THE RESPONSE OF COMPANIES TO INFORMATION-BASED ENVIRONMENTAL POLICIES

by

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1. Introduction

Environmental policy is traditionally based on two sets of tools: command and control regulations; and economic or market instruments, such as environmental taxes, emission charges, tradable permits, etc. The two sets of instruments have been adopted in subsequent waves, partly in response to economic analysis that shows command and control environmental policies are too costly in some circumstances, or incapable to achieve the desired objectives in other circumstances.

In the last few years, some policy makers, the business community and the media have increasingly emphasised the role of the so-called information-based environmental instruments. Such instruments, which are typically voluntary, range from *company environmental reports* to *environmental audit and management schemes*, such as ISO 14000, EMAS and related award and compensation systems.

Information-based environmental policies are the object of a lively debate. Their supporters claim that environmental reports and environmental management schemes are fundamental instruments to achieve the desired environmental quality. Their critics claim they are only “greenwashing”, basically ineffective and devoid of any real effect.

This paper tries to shed some light on the companies’ behavioural response to information-based environmental policies, dwelling on two building blocks: an original database, at the company level,

collected by Fondazione Eni Enrico Mattei since 1995; and some recent literature on information and incentive schemes within companies.

The paper is divided into seven sections. Sections 2 and 3 briefly describe the main information-based environmental management tools and recall the theoretical rationale for their adoption; Section 4 describes the database and identifies a subset of homogeneous companies in three polluting industries: oil & gas; petro-chemicals; power generation. Sections 5 and 6 present some empirical results on the relationship between information-based environmental strategies, economic performance, and environmental performance at the company level. Section 7 contains some concluding remarks.

The paper presents preliminary work that needs refinement: information-based environmental policies are still in their infancy and their history is too recent to allow for a sound econometric analysis. The existing data, and the relevant theory, however seem to support the hypothesis that information-based environmental policies are indeed an instrument to change company behaviour and to implement environmental policies and regulations.

2. The theoretical background

In the textbook institutional setting, governments set environmental standards and companies comply. In addition to this, companies try to follow sound environmental strategies in order to avoid litigation and the emergence of future environmental liabilities. In some industries, such a strategy may also establish a good environmental reputation, which can be a powerful tool in the relationship with consumers, communities, and environmentalists. In the two latter cases, far-sighted companies may even exceed environmental standards.

In the situation we have just described, information plays a crucial role. In a world with imperfect information, regulators, investors, consumers, and other stakeholders want to know the companies' environmental performance, the achieved results, the remaining problems and the schedule to solve them. Companies, symmetrically, need to communicate their environmental strategy and performance, in order to deal with their shareholders, stakeholders and regulators. Against this background, the communication aimed at the external stakeholders has been widely discussed in the recent literature (Cf. Tietenberg, 1997; Lanoi et al., 1997; Khanna-Damon, 1997; Mc Intosh et al., 1998).

The same flow of environmental information, however, can play a key role in re-shaping company behaviour, and this is the focus of our paper.

A useful starting point can be found in two papers, by Brehn-Hamilton (1996) and Pfaff-Sanchirico (1999), which claim that the lack of internal information - i.e. ignorance -is often responsible for the non compliance of environmental regulation by big companies and for their wrong assessment of environmental damage: hence, the need of information tools and self-audit. The issue, however, is more complex than this.

For many years companies (as well as regulators and the general public) have somewhat neglected environmental issues, concentrating their efforts on the short-run economic and financial performance. But the neglect of environmental standards, particularly in the traditional industries, has gradually created liabilities which can seriously harm shareholders' value through different channels: trials and litigation about health, safety and pollution; loss of reputation with clients and consumers; conflict with local communities and environmental groups; etc. This novel situation - which is well known to shareholders and companies' Chief Executive Officers - requires a change in company behaviour, which in turn implies a typical agency problem.

Given the present (and the expected) environmental, health and safety regulation, the principals (i.e. the shareholders and Chief Executive Officers) must inform the agents (i.e. the managers and the employees) of the firm's environmental objectives and must induce them to allocate their efforts to both the economic and the environmental tasks. While the economic performance is systematically monitored, the environmental performance is not, and this requires *ad-hoc* tools, such as environmental reports and self-audit. Such information can be complemented by incentive schemes that induce managers to pursue simultaneously economic and environmental tasks, thus maximising the long-run shareholders' value. We define such an integrated set of instruments as *information-based environmental strategy*, aiming at a change in company behaviour through appropriate flows of information, audit, and incentives. (For a theoretical example Cf. Desgagné-Gabel, 1997; for a non-environmental survey of such instruments Cf. Pendergast, 1999)

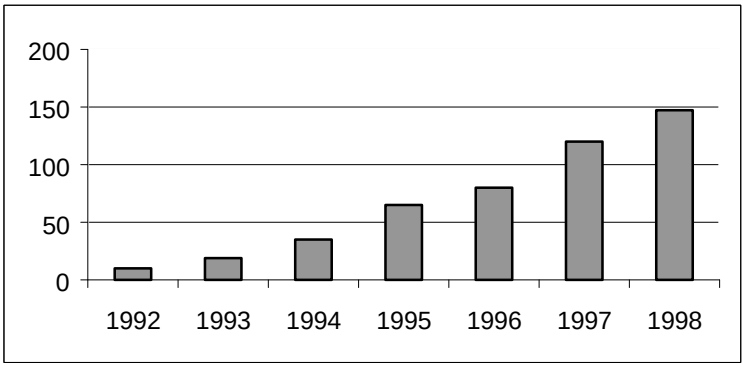
Given the nature and the objectives of information-based environmental strategies, governments and regulators too have a clear interest in promoting their standardisation and wide adoption: this is why they sometimes propose guidelines for such schemes, and even make them mandatory. In such cases we can refer to *information-based environmental policies*.

