costing and flow cost accounting the flows of residual materials are more precisely determined and allocated to cost centers and cost carriers.

Environmental revenues derived from sales of waste or grants of subsidies are accounted for in a separate block.

Costs that are incurred outside the company and borne by the general public (external costs) or that are relevant to suppliers and consumers (life cycle costs) are not dealt with.

Figure 4 shows the environmental cost assessment scheme developed for EMA. The workbook provides information on the different cost categories. The annex provides checklists for determination by environmental media.

Environmental media **Environmental cost/expenditure categories**	**Air + Climate**	**Waste Water**	**Waste**	**Soil + Ground Water**	**Noise + Vibration**	**Biodiversity + Landscape**	**Radiation**	**Other**	**Total**
1. Waste and Emission treatment									
1.1. Depreciation for related equipment									
1.2. Maintenance and operating materials and services									
1.3. Related Personnel									
1.4. Fees, Taxes, Charges									
1.5. Fines and penalties									
1.6. Insurance for environmental liabilities									
1.7. Provisions for clean up costs, remediation									
2. Prevention and environmental management									
2.1. External services for environmental management									
2.2. Personnel for general environmental management activities									
2.3. Research and Development									
2.4. Extra expenditure for cleaner technologies									
2.5. Other environmental management costs									
3. Material Purchase Value of non-product output									
3.1. Raw materials									
3.2. Packaging									
3.3. Auxiliary materials									
3.4. Operating materials									
3.5. Energy									
3.6. Water									
4. Processing Costs of non-product output									
å **Environmental Expenditure**									
5. Environmental Revenues									
5.1. Subsidies, Awards									
5.2. Other earnings									
å **Environmental Revenues**									

Figure 4: Environmental Cost Assessment scheme

The basis of environmental performance improvements and for assessing the amounts and costs of Non-product output (NPO) is the recording of material flows in kilograms by an **Input-Output analysis**. The system boundaries can be on the corporate level, or further split up to sites, cost centers, processes and product levels. The material flow balance is an equation based on "what comes in must go out - or be stored". In a material flow balance information on both the materials used and the resulting amounts of product, waste and emissions are stated. All items are measured in physical units in terms of mass (kg, t) or energy (MJ, kWh). The purchased input is cross-checked with the amounts produced and sold as well as the resulting waste and emissions. The goal is to improve efficiency of material management both economically and environmentally.

A material flow balance can be made for a few selected materials or processes, or for all materials and wastes of an organization. The aim of process balances is to track materials on their way through the company. The starting point often is the corporate level, as much information is available on this system boundary. Also, this level is used for disclosure in environmental reports.

Figure 5 shows the generally applicable structure of the input-output balance at corporate level, which could also be used for environmental reporting. Specific subcategories will be needed for different sectors, but, it should always be possible to aggregate in a standardized manner, in order to be able to compare them.

INPUT in kg/kWh	**OUTPUT in kg**
Raw materials	**Product**
Auxiliary materials	Main Product
Packaging	By Products
Operating materials	**Waste**
Merchandise	Municipal waste
Energy	Recycled waste
Gas	Hazardous waste
Coal	**Waste Water**
Fuel Oil	Amount
Other Fuels	Heavy metals
District heat	COD
Renewables (Biomass, Wood)	BOD
Solar, Wind, Water	**Air-Emissions**
Externally produced electricity	CO2
Internally produced electricity	CO
Water	NOx
Municipal Water	SO2
Ground water	Dust
Spring water	FCKWs, NH4, VOCs
Rain/ Surface Water	Ozone depleting substances

Figure 5: General Input/Output chart of accounts

Environmental performance indicators condense extensive environmental data into critical information that allows monitoring, target setting, tracing performance improvements, benchmarking and reporting. Several publications and pilot projects

highlight their relevance for supporting environmental management systems. As a general outline for generic indicators that can be applied throughout all sectors, the following items should be monitored. Sector specific, more detailed indicators may be valuable, but aggregation to general categories should be possible. The indicator system should covers all major input and output categories.

	Absolute quantity	**Relative quantity Eco-intensity**
Production output (PO)	Kg, Liter,	
Raw material input	Kg	kg/PO
Auxiliary material	Kg	Kg(PO
Packaging	Kg	Kg/PO
Operating material	Kg	Kg/PO
Energy	KWh	kWh/PO
Water	M3/liter	m3/PO
Waste	Kg	kg/PO
Waste water	M3/liter	M3/PO
Specific pollution loads	Kg	Kg/PO
Air emissions	M3	M3/PO
Air emissions load	Kg	Kg/PO
Other denominators		
Number of employees	Number	
Turnover	Money value	
EBIT	Money value	
Production hours	Time	
Workdays	Days	
Building area	M2	
Management performance indicators		
Number of achieved objectives and targets		
Number of non compliances or degree of compliance with regulation		
Number of sites with certified environmental management systems (EMS)		
Number of sites with environmental reports		
% turnover from EMS certified sites		
% turnover of green products (e.g. organically grown versus conventional crops)		

Figure 6: Environmental Performance Indicator System

For the purpose of verifying sustainability, the principles of financial statement audits provide the underlying methodology. There also is a trend from separate financial and environmental reporting towards combined sustainability reports. There is little merit in the long term in the development of environmental verification principles and financial statement audit principles on separate tracks, as "in principle" they should be the same. Likewise, there is little merit in two separate information systems in an organization, one for financial and cost accounting, the other on for process technicians, **if "in principle" they should be the same, following the material flows through the company**.