

## **ECA (Environmental Cost Accounting)**

The project includes an environmental economic analysis with the following goals:

- a) to calculate the costs of the measures implemented by the companies to prevent, reduce or repair environmental damage caused by their operations (environmental costs);
- b) to identify, in qualitative terms, those cost areas that would be modified by the creation of the eco-industrial metabolism program;
- c) to identify those phases of the process for which reduction of environmental impact coincides with a reduction in business costs, constructing a win-lose diagram for that purpose.

The assessed costs include decreased waste production and disposal, water protection, air quality improvement, noise reduction, pollutant removal, proper environmental management, and the search for products and process with lower environmental impact.

To measure environmental cost we used the wholly and exclusively approach of the Canadian Institute of Chartered Accountants (CICA), the Federation Experts Comptable (FEC), the Institute of Chartered Accounts of England and Wales (ICAEW) and UNEP, while keeping in mind the Eurostat work for defining environmental costs.

The Environmental economic analysis made it possible to start the process of identifying the win-win phases in which environmental savings are matched by economic-business savings. If they are functional for the eco-industrial district that is being planned, these are the phases around which to motivate the entrepreneurs to participate in the EID.

In more general terms we can state that the environmental cost analysis phase planned within the context of the CLOSED Project fits, more broadly, into the context of the European environmental accounting program which, in turn, implements the guidelines contained in a paper the European Community Commission sent to the Council of Europe and the European Parliament.

Domestic environmental accounting records and arranges the whole of the public decision maker's entries and tables in order to outline a macro-economic picture and to draft measures and proposed action plans. The introduction of the environmental variable into national accounts makes it possible to correct the distortions in business accounting that do not take the utilization of natural resources and land, waste production, polluting emissions and similar factors into consideration.

This paper gives two main lines – at the public environmental accounting level – for achieving the goal of integrating environmental and economic information systems: satellite accounts and environmental indicators and indices.

Satellite accounting responds to the need for an analytical presentation of the relationships between business and environment. However, it is less suitable for obtaining indicators for immediate use. For this reason, one of the directions in which environmental accounting is moving – to complement the development of the satellite accounting – is the construction of indicators and indices.

Environmental economic analysis (a subheading in company environmental accounting that includes physical flows), on the other hand, is configured as

the representation of the enterprise's economic and financial efforts to protect the environment.

### **COMPANY EEA**

A company's environmental economic analysis is the whole of the information regarding environmental figures and the respective business figures that have to be reported internally – to management – and externally to monitoring agencies, shareholders, insurance companies, and banks to facilitate control, communications and management.

Environmental accounting may be expressed in physical terms through tools such as environmental reports, environmental balance sheets, Material Flow Accounts and Life Cycle Assessments that are indispensable for quantifying a company's material and energy flows and in monetary terms (as in eea for example).

A monetary analysis of the environment serves to quantify environmental costs and environmental income related to the production of external diseconomies and internal costs that are traceable to environmental reasons. Both of them involve the loss of environmental functions, i.e. the different components of the biophysical environment (air, water, land, subsoil, raw materials, fossil resources, wind, forests, landscape, natural reserves) used by the economy as inputs or as a reservoir for outputs.

Having accepted that we will speak of environmental costs or expenses without distinction, even if the difference between the two emerges clearly when we begin to post investments since we speak of expenditure if the investment is entered at its full value and of costs if only the amortization portion is posted. By environmental cost we mean the costs of the activities directly incurred by the company or on its behalf by third parties to prevent and control environmental degradation or to eliminate it and defend it from its negative effects or to conserve renewable and non-renewable resources.

The whole of the environmental costs related to a business activity can be broken down into two large categories:

- external costs
- internal costs which, in turn are broken down into potentially hidden costs (conventional and hidden costs), contingent costs, communications/advertising costs and non-quality costs.

External social costs, i.e. those related to damages due to environmental degradation can be assessed in monetary terms both by those who produce the pollution and those who suffer the damages.

The first case will be estimated by assessing the additional costs needed to upgrade technologies, processes and products to reduce pollution.

