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Environmental and Material Flow Cost Accounting

Good or bad?

NACHHALTIGwirtschaften

Warum wir immer weniger Geld in die Abwasserreinigung stecken.

Und darauf sind wir auch noch stolz.

Aber: Hätten Sie von uns nicht eher eine ganz andere Nachricht erwartet?

Zum Beispiel, daß wir auch in diesem Jahr wieder 1 Milliarde Mark für den Umweltschutz aufwenden?

Erwa für noch bessere Filter, Kläranlagen, Abfallbe- reitigung! Also im Grunde für Reparaturleistungen nach der Produktion? Nein, unsere Ziele sehen ganz anders aus.

Der beste Abfall ist der, der gar nicht erst entsteht.

Wir wollen Produkte und Verfahren entwickeln, bei denen Umweltbelastungen gar nicht erst entstehen. Dieser produktionsintegrierte Umweltschutz wird bei uns mehr und mehr den adäquaten, das heißt nachgeschalteten Umweltschutz ersetzen.

Und hier sind wir einen ganzen Schritt weitergekommen: In den letzten Jahren konnten wir rund 300.000 Tonnen Abfälle durch neue, abfallärmere Technologien



einparen. Diese Entwicklung hat sich auch bei der Abwasserreinigung auf verblöfende Weise ausgewirkt: Vor noch nicht allzu langer Zeit waren wir stolz darauf, daß wir mit der Technik der "Biohoch-

Reaktoren neue Maßstäbe in der Abwasserreinigung setzen konnten.

Nun: Weil es wegen immer intelligenterer Produktionsverfahren bei uns einfach nicht mehr so viel zu klären

gibt wie früher, sind die ersten unserer Kläranlagen kaum noch ausgelastet – und vielleicht bald schon überflüssig.

Hochst High Chem für eine lebenswerte Zukunft.

Wenn wir also sagen, daß es unser Ziel ist, die Umweltschutzkosten zu senken, dann nicht etwa, weil wir weniger Umweltschutz betreiben wollen. Sondern weil wir durch neu entwickelte Verfahren weniger Abfälle benötigen und weniger Abwasser reinigen müssen.

Dies ist auch ein wichtiger Schritt im Sinne von Sustainable Development, also einer nachhaltig zukunftsverträglichen Entwicklung, die uns und den kommenden Generationen eine neue Qualität des Wachstums ermöglicht.

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Structure of the presentation

NACHHALTIGwirtschaften

- What is environmental and material flow cost accounting?
- What is it used for?
- Financial accounting basics
- Cost accounting basics
- Input Output Balance and Non-Product-Output
- Annual Cost Assessment
- Distribution to processes and cost centres
- Material Flow Cost Accounting

What is EMA?

- **Environmental Management Accounting (EMA)** is the identification, collection, analysis and use of two types of information for internal decision making (Jasch, UN DSD 2001):
 - physical information on the use, flows and destinies of energy, water and materials (including wastes) and
 - monetary information on environment-related costs, earnings and savings.

What is Material Flow Cost Accounting?

- According to the upcoming ISO standard on Material Flow Cost Accounting, ISO 14051:CD, 2009, **MFCA** is “a system for measuring the flow and stock of materials in processes or production lines in both physical and monetary units”.
- MFCA is a tool for improving material productivity in order to reduce the relative consumption of materials, energy and water and closely linked to EMA.
- MFCA improves material productivity in processes or production lines and may consequently help reducing related environmental.
- In MFCA, the flow and amount of the inventory of materials used within an organization are measured in physical units (e.g. weight, capacity, and volume) and subsequently evaluated in monetary units, which are based on the manufacturing costs incurred.

Jasch Ch., EMA, Procedures and Principles, United Nations, New York, 2001

NACHHALTIGWIRTSCHAFTEN

- The book was prepared for the UN DSD, EMA WG. It was commissioned by the Austrian Ministry for Transport, Innovation and Technology, the Austrian Ministry for Agriculture, Forestry, Environmental Protection and Water Management and the Austrian Chamber of Commerce.
- Translations available into German, Spanish, Portuguese, Japanese, Korean, Chinese, Czech, Lithuanian, Estonian, etc
- You can also find the excel tool and case studies under www.ioew.at



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***INTERNATIONAL GUIDANCE
DOCUMENT ON
ENVIRONMENTAL
MANAGEMENT
ACCOUNTING
(EMA)***

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- **Environmental and Material Flow Cost Accounting**