3. Some information-based environmental management tools

Historically speaking, the first management tool adopted by firms was the *Corporate Environmental Report*, published annually by companies to audit and communicate the most relevant environmental issues related to their operations (emission, effluent, wastes, as well as expenditure and investment in the environmental area). The voluntary nature of environmental reports is an explanation of their rapid success, but it can also be considered the cause of the lack of their initial homogeneity and comparability.[i]

Environmental reporting by leading international companies has been monitored by Fondazione Eni Enrico Mattei since 1992, when an Environmental Reporting Monitor was set up. The data collected confirm that the trend, which began in 1990, was started by firms in highly polluting industries, such as chemicals and oil & gas. But environmental reporting quickly spread to other industries such as the auto-motive and transportation industries, telecommunications, electronic appliances, financial services and consumer goods. The number of companies publishing environmental reports has been rapidly growing from 1992 to 1998 (Figure 1).

Figure 1- Number of Companies producing CER World, 1992-98



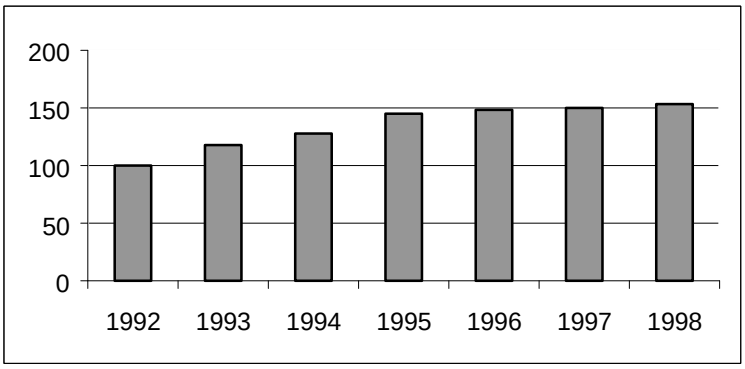
Source: Environmental Reports Monitoring, FEEM, 1999.

As previously mentioned, the quality of the data reported can vary substantially across companies and time. The earlier reports typically included many statements and very few data, typically referred to hot-spots in the company operations. The most recent reports include comprehensive environmental data, together with indicators and analyses which usually cover all the companies' activities.

In order to conduct a quality analysis, a specific rating system (based on scores to evaluate and benchmark all the environmental reports) has been defined by Fondazione Eni Enrico Mattei within

the Environmental Reporting Monitor, and published regularly since 1997. Figure 2 shows that the quality of environmental reports has been constantly increasing.

Figure 2 - Average quality of CER (1992 =100) - World, 1992-98



Source: ERM, Environmental Reports Monitoring; FEEM, 1999

Following the trend in environmental reporting, in the mid'90s, companies began to introduce more sophisticated *environmental audit systems,* aiming at promoting continuous improvements in the environmental performance of their operations. Such systems introduce environmental programmes and organisations within the company, assign objectives to these units, and provide a systematic evaluation of their performance.

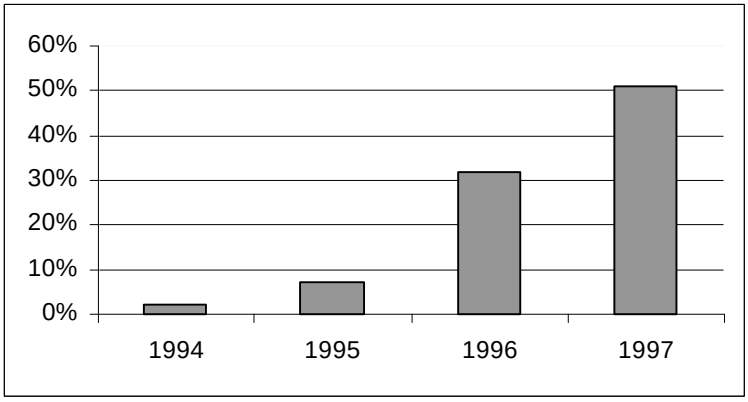
To facilitate and standardise the implementation of such audit systems in 1993 the European Commission adopted the EMAS (Eco Management Audit Scheme) Regulation. This scheme recommends the voluntary participation by companies and gives them guidelines, with the objective of promoting better environmental performance at the site level. Similarly, at world scale, the International Standard Organisation launched the ISO14000 scheme for the certification of corporate environmental management[ii] at the company level.

The number of companies that certify their environmental management systems against EMAS and ISO 14000 is increasing. Since 1996, year of the publication of the first five ISO 14000 standards,

10,439 companies have been certified. More than 2,790 sites have been certified against EMAS, since 1993, year of enactment of the Council Regulation 1836/93.

In our sample, the number of EMAS or ISO 14000 certified firms increases from 2% to 52% of the total, from 1993 to 1997 (Figure 3).

Figure 3 Number of EMAS or ISO 14000 certified companies World, 1994-97

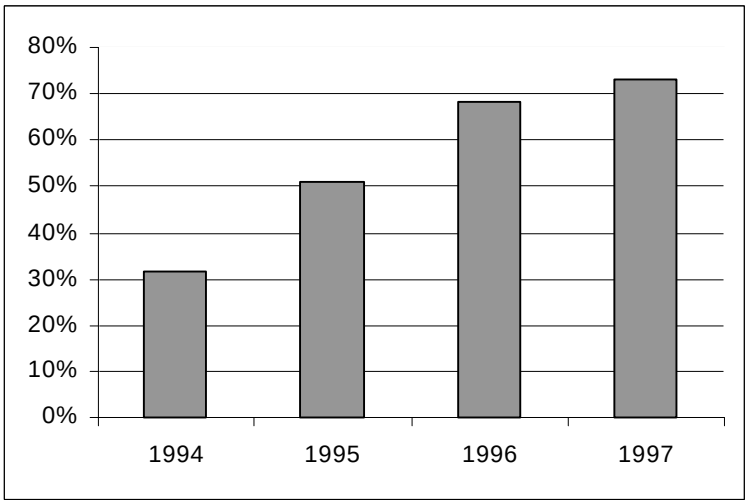


Source: ERM, Environmental Reports Monitoring; FEEM, 1999

In addition to environmental reports and auditing schemes, other management tools, such *as compensation programmes and award schemes*, have been gradually introduced by many big companies in order to link environmental performance with economic incentives. The adoption of award and compensation programmes related to environmental results can be viewed as an incentive compatible strategy for integrating environmental issues within the company's management.