The second case will be estimated by assessing the costs incurred to avoid the damage or to remedy the negative effects, or as an alternative (according to the "willingness to pay" method) the amount that the damaged parties would be willing to pay to avoid/prevent pollution.

The areas in which monetary environmental assessment has enjoyed increasing applications concern the assessment of the costs/benefits of projects, public policy and the national environmental accounting.

Companies themselves can post internal costs using traditional techniques. In a company management logic the concept of "environmental cost" may vary according to the objectives of the assessment itself: evaluation of investment alternatives, budget activities, efficiency control, etc.

In order to be able to calculate internal environmental costs it is necessary to break them down into four categories: potentially hidden costs, contingent costs, communication/advertising costs and non-quality costs.

The *potentially hidden costs* are, in turn, divided into two categories: conventional and hidden costs.

*The conventional costs* derive from the use of raw materials, services, labor, systems and structures; they are considered in general cost accounting and are a significant part of the company's decision making processes. Even if these costs are linked to typically environmental functions, they are not posted as "environmental costs" and in order to fit under that heading they must undergo an "allocation" process.

And yet, an operation such as reducing raw material consumption (of the priority goals of environmental sustainability) would be classified as specifically environmental since it leads to both an environmental advantage – in the reduction of non-renewable material use and an economic advantage – in cost reduction. The construction of a company's environmental accounting system makes it possible to reclassify amounts that were already entered under other cost centers under environmental cost centers.

*The hidden costs*, defined as such since they are allocated to general accounting or non-environmental headings are broken down – according to the period in which they are incurred – into upfront, operational and back-end environmental costs and each one has different posting issues.

*The upfront environmental costs* are those that a company incurs at the start of its business: location studies, site preparation, plant layouts to meet environmental standards, environmental process and product design, environmental impact assessment, research and development. These, in turn are all posted under research and development, and do not present any particular problems regarding containment, description and quantification.

*The operating costs* of processes, products, systems and services are classified distinctly according to whether they fit under "*standards, laws and regulations*" or "*voluntary behavior*." These are the costs resulting from running the business and do not receive adequate attention from management: reporting, monitoring, studies, planning, training, research and development, labeling, environmental insurance, legal fees, production, monitoring environmental performance, waste and discharge treatment, **recovering, reutilizing and recycling wastes**, purification, data collection and dissemination, fines, penalties, inspections, tests, expenditures for habitat protection, financing associations. These costs, that are always entered under other headings, must also be allocated to environmental cost centers.

*Back-end environmental costs* are future costs that cannot be overlooked even if they will be incurred when the plants are closed. These costs are related to dismantling, reclaiming and restoring the sites. In general these costs are not even calculated although they must be quantified for correct accounting of environmental costs. In this case accounting forecasts will be used.

*Contingent costs* are costs associated the occurrence of accidental events, and for this reason they are expressed in terms of expected value and are linked to meeting the requirements of future legislation, the need for converting plants/systems to meet standards, harm to physical persons by future emissions/release, repair costs and future damage to natural resources. For

back-end environmental costs and contingent costs we speak of "hidden environmental liabilities."

*Communication and advertising costs* are linked to [public] relations and necessary communications tools (such as reports), with suppliers, shareholders, consultants, staff, clients, local communities and institutions. Some of these costs are "intangible", others fit under the heading of corporate communications: both must be identified and quantified.

And finally, we speak of *non-environment costs* related to the inefficient use of resources. They can be identified by the difference between costs actually incurred by the company and those it should incur in a zero-inefficiency model. In this case, too, the costs are estimated and require a good deal of information before they can be quantified.