Principles and Procedures

Jasch, Christine

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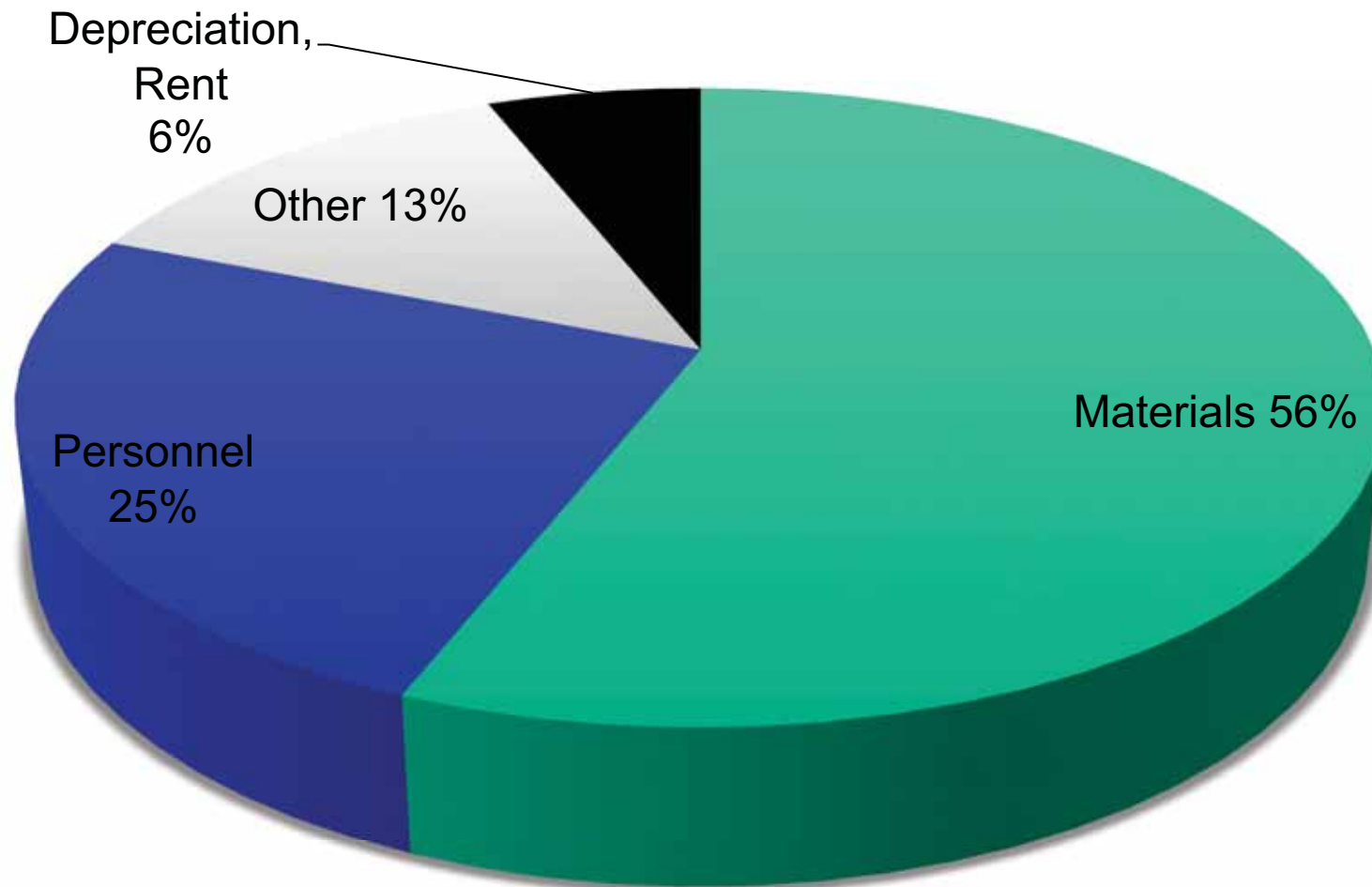
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EMA focus on materials & related costs:

- the use of energy, water and materials, as well as the generation of waste and emissions, are directly related to the environmental impacts of organizations and their products, and
- material purchase costs and materials lost in waste and emissions are the most prominent cost drivers in many organizations.
- Especially in countries with low enforcement of legal compliance and relatively low labor costs, material and energy use and related losses are a significant cost driver.

Typical cost structure in production companies



Waste is a sign of inefficient production

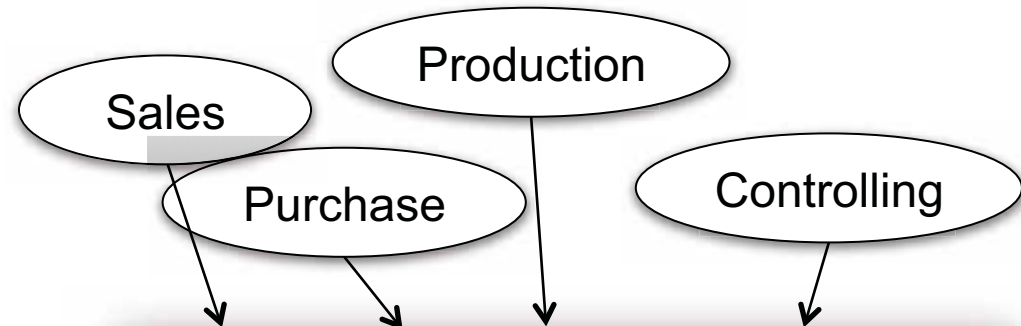
- All purchased materials must by physical necessity leave the company either as product or waste and emission.
- Waste is a material which has been purchased and paid for but which has not turned into a marketable product.
- Waste is being paid for 3 times: at purchase, at production and for disposal
- Waste and Emissions comprise all **non-product output of input materials** including water and energy.
- Therefore when calculating environmental costs, not only disposal fees are calculated, but in addition the wasted material purchase value and the production costs of waste and emissions.