Compensation and award schemes quickly spread and became common practice in big business: in our sample, the companies that implemented a compensation programme from 1994 to 1997 span from 2% to 73% of the total (Figure 4).

Figure 4 Number of companies adopting compensation programme and award schemes World, 1994-97



Source: ERM, Environmental Reports Monitoring; FEEM, 1999

From a conceptual point of view, environmental reports, audit schemes, and compensation mechanisms can be seen as components of an integrated *information-based environmental strategy*, aimed at changing company behaviour. Let us see how these instruments work, by analysing an appropriate database at the company level.

4. The Database

The database we built at Fondazione Eni Enrico Mattei covers 476 Corporate Environmental Reports published in the world from 1993 to 1997 (i.e. all the reports we could collect).

To carry out a meaningful empirical analysis we selected a sample, which includes all the companies belonging to three polluting industries: petro-chemicals; oil & gas, electric power generation. These companies are 39 big firms, based in 16 countries (Appendix 1).

The criteria we followed in selecting the sample are quite obvious. First of all, the three selected industries are highly polluting sectors, which produce comparable emissions (such as NOx, SOx) using similar feedstock; secondly, these are the industries which first produced the environmental reports, so that the panel can date back to 1993 without too many missing data.

In addition to the Corporate Environmental Reports, the sample gathers information on the environmental management systems adopted by the companies included in the sub-sample (i.e. ISO 14000 and/or EMAS), on the companies' environmental compensation and award schemes, and collects data on the main economic variables at the company level (the latter being extracted from the standard annual reports).

Starting from the above data we built a panel with several variables: i) a standardised index of pollution; ii) measures of the size and of the economic performance of the company; iii) an indicator of the quality, comprehensiveness and transparency of the environmental information; iv) an indicator of the adoption of one or more environmental audit, compensation or award schemes; vi) several control variables, at the company, industry, and country level (Appendix 1).

The panel is obviously affected by a sample selection bias, because it includes only companies that voluntarily decided to publish Corporate Environmental Reports showing that, for some reason, they care about the environment more than companies that do not publish any information. Due to the scarcity of official data on firms' environmental performances (apart from some exceptions like TRI in USA), in order to test the role of the voluntary instruments in influencing companies' pollution, we had to consider only firms publishing Corporate Environmental Reports. We cannot test the impact of environmental information on companies' environmental performance because of sample selection. However, among the companies which publish Corporate Environmental Reports we can investigate whether some differences exist between the environmental performance of those which attain a higher level of environmental information accuracy, which implement certified environmental management systems (ISO14000 and EMAS), compensation programmes and award schemes and other firms. In this case our sample has no sample selection bias but it is worth noticing that while for environmental information accuracy data are available for the whole period under consideration, for the more recent tools, such as the environmental audit, compensation and award systems, the sample includes many zeros in early years.

The environmental performance variable is defined on an annual basis as SOx plus NOx emissions per unit of standardised output (tons of oil equivalent – Toes -are a suitable measure unit in the three industries under review). The indicators have been chosen on the basis of their impact on the environment and on data availability. SOx is a main indicator used by the regulators as a base for the environmental taxation system (see the North European or the Italian taxation systems). NOx plays a major role in land acidification. At this stage we could not consider data on waste and water discharges because classification across countries and regulations on waste have significantly changed over the last five years, and the available water discharges parameters do not account for the damage associated with different discharged pollutants (a firm emitting a large quantity of a

relatively harmless substance would rank as a larger polluter than another firm emitting a small quantity of a very toxic substance).

The size of the company is proxied by the number of employees, which also indicates the complexity of the agency problems within the organisation.

The economic performance of the company is measured by the operating income, in current US$ (nominal exchange rates).

The quality of the information disclosed in the environmental reports is measured by a score system, based on three sections. The first section evaluates the descriptive information contained in the report (mission, objectives, strategy, organisation, programmes). The second section evaluates the completeness of the variables and indicators (for example, some reports depict environmental data, but omit economic data, such as defensive and environmental expenditure. Others include indicators, but do not publish raw data for emissions, effluents and wastes). The third section evaluates the completeness and the comprehensiveness of the report (for example, many reports cover a subset of sites or ignore some foreign countries where the company operates). This score system has been developed by the Environmental Reporting Monitor at Fondazione Eni Enrico Mattei, on the basis of the Corporate Environmental Reports requirements defined by the Forum on Environmental Reporting Guide Lines (for a better explanation of the requirements, see Appendix 2).

The information-based environmental management is measured by a 0-3 index called EAC (Environmental audit, Award and Compensation) which is the sum of three dummy variables: the first dummy (E) records the adoption of an environmental audit scheme: EMAS and/or ISO 14000[iii]; the second dummy (A) records the existence of an environment related award system,

which does not give immediate benefits but directly influences the future career of the managers and the employees; the third dummy (C) records the adoption of an environment related compensation scheme[iv].

The selected company variables and indicators are rather crude, and can be improved. But even at this level of detail, the collection and standardisation of the data has involved many difficulties. In addition to the company data, some control variables have been collected at the country level. Even in this case, the choice of the data on environmental policy (like the energy tax burden or the indicator on the strictness of the legislation) involves some arbitrariness. Many companies operate in more than one country and are subject to different legislation. Similarly, many indicators and proxy variables can be better defined.

5. A first look at the data

Do information-based environmental policies work? Do they influence company behaviour, following the intuitions of the theory recalled in paragraph 2? Some preliminary answers to such questions can be reached by looking at our sample, broadly comparing companies which adopted some information-based environmental strategies (henceforth “EAC companies”, where EAC, calculated for each year is greater than 0) with companies which did not adopt such schemes between 1993 and 1997.