## **ENVIRONMENTAL COSTS INCURRED BY COMPANIES**

### **Potentially Hidden Costs**

#### **Compulsory**

- notification**
- reporting**
- monitoring / tests**
- studies / models**
- repairs**
- records**
- plans**
- training**
- inspections**
- document storage**
- labeling**
- state of readiness**
- protective equipment**
- medical monitoring**
- environmental insurance**
- financial insurance**
- pollution control**
- emissions control**
- water management**
- waste management**
- taxes / charges**

#### **Anticipated Costs**

- site studies**
- site preparation**
- permits**
- R&D**
- planning and procurement**
- installation**

#### **Conventional Costs**

- plant**
- materials**
- workforce**
- supplies**

- utilities (electricity, gas, water)**
- structures**
- residual value**

#### **Deferred Costs**

- closing / disposal**
- stock disposal**
- post-closing reclamation**
- site inspection**

#### **Voluntary Costs**

- community relations**
- test monitoring**
- training**
- internal controls**
- reporting (e.g. annual environ.)**
- insurance**
- planning**
- feasibility studies**
- repairs**
- waste recycling**
- environmental studies**
- R&D**
- habitat protection**
- landscaping**
- other environmental projects**
- financial aid for environmental groups and/or researchers**

#### **Contingent Costs**

- costs for future obligations**
- fines**
- upgrading to future standards**
- repairs**
- property damage**
- personal injury**
- legal expenses**
- damage to natural resources**
- economic losses**

#### **Communications/advertising costs**

- corporate image**
- customer relations**
- investor relations**
- insurance company relations**
- consultant relations**
- staff relations**
- supplier relations**
- creditor relations**
- local host community relations**
- government/legislator relations**

Source: EPA, An Introduction to Environmental Accounting as Business Management Tool: Key Concepts and Terms, 1995.

Another element that is very important in the context of the CLOSED Project is related to environmental income linked to environment management and specifically, the eco-industrial symbiosis.

It is obvious that this element, which balances the environmental costs, will be strengthened after the CLOSED Project is implemented.

We can, in fact, state that the objective of the CLOSED Project is to enhance environmental income.

The definition of *environmental income* is obtained from three separate elements: cost reduction, sale of by-products that were considered wastes and environmental sales.

*Cost reduction* as a consequence of environmental improvement can come from several sources: reduction of the amount of wastes to be treated, reduction of high-treatment cost hazardous wastes, reduction in the amount of environmental taxes to pay, reduced water consumption, reduction in the drainage water to be treated, and reduced energy consumption. When it can be quantified, this cost reduction is considered true environmental income.

*The sale of by-products that were once considered wastes* is only possible if, by extending its value chain, the company, starts considering **waste recovery, reutilization and recycling** of raw materials that were considered mere wastes. In general this is only possible if the wastes are subjected to intermediate processing that makes it possible to mainstream them into an industrial chain.

And finally, *environmental sales* are related to the sale of eco-compatible goods and they are calculated by multiplying the presumed size of the sale by the margin of unit contribution. This income heading has to find its equivalent cost heading (in the sense of "losses from environmental sales", included in non-environmental costs) in the event of environmental performance inferior to that of the competitors, a company incurs the opportunity costs related to losses on environmental sales.

#### *The eco-financial indicators*

One of the first results of the construction of a company environmental cost accounting system was the construction of a group of indicators that are standardized by ISO 14031 or the Global Reporting Initiative plan.

The eco-financial indicators make it possible to evaluate a company's economic efficiency in the management of the environmental variable and the amount of financial resources committed to improving environmental performance.

A company that spends large sums for environmental protection can be considered defensive if it has no environmental income and reactive if it has some such income. A company that spends little on environmental protection and has much environmental income can be considered proactive with anticipatory or innovative strategies.

The eco-financial indicators that could be developed starting from the CLOSED Project are the following:

Economic indicators of conventional costs: conventional costs/total costs, conventional costs/environmental costs;

Economic indicators of potentially hidden costs: potentially hidden costs/total costs, potentially hidden costs/environmental costs;

Economic indicators of back-end environmental costs: back-end environmental costs/total costs, back-end environmental costs/other back-end costs, back-end environmental costs/environmental costs;

Economic indicators of operating costs: environmental operating costs/total costs, environmental operating costs/operating costs, environmental operating costs/environmental costs;

Economic indicators of operating costs deriving from meeting standards: operating costs from meeting standards/total costs, operating costs from meeting standards/environmental cost;

Economic indicators of environmental taxes: environmental taxes/total costs, environmental taxes/taxes, environmental taxes/environmental costs, environmental taxes/conversion costs to eliminate environmental taxes;

Economic indicators of operating costs deriving from voluntary behavior: operating costs deriving from voluntary behavior/total costs, operating costs deriving from voluntary behavior/environmental costs.