Pollution Prevention Pays, but Accounting Systems hardly show it!

- Environmental protection and management, when combined with integrated prevention technologies and material flow cost accounting, pay!
- But, in order to be able to show it, data must be available!
- However, many companies do not have the accounting and management systems in place that allow monitoring of material flows and related costs.
- Companies (and environmental managers) thus find it difficult to analyze the benefits of Cleaner Production (CP) and Environmental Management Systems (EMS) properly and to obtain funding for their projects.

- Issues that triggered interest in EMA and pose challenges to its implementation are current accounting practices:
- **inadequate links** between accounting and other departments;
- unintentional **hiding** of environment-related cost information in overhead accounts;
- inadequate tracking of information on **materials use, flows, and costs**;
- **lack of some environment-related information** in the accounting records; and
- **investment decisions** made on the basis of incomplete environment-related information.

Fishing in Darkness...



Chemikaliendosierung PM 3, AK 173,3, 100 %, Afa 10 J.		
Teilwaschmaschine 1999 AK 181 10 J		
Ausstattung f. Abfallsammlung 2000 AK 1500 € 10 J		
Flotatschlambunker + Rejektbunker, Anschaf	54.504,63	
Entwässerungsmaschine Schneckenpresse A	19.985,03	
RejektpresseAnschaffungskosten 7,5 Mio, Afa	8.720,74	
Lader Anschaffungskosten 3 Mio., Afa 10 j., 40	37.644,53	Anlagenbuchhaltung
Afa Stand by Kessel 1728, davon 30 % Wirkun	3.997,01	12541
Wärmetauscher AK 550, Afa 10 J., 100%	10.682,91	12607
Zellstoffmahlung AK 1446, Afa 10 J., 100%	581,38	
Rußfilteranlage AK 83,3, Afa 10 J.	718.370,97	Kst 806
Kläranlage Afa 100 %	47.455,36	
KLWprojekt AK 6.533 Kats Afa 10 j.	799,40	12611
Erw. TGW Kühlung 2. Teil 100 % AK 110,4 10	1.235,44	12634
Chemikaliendosierung PM 3, AK 173,3, 100 %	1.308,11	Inv. Liste 12837
	150,00	Projekt Nr 1026
	905.435,50	50393

The Problem:

- Every Department has its own data system
- Large projects
- missing transparence

The goal:

- Consistent Material Flow Data
- Consistent Information Systems and Reporting

- information system for the EMS,
- corporate controlling and budgeting,
- investment appraisal,
- environmental performance indicators,
- chemical management systems,
- life-cycle assessment and costing,
- supply chain management,
- external financial reporting (Modernisation Directive)
- external environmental and sustainability reporting (EMAS, GRI EN 30 = EMA!)
- external reporting to statistical agencies and EPAs

Conventional corporate accounting

INTEGRATIVE WIRTSCHAFTEN

- Financial accounting (bookkeeping, balancing, consolidation, auditing of the financial statement and reporting)
- Cost accounting (also called management accounting)
- Corporate statistics and indicators (past oriented)
- Budgeting (future oriented)
- Investment appraisal (future oriented)

Terminology of financial & cost accounting

Financial Accounting	Cost Accounting
Balance sheet	
Assets	No equivalent
Liabilities	No equivalent
Profit and loss accounts	Cost statement
Expenditures	Costs
Expenditure items	Cost categories
Revenues	Earnings
	Cost calculation
No equivalent	Cost centers
Calculation of production expenditure	Cost carriers/objects (Products)