At a first glance, we have observed that on average the companies that have implemented compensation and award schemes and have certified environmental management systems present better environmental performances, thus we have performed a t-test on the mean to verify whether the difference is statistically significant. Although they are not significant at the standard 5% or 10% level (except for 1997), the results seem to indicate that EAC companies perform better (see

Table 1). Moreover, Table 2 shows that pollution decreases faster among EAC with a significant difference compared with the total sample in the periods 1995-1996 and 1996-1997.

Table 1 Average Pollution Rates

	1994	1995	1996	1997
EAC=0	0.0038	0.0028	0.0036	0.0052
EAC>0	0.0014	0.0011	0.0009	0.0007
t-test	0.78	0.81	1.34	1.87

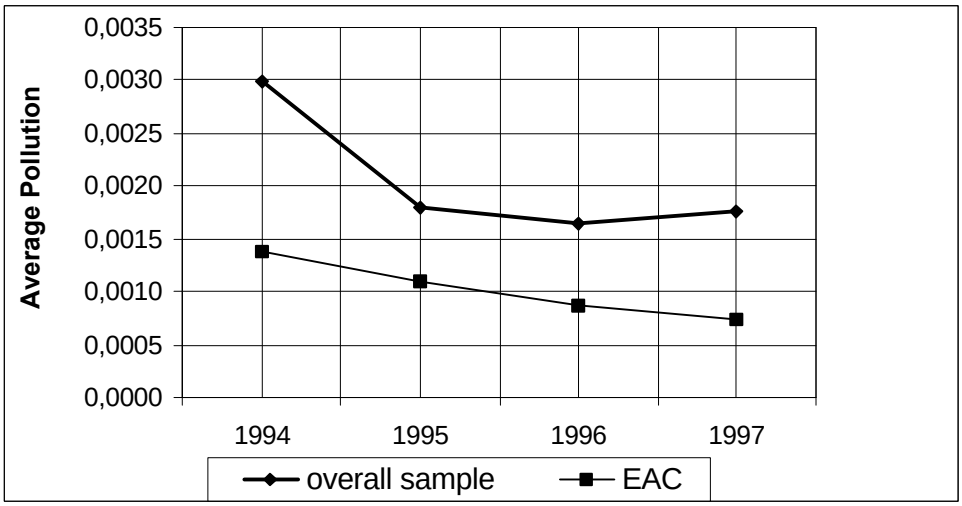
Table 2 Average Pollution Growth Rates

	1994-1995	1995-1996	1996-1997	Average 1994-1997
Overall sample	-0.39688	-0,086121	0.068504	-0,1618
EAC	-0,20206	-0.21496	-0.14913	-0,18921

Source: see Appendix 1

When we consider average pollution rates (see Figure 5) we can observe that EAC companies pollute much less than the total sample, and reduce pollution throughout the time span we considered while in the overall sample we can observe that pollution drops from 1994 to 1996 but there is an upward trend between 1996 and 1997.

Figure 5 The impact of information based environmental policies: EAC companies vs. total sample in three selected industries World, 1994-97



Source: see Appendix 1 (the average pollution has been calculated without considering the values of two outlier companies)

Aggregate data reflect homogeneous trends at the company level. And the latter level of analysis makes it possible to relate pollution trends with the precise timing in the adoption of information-based environmental policies (EAC).

To clarify this point we select three important case studies among the companies in our sample: BP Chemicals (in petrochemicals); ELF (in oil & gas); PowerGen (in electric power generation). According to our data base and score system, such companies were among the first to adopt EAC in their industries and to produce the highest quality environmental reports.

We look at their environmental performances considering their emissions' reduction rates before and after the EAC adoption. We also relate their emissions to the quality of the environmental information produced to see whether information quality and quantity are related to emission reduction.

Table 3 Average Pollution Growth Rates – Case Studies

BP Chemicals	
Average growth rate 93-94	-0,1202683
Average growth rate with EAC 94-97	-0,0204621
ELF	
average 93-95	-0,1074995
average with EAC 95-97	-0,1729896
Powergen	
average 93-94	-0,0842359
average with EAC 94-97	-0,1358968

Source: see Appendix 1

The analysis of emissions at BP Chemicals shows that the introduction of environmental awards and compensation programmes did influence the pollution decreasing rate, which diminished faster since the implementation of a pioneering award scheme in 1994. The negative trend in emissions, after a slow down in 1995, was revamped by the introduction of a certification and compensation scheme in 1996 (see Table 3 and Figure 6)

Elf is an equally interesting case. The company sequentially introduced an award scheme in 1995, and a certification-compensation scheme in 1996, constantly improving its environmental performance (see Table 3 and Figure 7)

PowerGen adopted in sequence an environment related award scheme, a compensation mechanism and finally a certification system; its emissions constantly diminished at increasing rates, from –0.084 in 1993-1994 to –0.136% per annum in 1994-1997 (see Table 3 and Figure 8).

In these case studies, we can also observe a negative relationship between the quality of corporate environmental information and the emissions index. Figures 6, 7 and 8 illustrate these findings, highlighting the year of adoption of the various management tools.

Figure 6 BP Chemicals - The impact of information based environmental policies, 1993-97