Economic indicators of upfront environmental costs: upfront environmental costs/total costs, upfront environmental costs/total upfront costs, conventional costs/environmental costs;

Economic indicators of environmental communications-advertising costs: environmental communications-advertising costs/total costs, environmental communications-advertising costs/total communications-advertising costs, environmental communications-advertising costs/environmental costs;

Economic indicators of non-environmental costs: non-environmental costs/total costs, non-environmental costs/environmental income;

Economic indicators of the costs per single domain (air and climate, water, wastes, ground, noise and vibrations, nature protection): domain costs/total costs, domain costs/environmental costs;

Economic indicators of environmental income: environmental income/total income, environmental income/environmental costs, environmental income/total costs.

The indicators must be monitored annually and show the three year curves.

A combined reading of these indicators would allow the district to have an economic control panel at its disposal that is capable of providing accurate information on three fundamental aspects:

- the level of the district's commitment to environmental protection;
- the flow of environmental income, i.e. the sum of the activities that lead to economic improvement (reduced costs, increased sales and earnings) of the district's enterprises through the environment.
- the curve of environmental cost reduction (over the medium term) confirming that an investment in environmental improvement leads to an initial increase in environmental protection costs (that will then

diminish) and an increase in environmental income with a growing positive balance (income – costs).

## **ENVIRONMENTAL ECONOMIC ANALYSIS: THE CONSTRUCTION PROCESS**

Each environmental cost heading can be effectively classified by the environmental domain to which it refers and by type.

The SERIEE manual distinguishes activities for environmental improvement on the basis of the environmental domains to which they refer according to the various elements of the natural assets for which the expenditures are earmarked: air and climate protection, water protection, waste management, ground and underground water protection, noise and vibration reduction, protection of natural assets and of biodiversity.

The European System of Integrated Economic Business Accounts is based on the breakdown into two types: “capital expenditures” consisting of the gross fixed capital, variations in material inventories, net acquisitions of intangible assets and land for environmental protection and “current expenditures” that include labor, intermediate consumption, taxes, amortization of environmental protection activities.

### *The process of identifying environmental expenditures*

Constructing a monetary type environmental cost accounting system requires the identification of those activities whose can be considered environmental. The subject of the survey must be the expenses relative to activities that mainly target environmental protection. The basic criterion for allocating an expense as an environmental expenditure is that its final objective is the defense and improvement of the environment and not economic, technical, security or health reasons.

The European Statistical Bureau (Eurostat) has defined as environmental those expenses incurred for activities whose main goal (direct or indirect) is environmental management or protection. That is to say, activities aimed at preventing, controlling, reducing and eliminating pollution and environmental degradation caused by production, distribution and consumption.

Once those activities have been identified it is necessary to verify whether the service is produced entirely internally or if it purchased outside. In the latter case the entire expense incurred can be considered environmental. If the service is produced internally we must identify the company unit (management, area, etc.) that produced it. This will be easy and immediate if the company unit that performs the service has the exclusive task of providing environmental management and protection services; it will be more complex if environmental protection activities are part of other production activities.

In this latter case we must “isolate” the environmental component of the expenditure. Sometimes this is quite simple (e.g. in “end of cycle” facilities), at others (units that do environmental and other work, or systems that are integrated into the production cycle) it is necessary to estimate the environmental expenditure.

This estimate can be made in either of two ways: using conventional estimates of the “environmental component” or using the “additional cost” method that estimates the differences between the cost incurred for the acquisition of systems



and technologies with devices for environmental improvement and the hypothetical cost of systems and technologies without such devices.