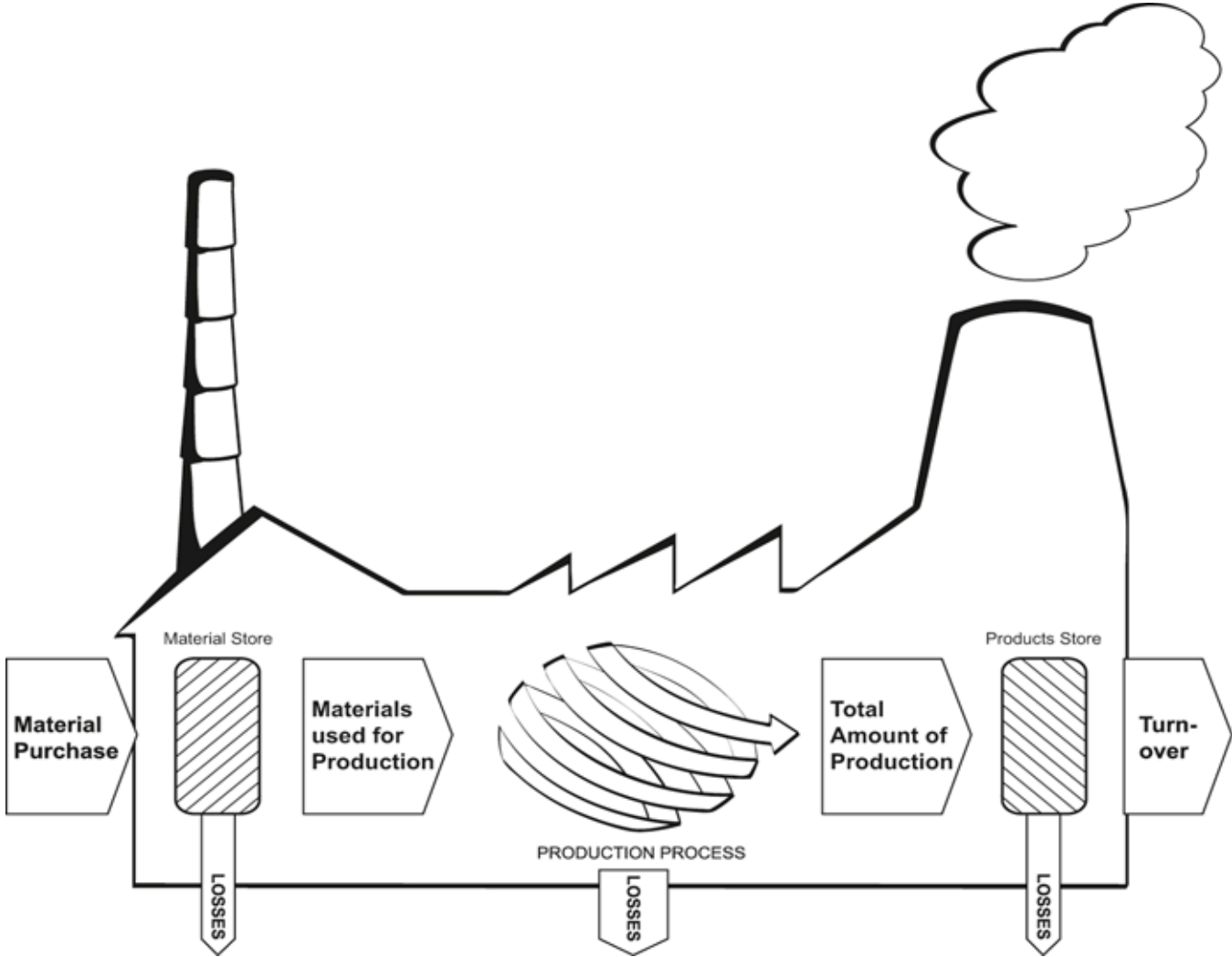
Cost Accounting Terminology (1)

- **Fixed Costs** are costs independent of employment and production volume, such as rent, interest on bank loans etc.
- **Variable Costs** are directly related to production volume, e.g. raw materials and production labor hours;
- **Individual Costs** are directly attributed to the corresponding cost centers (process steps) and cost carriers (products). They include at a minimum raw materials and production wages;
- **Overhead Costs** are costs that cannot be directly attributed (true overhead) or costs that are not directly attributed for reasons of economic efficiency (untrue overhead), e.g. administrative costs, insurance, advertising costs. There are a number of methods to attribute overhead to cost centers and cost carriers.

Cost Accounting Terminology (2)

- **Calculated Costs** are used in cost accounting because they are not – or in a different form - considered in bookkeeping, but influence operating results.
- **Costs Centers** are those parts of the company that are organized as independent clearinghouses; they should be connected to production processes. Maximum consistency between cost centers and process-oriented material flow analyses is the prerequisite for good data. Cost centers generate costs, are responsible for costs or are attributed costs, e.g. for production and administration.
- **Cost Carriers or Objects** are products and services produced either for the market or for internal needs. By attributing types of costs to cost centers and cost carriers, production costs and sales price floors are calculated.

Cost Accounting	Category		Cost Accounting	Center	NAC	Cost Accounting (Product)	Carrier
Which costs have been incurred in which amounts? Cost distribution to direct costs and overhead Cost roll-over from financial accounting			Where and in which amounts have which costs been incurred during the accounting period? Internal cost attribution and cost estimates or billing rates			Which types of costs have been incurred in which amounts for a certain product or service?	
e.g. Labor Raw Materials Operating materials Energy External Services Calculated Write-Off Calculated Interest Calculated Risk Other Costs		→	e.g. I Manufacturing Process Ia Process Ib Process Ic II Warehouse III Distribution IV Administration		→	Product A Product B Product C	



Environmental Costs hidden in Overhead Accounts

	Product A	Product B	Example		
			Overhead	Product A	Product B
Materials by recipe/formula and stock issuing	Direct costs	Direct costs		70	70
Working hours by time records	Direct costs	Direct costs		30	30
Overhead	distribution by % product turnover				
Depreciation			50		
Rent			10		
Energy			5		
Communication			10		
Administration			25		
Top management's salary			10		
Waste & Emission Treatment			10		
Total Overhead			120	60	60
Total Product Costs				160	160

Environmental Costs attributed to Cost Centers & Products

	Product A	Product B	Example		
			Overhead	Product A	Product B
Materials by recipe/formula and stock issuing	Direct costs	Direct costs		70	70
Working hours by time records	Direct costs	Direct costs		30	30
Energy	Attribution to cost centers and products by actual process flows		1	1	3
Waste and Emission treatment			1	3	6
Depreciation			7	13	30
Overhead	distribution by % product turnover				
Rent			10		
Communication			10		
Administration			25		
Top management's salary			10		
Total Overhead			64	32	32
Total Product Costs				149	171

What is EMA?