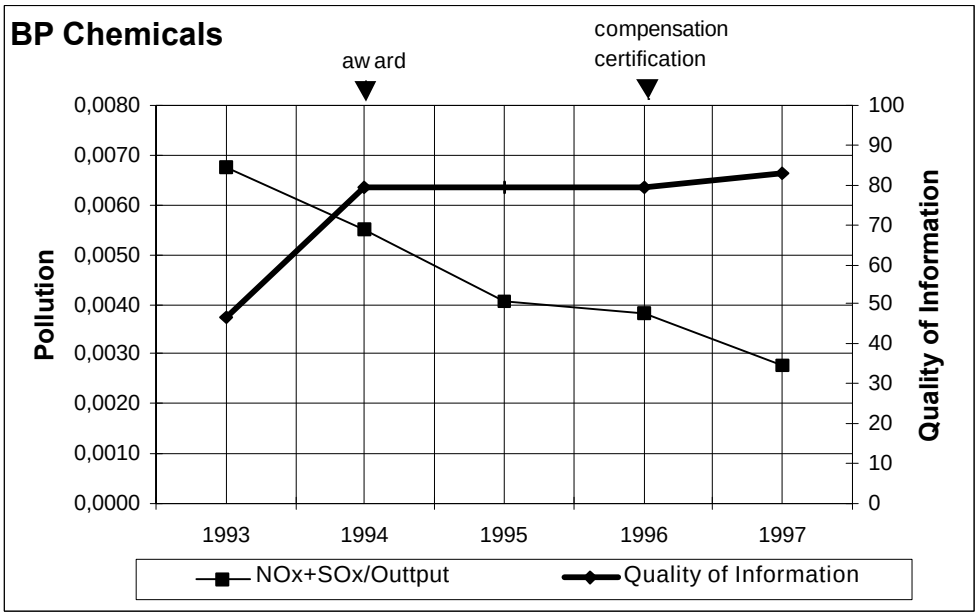


Figure 7 ELF - The impact of information based environmental policies, 1993-97

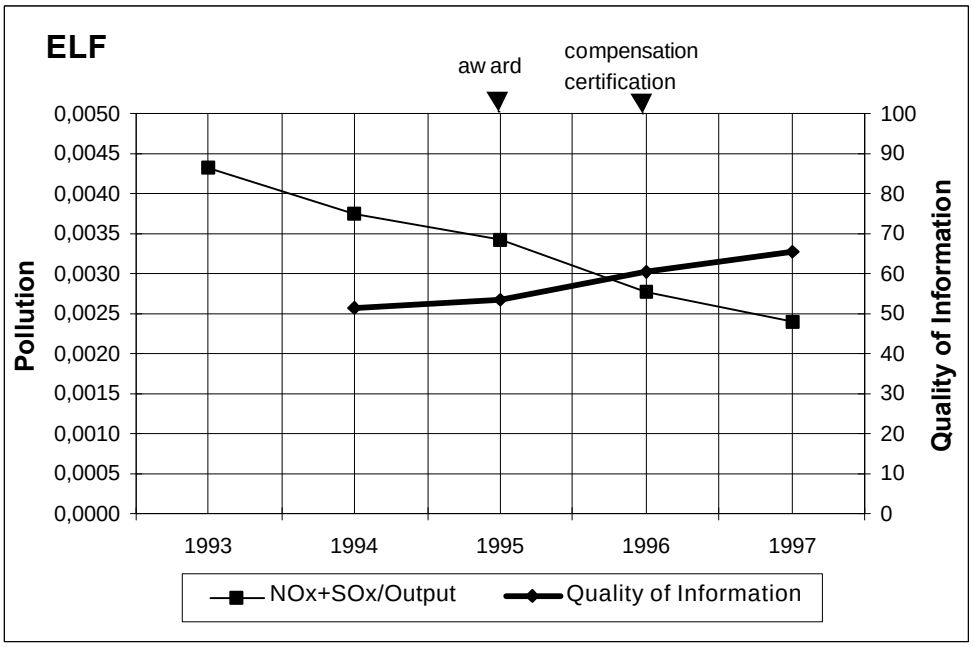
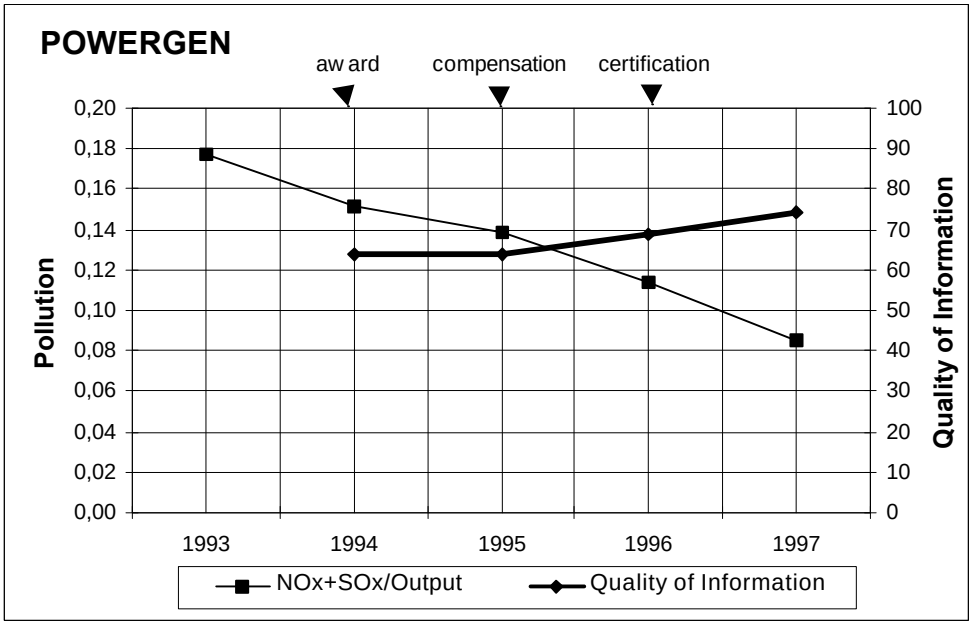


Figure 8 PowerGen - The impact of information based environmental policies, 1993-97



The above results seem to be consistent with two ideas: i) that the adoption of information-based environmental tools facilitate company environmental performance and ii) that such management instruments are complementary with each other.

Critics of information based environmental strategies, could object that our findings are possibly spurious, because the analysis neglects standard environmental regulation, taxation, and several other variables which may work in parallel with EAC, and influence emissions.

To overcome this objection, we try to carry out a statistical analysis which also includes the other policy variables, together with some obvious control variables. For this purpose, our panel is disturbingly small. But we believe that, at this stage, it is worthwhile to present, with many caveats, some tentative results.