In the event that the additional cost is a negative figure the main goals of the expense should not be considered environmental, but economic and hence should not be included in the environmental costs. At the conclusion, the process of identifying environmental costs should be complete and lead to proper identification. Once the environmental cost centers and the respective headings have been constructed we can move on to constructing the eco-financial indicators.

## **A GUIDE TO THE IDENTIFICATION OF ENVIRONMENTAL EXPENSES**

Is the enterprise's corporate purpose environmental protection (waste and water purification)?

Does the enterprise do other types of work?

Are all expenditures "environmental expenditures?"

They must be broken down into:

Environmental protection activities

Non-environmental protection activities

Separate the environmental expenses deriving from the pursuit of the corporate mission of environmental protection from those deriving from environmentally responsible behaviors extended to the supply of services. Are these expenditures related to the corporate purpose of environmental protection?

Post under "internal environmental protection"?

Post under "for external environmental protection"?

Have you identified an activity whose main goal is environmental management and protection?

Identify all costs incurred

The expenditure is not environmental.

Is the activity performed entirely by the company?

All the acquisition costs are "environmental expenditures"

The service is produced by units or portions of the process that only perform environmental management and protection tasks.

Environmental protection activities are integrated with other production activities.

The unit's current and investment expenditures are "environmental expenses"

The environmental portion can be isolated within the context of the unit's activities.

\*

YES

The systems are of the "end of cycle" type. Current and investment expenditures related solely to means for environmental protection are "environmental expenditures"

The environmental protection measures are "integrated into the production cycle".

\*

The environmental protection measures are implemented through modifications to existing systems.

The environmental protection measures are integrated into a newly acquired system.

Estimate the environmental expenditure using the "additional cost" method with respect to a similar system that produces greater environmental impact.

The cost of modifying the systems is an "environmental expenditure".

## THE DISTRICTS' EEA DATA

We can begin this analysis with the Prato district which has filled out the questionnaires with a greater number of "no data available" responses.

The data cards for the 17 companies that responded to the questionnaire are given.

The first evident point concerns the enterprises' environmental awareness. They are all – with but one exception – convinced that "environment" means managing the phase "downstream from the manufacturing/production process" and "energy management."

All the enterprises filled in the energy item demonstrating a full awareness of the factor's importance – at least on the financial side – considering the cost of a kilowatt hour.

Therefore, we believe that this is an excellent starting point for showing the advantages of environmental improvement, i.e. highlighting the economic benefits deriving from energy savings is easily comprehensible to all the enterprise interlocutors.

Within the district the cost of a company's power bill ranges from Lit. 125 million to 1.4 billion. Energy savings of around 10% would lead to economic savings from Lit. 12 to 140 million.

Few (only 8) companies responded with the economic data concerning water consumption and there is a dual reason for this.

On the one hand the cost of water (which in only 3 cases is roughly Lit. 35 million and for the rest is always less than Lit. 10 million) is not considered a significant amount; on the other hand we cannot say that all the company's consume non-negligible amounts of water.

What we see, however, in this case is a total inadequacy of the control system, and hence an urgent need to introduce a pressure factor through the environmental variable.

Again only 8 companies gave the cost of water draining. In this case, since the costs given are always greater than Lit. 100 million, we can assume an environmental cost factor that may or may not be present.

Once again only 8 companies gave the costs of disposed wastes. In this case, since the "waste" element always exists in a production process we can assume an "information bug" or mere oversight. In this case, although they are not as high as the energy category, these costs are far from negligible and range from Lit. 10 to 60 million.

Only two companies provided data on incoming raw materials so any comparisons between virgin and potentially usable materials in a context of eco-industrial symbiosis are impossible.

And finally, only three companies provided data on environmental, technical and legal consulting costs relative to environmental management.

In the Pistoia district the questionnaires for the 11 that responded present a much more varied picture.

Once again the most accurate and complete responses concerned energy. Almost 90% of the companies responded, breaking down consumption into electricity, methane gas and gasoline. The mean cost of energy is around Lit. 40 million per year with peaks (three companies) between Lit. 70 and 500 million.