- **Environmental Management Accounting (EMA)** is the identification, collection, analysis and use of two types of information for internal decision making (Jasch, UN DSD 2001):
 - physical information on the use, flows and destinies of energy, water and materials (including wastes) and
 - monetary information on environment-related costs, earnings and savings.

Total corporate environment related costs

Environmental protection expenditure
(emissions treatment, control and waste prevention costs)

+ Costs of Non Product Output (Costs of unproductive material, capital, and personnel)

= Total corporate environment related costs

= saving potential by environmental management and cleaner production

Step by Step EMA Procedure

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1. Assessment of **materials inputs and outputs** for the previous business year.
2. Assessment of total **annual environmental costs**
3. Distribution of the annual costs to **cost centers** or more specific processes (optional, depending on project needs)
4. Selection of specific processes or material flows for in depth investigation (optional, depending on project needs)
5. Application of **MFCA for selected processes** (optional, depending on project needs)
6. Definition of **improvement options** for the accounting information system, in order to allow for better future data management
7. Application for **investment options**, comparing cleaner technologies and end-of-pipe solutions between each other and to the last business year or to existing technologies (optional, depending on project needs)

Recommendations for Data Collection

- The project team must include accounting and process engineering competences.
- The project team must have direct access to the accounting system.
- Don't waste time trying to collect what is not easily available (going back to many old invoices), rather make a protocol on what needs to be changed in the information system in order to be able to gather better data next time.
- Don't be shy to use estimates! They can be improved later. An estimate is better than no figure. But record, how the estimate was done/calculated.

Be efficient!

The goal of the first EMA assessment is to

- be able to present the entire material inputs and environmental costs of the previous business year to top management, and
- come up with improvement recommendations and
- gain support to improve the information system and technical processes.
- The first EMA assessment for the previous business year for any given company should not take longer than a 1 to 2 days workshop with the accountant and process engineer.

The EMA excel template consists of four sheets:

- Mass balance, Detail, Sum and Structure.*

Information is only added into the **Mass balance** and the **Detail** sheets.

System boundaries for mass balances

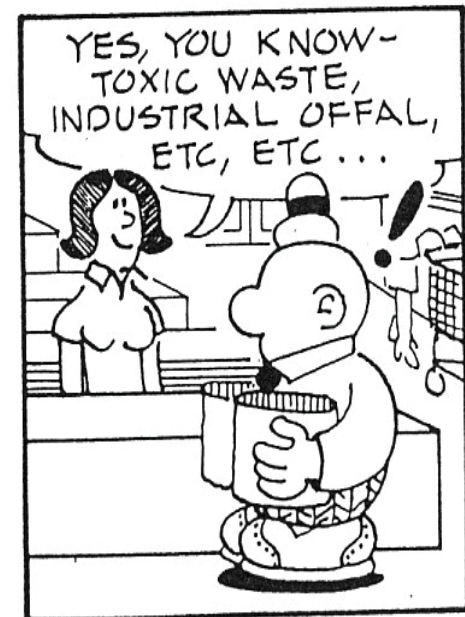
INPUT		System boundaries		OUTPUT
		Nations		
Materials	⇒	Regions	⇒	Products
Energy	⇒	Corporations	⇒	Waste
Water	⇒	Processes	⇒	Emissions
		Products		

Physical Mass Balance:

Input and Output Types

Materials Inputs	Product Outputs
Raw and Auxiliary Materials	Products (including Packaging)
Packaging Materials	By-products (including Packaging)
Merchandise	Non-Product Outputs (Waste and Emissions)
Operating Materials	Solid Waste
Water	Hazardous Waste
Energy	Wastewater
	Air Emissions

What are By-Products?



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Separating Material Inputs in Product Output and Non Product Output

1. MATERIALS COSTS OF PRODUCT OUTPUTS	%
➤ Raw and Auxiliary Materials	80
➤ Packaging Materials	90
➤ Water	5
2. MATERIALS COSTS OF NON-PRODUCT OUTPUTS	
➤ Raw and Auxiliary Materials	20
➤ Packaging Materials	10
➤ Operating Materials	100
➤ Energy	100
➤ Water	5

Material Flow related Costs:

- **Materials Costs of Product Outputs**
- **Materials Costs of Non-Product Outputs**

Environmental Protection related Costs

- **Waste and Emission Control Costs**
- **Prevention and other Environmental Management Costs**

Environmental Sound Technology (EST)

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- **End of pipe equipment – emission control** : traditional focus of reporting requirements, comparatively easy to trace, as stand alone equipment not related to production – additional burden, expensive
- **Cleaner technologies**: much more effective from an environmental protection point of view, much more cost efficient, as integrated into production processes, but difficult to estimate the „environmental share“. Inconsistent reporting requirements by statistical agencies, awareness problems.
- **Product oriented prevention measures**: reducing the environmental impact of products, e.g. desulphurisation of petrol, part of integrated prevention
- **NPO equipment**: relating material loss percentages to the responsible inefficient production equipment, most relevant for internal cost accounting

SEEA Environmental expenditure

UN SUSTAINABLE WIRTSCHAFTEN

- The SEEA approach to environmental expenditure explicitly only “concentrates on steps taken to **deal with residuals** and **does not consider explicitly protection of the environment through means of water and energy conservation or the effects of recycling**” . In effect, this means that the SEEA approach only focuses on the output of waste and emissions and neglects all activities to reduce the inputs of materials, water and energy. It is thus in complete contrast to the approach of cleaner production and pollution prevention.
- “Excluded are measures undertaken for cost saving reasons. (e.g. energy saving).”
- The primary purpose of spending must be environmental protection, without related cost reductions.