6. A statistical analysis

We perform a cross-country analysis for 16 countries assuming that governments adopt environmental policies based on command and control and economic instruments; companies comply and may also pursue a tighter environmental strategy to avoid future risks and liabilities. In this setting, we check whether environmental policies (command and control and energy taxation) affect the companies' economic and environmental performance. We also check whether the adoption of information-based environmental strategies (EAC) affects this relationship, influencing company behaviour, *given* the energy tax burden and the severity of environmental legislation.

The intuition is that environmental policy reduces pollution but harms economic performance. This trade-off, however, can be eased by information-based environmental policies which affect company behaviour and make compliance more effective and less costly.

To test this hypothesis we use once again our sample of 39 companies in three sectors (oil &gas, petrochemicals and electric power generation), over the 1993-1997 period, so that the panel estimates are based on 5 observations for each company.

The variables used in our estimates are listed in Table 4.

Table 4 – Variables used in estimation

VARIABLE	**Description**
LPOLL	Logarithm of company pollution, computed as SOx+NOx per Toe
CERTIFICATION	Dummy which is 1 when the company Environmental Management System is certified against ISO14000 standard and/or 1836/96 European Regulation EMAS
COMPENSATION	Dummy which is 1 when an environmentally based compensation programme at company level is implemented
AWARD	Dummy which is 1 when an environmentally based award programme is implemented
EAC	Sum of CERTIFICATION, COMPENSATION, AWARD (index 0-3)
INFO	Index ranging from 0 to 1000 which to assess the accuracy of company environmental information
WORK	Number of employees per firm.
OPERATING INCOME	Annual operating income in current US $
ENFORCE	Country index of environmental regulation enforcement
TAX	Country index of burden energy taxes/GDP
SECTOR	Sectoral index whose value is 1 for the electrical sector, 2 for oil and gas and 3 for chemicals

We estimate a random effects model. In fact, even if our database contains many companies which produce environmental reports in the three industries under review, we are still far from including all the environmental reports in the three industries world-wide. This implies that we can assume individual firms appearing in our sample are randomly chosen and taken to be representative of a larger population of firms and that the differences we observe across firms are stochastic disturbances around the population mean. Thus we allow the intercept to vary across firms, but we assume that it is constant over time.

The estimated model is:

$$y_{it} = \bar{\beta}_1 + \sum_{k=2}^{K} \beta_k x_{kit} + \varepsilon_{it} + \mu_i$$

We estimate the random model using an instrumental variable (IV) procedure as we cannot include all the variables simultaneously in our estimation, because of the endogeneity of the operating income with the dependent variable.

At first we estimate the link between operating income (OPERATING INCOME) and EAC (the existence of environmental certification, award and compensation schemes). We take into account the company dimension by using the number of employees (WORK) as a control variable. Secondly we relate the environmental performance of companies (the logarithm of company pollution LPOLL) to the quality of environmental information at time t-1 (INFO) to their instrumented economic performance (the instrumented operating income, IOPINC), to the energy taxation burden (TAX) and to the enforcement of legislation (ENFORCE)

The results of the estimated random effect model are shown in Table 5.

Table 5: Estimated OPERATING INCOME

Dependent variable: OPERATING INCOME

Mean of dep. var. = 1889.92
Std. dev. of dep. var. = 2489.03
Sum of squared residuals = .381484E+09
Variance of residuals = .374004E+07
Std. error of regression = 1933.92
R-squared = .421142
Adjusted R-squared = .404116
LM het. test = 17.1105 [.000]
Durbin-Watson = .075581 [.000,.000]

Variable	Estimated Coefficient	Standard Error	t-statistic		P-value
EAC	413.964	81.1986	5.09818	**	[.000]
WORK	.050996	.948368E-02	5.37726	**	[.000]
INFO(1)	6.01047	9.13842	.657715		[.511]
C	-77.6047	766.808	-.101205		[.919]

Hausman test of H0:RE vs. FE: CHISQ(3) = 29.548, P-value = [.0000]

As we expected OPERATING INCOME is positively related to EAC and to the company size (WORK). The quality of environmental information is non-significant.

Table 6 shows the results of the regression of the logarithm of company SOx plus NOx emissions (LPOLL) at time t on the instrumented OPERATING INCOME at time t (that is endogenous with respect to EAC), on the quality of environmental information (INFO) at time (t-1), on the enforcement of legislation (ENFORCE), and the burden of energy taxation (TAX) and the industry dummy (SECTOR).

TABLE 6: Panel Estimation

Dependent variable: LPOLL

Mean of dep. var. = -8.95649			R-squared = .276393		
Std. dev. of dep. var. = 3.49287			Adjusted R-squared = .234806		
Sum of squared residuals = 812.667			LM het. test = .015806 [.942]		
Variance of residuals = 9.34100			Durbin-Watson = .022598 [.000,.000]		
Std. error of regression = 3.05630					
Variable	Estimated Coefficient	Standard Error	t-statistic		P-value
IOPINC	-.186477E-03	.108226E-03	-1.72303	*	[.085]
INFO(1)	-.025010	.977345E-02	-2.55899	**	[.010]
ENFORCE	-.110039	.155892	-.705866		[.480]
SECTOR	2.61997	.911784	2.87345	**	[.004]
TAX	-.818044	.967608	-.845429		[.398]
C	-9.18296	3.70121	-2.48107	**	[.013]

Hausman test of H0:RE vs. FE: CHISQ(2) = 5.2067, P-value = [.0740]

LPOLL is negatively related to the IV operating income (IOPINC) , which is consistent with the idea that the adoption of EACs is reducing emissions. Moreover, the quality of environmental information (INFO) is negatively related with pollution, suggesting that managers' and employees' efforts on environmental matters is significantly influenced not only by the presence of EACs but also by the accuracy of environmental information. SECTOR is positively related with LPOLL, simply reflecting the structural and technological characteristics of production in the three industries under review. Finally, the relation between ENFORCE and LPOLL is negative but not significant (p-value .480).