Out of the 11 companies 8 responded to the questions concerning waste management; the mean annual figure ranges from Lit. 3 to 5 million with peaks of Lit. 40 million.

Transportation is very interesting, especially when compared with Prato where this item is almost missing. Here it is clearly perceived as an "environmental cost." Sixty percent (60%) of the companies gave monetary values for these cost factors when if they are not particularly significant (less than Lit. 10 million). Some companies, however, gave annual costs in excess of Lit. 1.6 billion.

Finally, there are two other interesting elements:

- 50% responded to questions concerning monitoring and control (even when they total less than Lit. 5 million);
- 35% of the companies also answered difficult items, such as the questions concerning administrative costs for environmental management, legal costs and compensation to third parties deriving from lawsuits.

In the final analysis we must also consider all the data related to incoming materials as extremely interesting and perfectly integrated with the concept of eco-industrial symbiosis.

Among these we must mention at least three elements:

- the significance (equal to an approximate mean of Lit. 200 million) of items related to chemical fertilizers, defoliants, fungicides and insecticides;
- the high costs of three materials that are potentially replaceable within the district: plastic flower pots (for a mean ranging from Lit. 30 to 50 million, with peaks of over Lit. 200 million);
- metal mesh (mean annual costs ranging from Lit. 10 to 40 million), rope and plastic materials (costs ranging from Lit. 4 to 5 million for each company).

When we multiply the mean economic scope by the number of companies in the district (let us assume that 100 companies are willing to use replacements) we can clearly see the minimum size of the recycled product market for eco-industrial symbiosis. This could be roughly:

- Lit. 20 billion for low environmental impact fertilizers/defoliants, and fungicides;
- Lit. 5 billion for flower pots;
- Lit. 2.5 billion for meshes;
- approximately Lit. 500 million for rope.

In Lucca the questionnaires answered by 10 companies reveal a situation similar to Pistoia, but it is much less analytical when it comes to incoming material costs. Even in this case the most accurate and complete responses concerned energy and transportation. Sixty-five percent (65%) of the companies responded breaking down the figure between energy, methane gas and gasoline. The mean energy cost is around Lit. 4 billion.

The importance of this element in economic terms for the paper industry that is historically characterized by "high energy input per mean product" becomes clearly evident.

Energy savings and rationalization programs (for a 10% reduction in total energy consumption) would amount to approximately Lit. 400 million per year.

About 50% of the companies interviewed also responded to the transport questions. Here too the economic element seems to take priority: this environmental cost ranges from Lit. 400 million to Lit. 1.3 billion annually.

Water discharge costs (75% of the companies responded) are also well perceived by the district's enterprises as environmental. The total amount of this expenditure ranges from Lit. 350 million to 1.4 billion annually.

Although the figures are considerably lower, 70% of the companies answered the questions concerning waste management costs: in this case the annual means range from Lit. 50 to 150 million.

All the cost elements related to environmental protection (noise, emissions, etc.) were also found in 60% of the companies' responses. The mean annual costs range from Lit. 110 to 300 million.

Finally, there are two more interesting elements, i.e.

- half the interviewed sampling responded to the item concerning environmental training and information; the figure is still limited and is around Lit. 30 million;
- 72% of the companies gave and detailed all the items concerning environmental control and monitoring for values ranging from Lit. 20 to 40 million per year.

In these last two cases the important factor was not so much the total value of the responses but fact that responses were given. Paradoxically, the fact that these items were filled in (albeit with low values) shows how fully the district's enterprises understand the issue and reveal a good amount of maturity in the path towards environmental improvement.

In the final analysis we must also consider all the data concerning incoming materials, whether or not they are recycled goods, as extremely interesting and perfectly integrated with the concept of eco-industrial symbiosis.

Here we see that:

- 30% of the companies use recycled materials (paper) for a total annual value of approximately Lit. 10 billion;

- only 35% of the companies systematically detail the incoming materials “that are not recycled”; this confirms that the industry’s firms have yet to understand the cost-reduction potential of a program such as eco-industrial symbiosis.