Environmental industries or products

YACHTWIRTSCHAFT

- The solution taken by SEEA is **not to include the energy efficient equipment**, which is not really understandable also from an environmental point of view. This has e.g. led to a strong decline in environmental investments since 1990 (Statistisches Bundesamt, 2006) which is not at all related to a degradation in the state of environment, as companies at the same time have invested in integrated pollution prevention techniques and management systems and actually improved environmental performance in relation to production.

IFAC EMA + MFCA Cost categories Wirtschaften

Material Flow related Costs:

- **Materials Costs of Product Outputs**
- **Materials Costs of Non-Product Outputs**

Environmental Protection related Costs

- **Waste and Emission Control Costs**
- **Prevention and other Environmental Management Costs**

- **WASTE AND EMISSION CONTROL COSTS**
- Equipment Depreciation
- Operating Materials,
- Water and Energy
- Internal Personnel
- External Services
- Fees, Taxes and Permits
- Fines, Remediation and Compensation

PREVENTIVE AND OTHER ENVIRONMENTAL MANAGEMENT COSTS

- Equipment Depreciation
- Operating Materials,
- Water and Energy
- Internal Personnel
- External Services
- Other Costs

ENVIRONMENT RELATED EARNINGS

- Other Earnings, from selling byproducts and waste for recycling
- Funding for CP/EMS Projects

Environmental domains (based on SEEA 2003)

- Protection of Ambient Air and Climate
- Wastewater Management
- Waste Management
- Protection and Remediation of Soil, Groundwater and Surface Water
- Noise and Vibration Abatement
- Protection of Biodiversity and Landscape
- Protection against Radiation
- Other

Environmental Costs SCA Laakirchen HALTIGwirtschaften

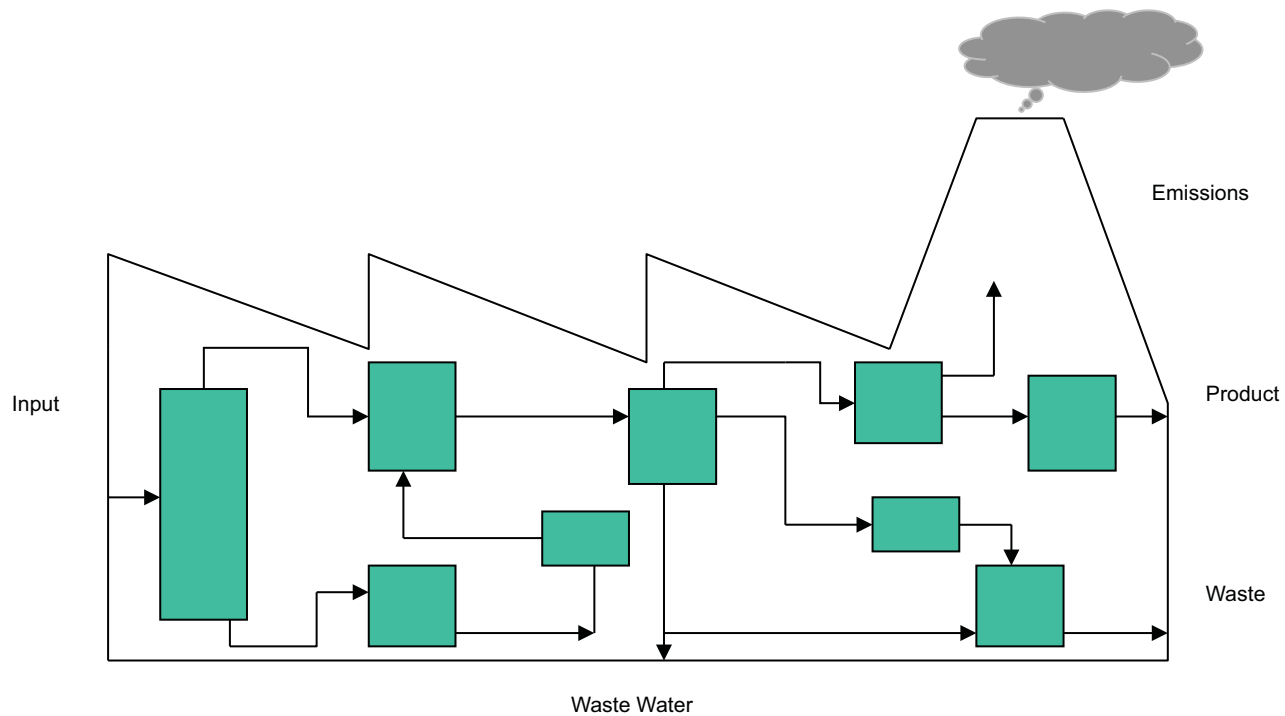
Percent distribution of environmental costs for 2000