7. Concluding remarks

In conclusion, information-based environmental strategies play a significant role in our sample: given environmental regulation, which is costly, they positively influence operating income and negatively influence pollution. Being primarily implementation tools, they need to be complemented by more traditional policies, and cannot substitute them. But given this *caveat*, governments which recommend such policies, are probably justified.

Our findings are consistent with a whole class of models on environmental information, incentives and company behaviour.

In our panel data estimation, the accuracy of environmental information is negatively related with pollution and the relation is significant. That is, information quality is crucial for companies' environmental management and there are explanations for corporate non compliance that are not related to the level of the penalties but to the company's scarcity of internal information (Brehn Hamilton, 1996).

On the contrary, from our results we cannot infer the role of environmental information accuracy on financial performance. In the estimation we used operating income as a proxy of companies' financial health, since we wanted to investigate the existing relation between environmental management tools and company results in the short period. Existing literature on environmental information and corporate financial performances finds significant relation between these variables, but it refers to external environmental information (information provided to external stakeholders) and to long term performances such as shareholder value or liabilities (Tietemberg, 1997, Lanoi et al., 1997, Khanna & Damon 1997). These differences help in understanding the distance between our analysis and prior analyses.

However, generic pleas to better and wider "environmental information" or "eco-management" are too vague and may be misleading. In order to exert a positive influence, environmental information needs to be integrated with a set of incentives, as recommended by economic theory for any company objective. This explains the nature of many integrated environmental and management schemes (such as ISO 14000 or EMAS) adopted by firms and recommended by policy makers.

Our empirical model confirms the positive role of self-regulated environmental audits and compensation programmes on corporate environmental performance, and this is consistent with an emerging research field that explores the possible pattern for integrating environmental issues with concrete management system (Sinclaire-Descgagné and Gabel, 1997, Pfaff and Sanchirico,1999).

The above conclusions, of course, are just tentative, given the preliminary nature of our empirical analysis. In order to reach more robust conclusions, better data have to be collected and better estimates have to be carried out. But the preliminary results we obtained so far seem to be consistent with economic theory and with common sense.

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[i] In order to guarantee a minimum standard for the Corporate Environmental Reports, in 1995 Fondazione Eni Enrico Mattei organised a Forum inviting leading Italian companies and the relevant stakeholders (such as officers from the Ministries of Industry and of the Environment, the Central Statistical Office, the Italian Security Exchange Commission, the main environmental groups, and academics) with the aim of drafting guidelines and minimum standards for Corporate Environmental Reports. The Forum led to an agreed recommendation and was quoted as a success story in the final communiqué of the G7 meeting in Halifax, 1996. Starting from this draft, very similar guidelines were adopted by the European Commission. See Appendix 2 for the final document of the Forum.

[ii] It should be reminded that the first national standard on environmental management was the BS 7750, developed in the UK in the early '90ties.

iii Data on companies' environmental management certification were obtained from EU EMAS official register and ISO14000 competent body in each country.

[iv] To gain information about Environmental Compensation Programmes and Award Schemes we relied on Corporate Environmental Reports and Annual Financial Reports and, only for US listed companies, also on official disclosure required by the US Security Exchange Commission (deliveries like 10K for American Companies quoted at New York Stock Exchange and 20F for not Americans quoted at the New York Stock Exchange). Whether those information were not available in corporate publications, we directly interviewed companies environmental managers and external relation managers.

APPENDIX

APPENDIX 1

List of the Companies

Company	Sector	Country	First year of CER Publication	First year of EMAS or ISO14000 implementation	First year of Award Scheme / Compensation Program Adoption
AGIP	OG	ITA	1995	1998	1994
AGIP PETROLI	OG	ITA	1993	n.i	1994
APS	OG	USA	1994	n.i	1994
BAYER ITALIA	C	ITA	1994	1996	1994
BG	OG	UK	before 1993	n.a	n.a
BP	OG	UK	before 1993	1996	1994
BP CHEMICAL	C	UK	before 1993	1996	1994
CIBA	C	CH	before 1993	1995	1994
CONOCO	OG	USA	1993	1998	1994
DONG	OG	DK	1994	n.i	n.i
EDISON	E	ITA	1994	n.i	1998
ENEL	E	ITA	1995	1998	1994
ENI	OG	ITA	1995	1998	n.i
EXXON	OG	USA	1995	1998	1994
ELF	OG	FRA	1994	1996	1995
ESKOM	OG	SA	1994	n.i	1995

IVO	E	FL	1996	1997	n.a
MOBIL	OG	USA	1995	1996	1995
NATIONAL POWER	E	UK	1994	1995	n.a
NESTE	OG	FL	before 1993	1997	1997
NESTE CHEMICALS	C	FL	before 1993	1997	1997
NORSK HYDRO	OG	FL	1995	1995	1995
NOVO NORDISK	C	DK	1993	1998	n.a
ONTARIO HYDRO	E	USA	1994	1997	1995
PETROFINA DOWNSTR.	OG	BEL	1994	1997	1995
PG&E	OG	USA	1995	1996	1994
POWERGEN	E	UK	1994	1996	1994
REPSOL	OG	SPA	1996	n.i	n.a
ROYAL DUTCH/SHELL GROUP DOWNSTR.	OG	UK	1996	1996	1996
SHELL INT E&P B.V.	OG	NL	1996	1997	1996
SHELL CHEM	C	UK	1994	1997	1996
SHELL UK	OG	UK	1993	1997	1996
SNAM	OG	ITA	1993	n.i	n.i

TRANSPORT.					
SNAM GAS	OG	ITA	1993	n.i	1996
SOLVAY	C	BEL	1994	1996	1995
STATOIL	OG	NOR	1993	n.i	1995
TEPCO	E	J	1994	n.a	n.a
TEXACO	OG	USA	1994	n.i	1996

Source: ERM, FEEM, 1999

Legenda:

