

# Eco-efficiency in the SMEs of Venezuela. Current status and future perspectives

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## ABSTRACT

This paper presents a comparison analysis of eco-efficiency in the small and medium sized enterprises (SMEs) of Venezuela. The research can be divided into three parts: the first part reviews similar studies in the literature on the level of eco-efficiency exhibited by the companies of Venezuela and other countries. In the second place, the findings of a survey conducted on Venezuelan SMEs allowed the definition of 54 eco-efficiency profiles. Thirdly, six national experts in cleaner production and eco-efficiency were interviewed. The interview was based on a questionnaire similar to that used in the survey of the Venezuelan SMEs. At a second meeting, the experts were asked to discuss on the similarities and differences between their answers and those of the company's managers.

The findings of the survey allow us to conclude that Venezuelan SMEs understand the legal environmental regulations that affect them but they do not perceive the influence of external driving forces like customers demand for green products or institutional incentives. The adoption of eco-efficiency practices is not perceived as an incentive to improve competitiveness so that the environmental strategies adopted generally aim at reducing costs or avoiding non-compliance sanctions and negative effects on the company image. Materials recycling and reuse, especially packaging materials, are common practices; however, other environmental tools or practices have not been implemented yet, e.g. environmental management systems (EMS), process, product and services design tools based on the product life cycle, renewable energy resources or green marketing. There are also differences among the eight industrial sectors analyzed, food and chemical industries having the higher index of eco-efficiency practices, and plastic and wood industries the lower.

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## 1. Introduction

SMEs concentrate most of the industrial activity in Venezuela, like in many other countries. Therefore SMEs generate most of the positive aspects associated with industry - development of goods and services, employment, tax payment, etc - but also most of the negative environmental effects, such as consumption of natural resources and emission of pollutants. Unfortunately few statistical data are available that confirm this fact. According to the Instituto Nacional de Estadística de Venezuela, and based on the definition of SME provided by the European Commission (European Commission, 2003), in the year 2003 (latest data available) there were 5970 industrial companies in Venezuela, 1592 of which (26.67%) are medium-size industries, 3820 (64%) are small industries and only 9.33% are large companies (Instituto Nacional de Estadística, 2003).

In Venezuela there are 11172000 registered workers, 56.5% of whom work in the “formal sector” and the rest in the “informal sector” (Instituto Nacional de Estadística, 2007). The informal sector of the economy refers to people that offer their products and services in the streets, do not pay taxes and, in turn, do not enjoy any labour benefits or protection from the administration. Our study focuses on the “formal sector” where 81.5% of the workers are hired by private enterprises, 99% of whom work in SMEs (Instituto Nacional de Estadística, 2007).

SMEs are generally family-based and produce for the local (80%) or regional (15 to 20%) markets. Only about 2 to 5% SMEs are oriented to the international market (Páez et al., 2004). Moreover, SME technological and efficiency levels are low (Mendoza and Villegas, 2004; Viana and Cervilla, 1999). Based on a survey conducted in 2007 by the entity that groups all companies, CONINDUSTRIA, during the first trimester the rate of industrial potential employed in medium-size companies was 63.5%, whereas in SMEs it was 54% (Conindustria, 2006). As reported in Conindustria (2007), the reasons for this low productivity are external to industry; in order of importance: political and economic uncertainty, lack of suppliers,

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difficulties to obtain foreign currency to import materials and supplies (due to the foreign currency exchange regime in Venezuela) and lack of demand. Thus, analysts consider Venezuelan SMEs as “little competitive and of high shut-down risk” (Viana and Cervilla, 1999; Fuster, 2004).

In this paper eco-efficiency performance in Venezuelan SMEs is analyzed. The World Business Council for Sustainable Development (WBCSD) in 1991 defined eco-efficiency as “competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing environmental impacts of goods and resource intensity throughout the entire life-cycle to a level at least in line with the Earth’s estimated carrying capacity” (UNEP, 1998).

According to this definition, eco-efficiency is seen as a key strategy for industrial sustainability and it is being driven into the market by what authors like Hilton name “Success Factors” or “Driving Forces” (DFs) (Hilton, 2001). Table 1, based on (Gómez-Navarro, 2004; Coté et al., 2006; Hilton, 2001), lists the main DFs divided into internal and external to the companies.

In fact, eco-efficiency is spreading and around the world industry has started to clean the product and services life cycle. Researchers within the institutional theory paradigm argue stakeholders like government agencies, the media, industry associations, and environmental groups are imposing on organizations the adoption of environmental organizational practices and structures (Rivera and Delmas, 2004). This is happening in both profit and non-profit institutions.