Environmental media ¹⁾	Air and climate	Waste water	Waste	Soil and groundwater	Other	Total
Environmental costs categories						
1. Waste and emission treatment						
1.1. Depreciation for related equipment	0.2%	3.2%	0.5%			3.9%
1.2. Maintenance, operating materials and services		5.0%		0.1%		5.1%
1.3. Related personnel	0.8%	1.6%	0.7%			3.1%
1.4. Fees, Taxes, charges	0.7%	1.3%	3.6%			5.6%
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					0.1%	0.1%
2.2. Personnel for general environmental management activities	0.1%				0.9%	1.0%
2.3. Research and Development		1.5%				1.5%
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			23.0%			23.0%
3.2. Packaging			0.1%			0.1%
3.3. Auxiliary materials			2.1%			2.1%
3.4. Operating materials	0.1%	32.0%	0.5%			32.6%
3.5. Energy	22.6%					22.6%
3.6. Water		0.1%				0.1%
4. Processing costs of non product output		0.2%	0.9%			1.1%
Total environmental costs	24.5%	44.9%	31.4%	0.1%	1.0%	101.9%
5. Environmental earnings						
5.1. Subsidies, Awards		-0.8%				-0.8%
5.2. Other earnings		-0.2%	-0.9%			-1.1%
Total environmental earnings		-1.0%	-0.9%			-1.9%
Saldo costs/earnings	24.5%	43.9%	30.5%	0.1%	1.0%	100.0%

Mapping process flows and cost centres

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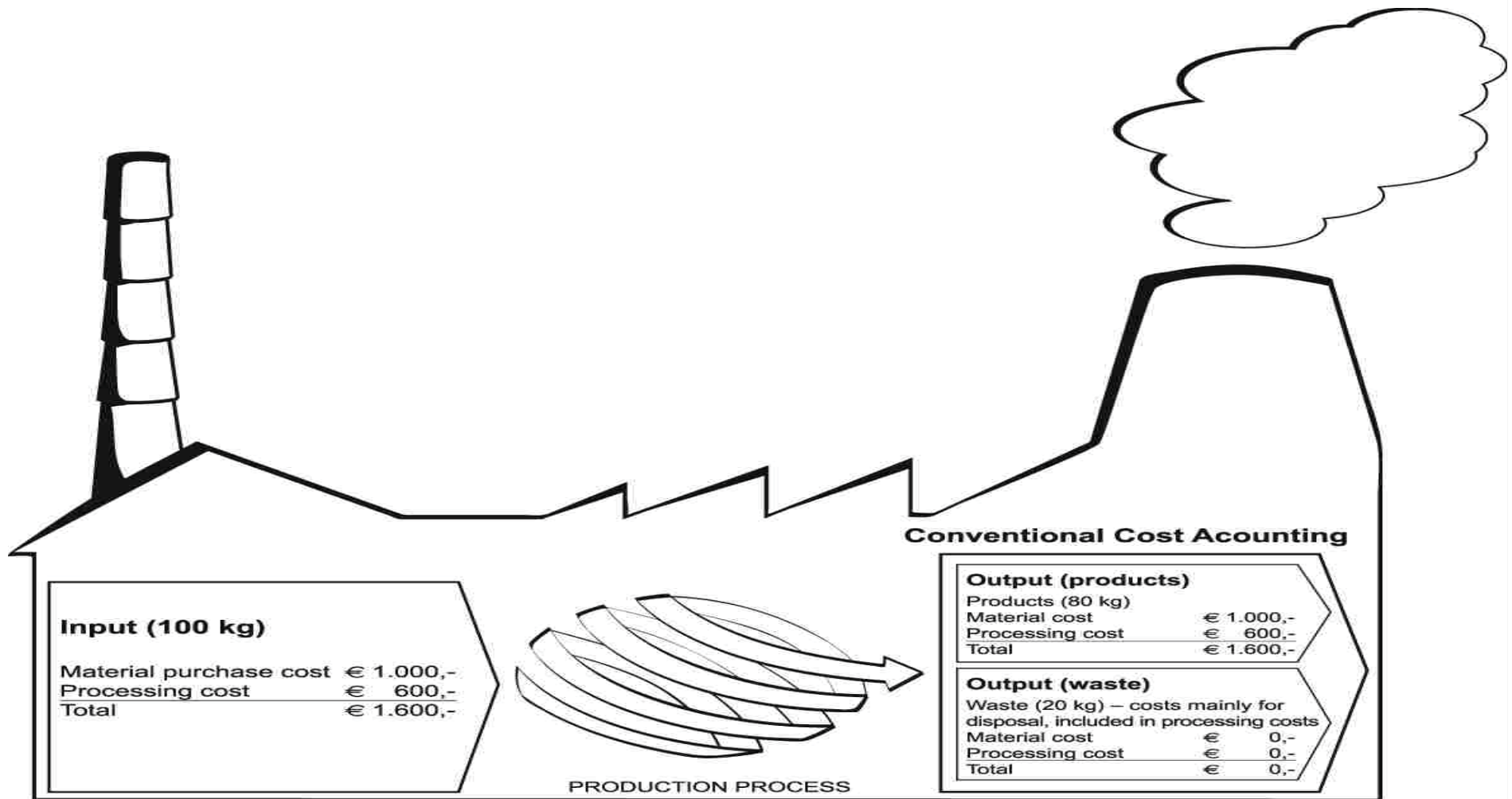
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Mapping of technical/production information systems with the structure of cost centres