C= Chemicals; E= Electrical Power generation; OG= Oil & Gas

n.a.= not available

n.i.= not implemented

APPENDIX 2

Forum on Environmental Reporting Guidelines

In order to guarantee a minimum standard of Corporate Environmental Reports (CER) as voluntary document, the Fondazione Eni Enrico Mattei (FEEM) organised in 1994 the Forum on Environmental Reporting (FER) by inviting some large companies emerging in the field of environmental management and reporting, and some of interested target groups for environmental reports, environmental groups and public administration to work together to draw up guidelines. The aim of the FER is to set guidelines for companies seeking to produce an effective environmental report, providing stakeholders with the information needed from other similar initiatives for the consensus approach.
Here follows the list of Minimum and Recommended Requirements to be included in CERs. These requirements have been used as the basis for the Environmental Reporting Monitor-ERM score system, aiming at evaluating the quality of environmental information

Qualitative Information (Notes to the Environmental Balance-Sheet)

1. COMPANY DESCRIPTION

a. Company size and activities	***Minimum Requirement***
b. Number and location of production sites	***Minimum Requirement***
c. General description of production processes	***Minimum Requirement***
d. Description of the main environmental issues related to production and distribution	***Minimum Requirement***

2. ENVIRONMENTAL POLICY

a. Year of introduction of environmental policy and content	***Minimum Requirement***
b. Expected achievements	***Minimum Requirement***
c. Achievements monitoring (comparison with previous reported objectives)	***Minimum Requirement***

3. ENVIRONMENTAL MANAGEMENT SYSTEMS

a. Organisation structure (environmental department and relationships with other business units)	***Minimum Requirement***
b. Programmes for environmental policy implementation	***Minimum Requirement***
c. Training activity	***Recommended Requirement***
d. Implementation level of environmental management system and certifications (EMAS, ISO or UNI)	***Recommended Requirement***

4. RISK MANAGEMENT

a. Audits, measures taken and achievements regarding risk management	***Recommended Requirement***
b. Description of Clean-up operations carried out	***Recommended Requirement***
c. Description of major accidents	***Recommended Requirement***

5. COMPLIANCE WITH ENVIRONMENTAL LEGISLATION

a. Description of the way the company ensures compliance with environmental regulations (in relation to previous violations as well as to prevention measures)	***Recommended Requirement***
b. Description of measures adopted to comply with new environmental regulations (EU, national, local) that became operational during the period which the report refers to	***Recommended Requirement***

6. PRODUCT POLICY

a. Description of products life cycle and of the related impacts and description of the most relevant measures to mitigate them	***Recommended Requirement***
b. Product innovation	***Recommended Requirement***
c. Products energy efficiency (when relevant)	***Recommended Requirement***
d. Company responsibility at the end of product use	***Recommended Requirement***
e. Co-operation programmes with consumers and clients	***Recommended Requirement***
f. Eco-label (where applicable)	***Recommended Requirement***

7. CONSERVATION OF NATURAL RESOURCES

a. Energy saving programmes	***Minimum Requirement***
b. Water saving programmes	***Minimum Requirement***
c. Other programmes for the protection of natural heritage	***Recommended Requirement***

8. STAKEHOLDERS RELATIONS

a. Participation in voluntary agreement schemes	***Recommended Requirement***
b. Relations with stakeholders (public administration, environmentalists, universities, ...)	***Recommended Requirement***
c. Department or name of the person to contact for further information	***Minimum Requirement***

9. CERTIFICATION

a. External certification	***Recommended Requirement***
b. Certification by EMAS accredited verifiers	***Recommended Requirement***

Quantitative Information (The Environmental Balance Sheet)

1. ENVIRONMENTAL EXPENDITURES

a. Data on environmental expenditures	***Recommended Requirement***
b. Explanation of accounting criteria	***Minimum Requirement***

2. EMISSIONS AND CONSUMPTION OF RAW MATERIALS

a. Site by site quantitative information (for main sites)	***Minimum Requirement***
b. Raw materials	***Recommended Requirement***
c. Energy as input	***Minimum Requirement***
d. Wastes, air emissions, water discharges and soil pollution and other pollutants relevant for company's activity	***Minimum Requirement***
e. Quantity of products or a relevant figure to describe production level	***Minimum Requirement***
f. Impacts (scientifically accounted) related to production activity	***Recommended Requirement***
g. Reduction objectives for: raw materials, energy, pollutants and impacts	***Recommended Requirement***

3. ENVIRONMENTAL PERFORMANCE INDICATORS

a. Environmental performance indicators compared with previous periods	***Minimum Requirement***

Source: FER, FEEM, 1995

APPENDIX 3

Environmental Reporting Monitor – ERM

Starting from the Forum on Environmental Reporting guidelines the FEEM has set up an Environmental Reporting Monitor defining a three sections check-list as a score system. The first two sections are the representation of the two parts of the report: the first section checks for the qualitative information, the second one the quantitative information, following the Forum on Environmental Reporting requirements (see Appendix 3); the third one is the comment section, better explained below. The structure of the check-list is as follows:

- qualitative section: it verifies if 4 minimum requirements and 11 recommended requirements are met. The score: the report can rank from 0 to 2 points for every minimum requirement met; from 0 to 1 for every recommended requirement met.
- quantitative section: it verifies if 9 minimum requirements and 5 recommended requirements are respected. The score: the report can rank from 0 to 2 points for every minimum requirement respected; from 0 to 1 for every recommended requirement respected.
- comment: first of all it checks if the Corporate Environmental Reporting structure complies with the Forum on Environmental Reporting guide-lines. Then it checks whether the report is complete or not. For data quantity: if it is exhaustive it gets 2 points, if medium 1 point, if it is not enough 0 points. For data quality: whether the environmental report refers to a sample or not, whether the report maker used a specific methodology for the data collection and whether an audit has been implemented to check the data or not (for any of these four, from 0 to 2 points). Finally, it checks report legibility (from 0 to 2 points), it verifies whether the report gives other information and whether there is a positive evolution in act from the last reports to the present one (if yes, 1 point).

Each Corporate Environmental Report can rank till 19 points in the first section, 23 points in the second one and 16 points in the comment section. The maximum score is 58 points. For this paper propose each score has been normalised.