It could be said the best eco-efficiency practices are generally observed in large and medium sized enterprises of industrialised countries. In fact, large companies have a variety of advantages: better training, more resources, more visible environmental practices, more incentives and pressure for improving eco-efficiency, etc. However, many authors defend the idea that eco-efficiency is an opportunity for all enterprises, not only for the largest ones. According to this they analyze eco-efficiency practices in SMEs as a strategy for innovation and change towards a more efficient and competitive production (Gómez-Navarro, 2004; Safari, 2005; UEAPME, 2007; Woolman and Veshagh, 2007; Vernon et al., 2003; van Berkel, 2006). Besides, some studies demonstrate that the projects of Cleaner Production, eco-efficiency and eco-design in developing countries do help SMEs to improve productivity and competitiveness (Ciccozzi et al., 2003; Byung-Wook et al., 2006; Hilson, 2002; Sangwon et al., 2008). As a conclusion, effective eco-efficiency increases SMEs sustainability almost independently of their activity and in a vast range of sizes and economical situations.

## 2. Eco-efficiency in SMEs

General studies on eco-efficiency in SMEs can be found in the literature (Vettori, 2007; Capuz et al., 2003; Otero, 2002; Hilton, 2001). These studies analyze the driving forces that enhance eco-efficiency in companies and the barriers that hamper the

**Table 1**  
Driving forces of eco-efficiency.

Internal driving forces	External driving forces
Costs reduction	Customers’ demands
Improving products and services quality	Competitors changes
Innovation	Access to capital
Increasing employees motivation	Cleaner technology development
Commitment with the local community	Government regulations
Decreasing risks related to the environment	Cultural changes
Maintaining or increasing company’s image and reputation	Raw materials and energy prices

**Table 2**  
Advantages and disadvantages of SMEs regarding eco-efficiency.

Advantages	Disadvantages
Less complex, and more flexible to introduce changes	Pollution generation perceived as low. As a result no budgetary resources invested to reduce environmental impacts
More aware of the changes in the market	Better environmental performance is not perceived as useful for motivating employees, increasing benefits or improving competitiveness
Close relationship with costumers based on mutual trust	Not clearly noticeable by the market or public administration
Lower dependence on certain stakeholders: shareholders, financial agents, suppliers...	Insufficient resources to benefit from eco-efficiency tools.
	Reluctant to changes

implementation of eco-efficient strategies. Table 2 summarizes the advantages and disadvantages of SMEs regarding eco-efficiency:

Other studies in the literature address the topic of eco-efficiency, eco-design and cleaner production in different regions. These works are comparable in scope and methodology, though they differ in their specific aims:

- Van Hemel and Cramer (van Hemel and Cramer, 2002) analyzed 77 small and medium manufacturing companies of The Netherlands belonging to the metal, wood, plastic, textile and electronic industrial sectors. The study analyzes SME eco-design barriers and stimuli. Eco-design is an essential eco-efficiency tool that needs the use of many other eco-efficiency tools.
- Coté et al. (2006) carried out a survey on 25 SMEs in Nova Scotia, Canada, in order to measure the levels of eco-efficiency.
- Erkkö et al. (2005) analyzed to what extent Finish companies with EMAS (Eco-Management and Audit Scheme) statements have added eco-efficiency strategies to their practices. The study is based on the EMAS reports published by 40 companies in the chemical, paper, plastic and metal sectors.
- NETREGS is the UK resource for the protection of the environment; it carried out a telephone-based survey of 5554 SMEs about their environmental management and practices (Netregs, 2005a,b).
- Capuz et al. (2003) analyzed the environmental performance of 146 SMEs in the Region of Valencia, Spain.
- Vives et al. (2005) conducted a comparison analysis in SMEs of different Latin-American countries (Argentina, Brazil, Chile, Colombia, El Salvador, México, Perú and Venezuela) in order to determine the level of implementation of Corporate Social Responsibility (CSR). CSR, among others, involves improving the level of eco-efficiency in companies.
- Guzmán (2005) assessed the level of eco-design in 96 SMEs of the wood sector in Jalisco (México).

The in-depth review of these studies allowed us, on one hand, to finally formulate the objectives of the present work. On the other, to design the questionnaire used in the research in order to allow the comparison of results. Finally, the Fig. 10 was elaborated including the main findings and conclusions of these surveys, letting aside the ones not directly related to this paper.