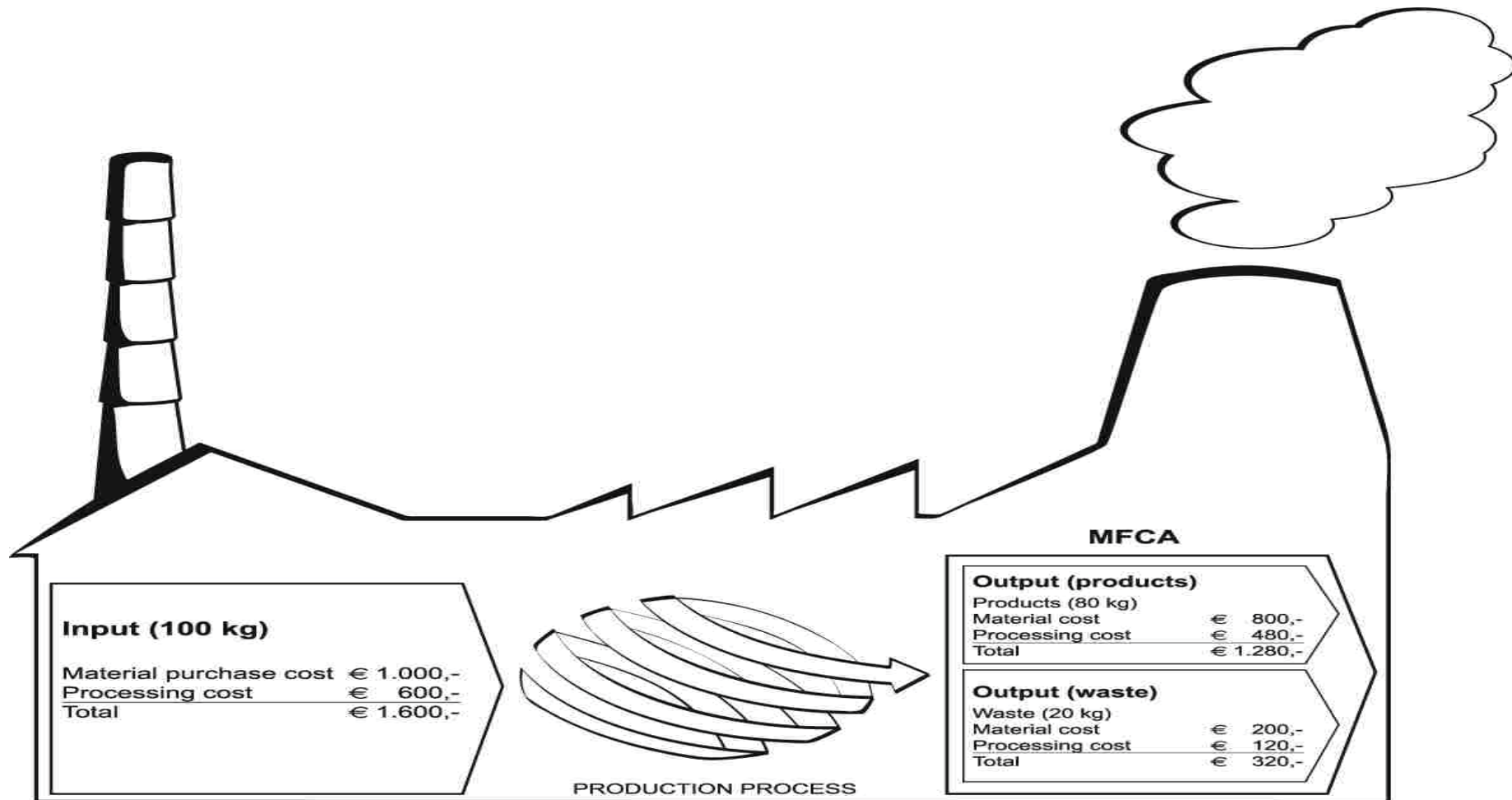
- Goals:
- Consistency
- Defined interfaces
- Basis for material flow cost accounting
- Basis for investment appraisal

Conventional cost accounting



MFCA principles

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Should we report rather high or low environmental costs?

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- From a financial point of view, lower costs are always better!
- From an environmental point of view, not the costs, but the environmental impact is important.
- It is therefore preferable to invest in technologies and management systems, that prevent the creation of waste and emissions at source. But the „environmental share“ of these integrated measures is difficult to assess.
- From a communications point of view, not the total of environmental costs, but the distribution between and shift from EoP to integrated and material flow related measures is desirable.

- What are internal and external environmental costs?
- What is an Input-Output-Analysis and what are the sub-categories?
- From which information systems can you draw data for the Input-Output-Analysis?
- What is Non Product Output?
- Which ISO standards are based on input output data?