## 3. Eco-efficiency in Venezuelan SMEs

### 3.1. Background

No specific studies have been found in the literature that address the specific topic of eco-efficiency in Venezuelan SMEs. However,

related studies (Mendoza and Villegas, 2004; Otero, 2002; Díaz et al., 2006; Mercado and Testa, 2001) report on the loss of competitiveness in Venezuelan SMEs since 1970 from both an economic and environmental point of view. Production has become less and less sustainable and more and more focused on local markets, R&D investment has decreased, and the consumers' demand for product/service quality has decreased.

The survey undertaken by the Venezuelan entity VITALIS in 2006 (Díaz et al., 2006) reveals that the key factors of the environmental problems in the national industries of Venezuela are:

- Increasing environmental problems in different regions of the country, without due attention by the responsible public and private enterprises or by the administration.
- Uncontrolled growth of the informal sector.
- A perception of weak enforcement actions against non-compliers, in particular by the "Fiscalía General de la República" and the "Defensoría del Pueblo".
- Little coordination between environmental and development action plans, neglecting the close relationship that exists between environmental preservation and quality of life.
- Development of regional, national and supranational infrastructure projects without the corresponding Environmental Impact Assessment (EIA) reports.
- Lack of environmental education and social awareness as well as little knowledge of the environmental regulations and norms.
- Inappropriate solid waste disposal and management.
- Poor management of hospital, toxic and hazardous waste materials.

However, according to Mendoza and Villegas (2004), Otero (2002), Mercado and Testa (2001), Venezuelan SMEs develop their productive activity within a strict environmental legal framework that regulates any industrial activity susceptible of harming the environment. Hence, this legal framework is inefficient because of:

- Restricted operational capacity of the national Departments for the Protection of the Environment and lack of definition of the tasks and responsibilities of the environmental departments and agencies.
- Lack of real or apparent definition of the tasks and functions of the public agencies in charge of the protection of the environment.
- No information system or data exchange among public agencies.
- Duplication of efforts and functions.

### 3.2. Field survey

The lack of accurate data available motivated us to undertake this survey on the level of eco-efficiency demonstrated by the SMEs of Venezuela. The aim of the survey was to know:

- To which extent SMEs are environmentally concerned and how much knowledge they have about the environmental impacts they generate.
- Which eco-efficiency tools are implemented in Venezuelan SMEs.
- Which driving forces lead to eco-efficiency in SMEs.

The survey data may help not only to know the level of eco-efficiency in Venezuelan SMEs but, also, what enhances and what hampers eco-efficiency in Venezuelan SMEs. The analysis of the

results towards obtaining conclusions about this second objective is based on the assumption that companies, like most organizations, take decisions driven or influenced by many different stakeholders' pressures or driving forces (Delmas and Toffel, 2004).

For this end, the SME managers were interviewed, using a 35-item questionnaire clustered into 16 topics. The questionnaire was designed according to the concepts and structures used in the previous analysis of the state of the art (Netregs, 2005a,b; van Hemel and Cramer, 2002; Coté et al., 2006; Capuz et al., 2003; Erkkö et al., 2005; Vives et al., 2005; Guzmán, 2005).

The survey sample was defined based on the national classification published by the SME Observatory of Venezuela in 2001 and 2004 (Páez et al., 2004; Páez, 2001). The main statistical characteristics of the survey can be consulted in Table 3. SMEs of the central region of Venezuela were selected for the survey as this area presents a high economic development of the manufacturing industries not directly related to the basic industries: oil and mining. Low quality, incomplete and inadequately answered questionnaires were not considered for further analysis (21 in total), giving a total of 54 acceptable samples.

In order to contrast the results obtained in the survey and obtain a more objective view of eco-efficiency performance in Venezuelan SMEs, six national experts in the fields of industry and environment were interviewed (the experts' profiles are in the appendix at the end).

Due to the complexity and multifaceted dimensions of eco-efficiency, qualitative rather than quantitative analysis can be used to explore eco-efficiency development levels in Venezuelan industries (Okoli and Pawłowski, 2004). This survey involved the formation of a panel of experts, whose interaction was moderated in a manner that allowed both closed and open questions. By being able to ask experts about the facts of a matter as well as their opinions, data and individual insights were fostered (Yin, 2003; MacMillan and Marshall, 2006). Methodologies of soliciting opinions from groups of experts have been explored. These include, among others, Delphi studies, Technology Roadmapping methods, the Analytic Hierarchy Process, and structured interviews (Yin, 2003). According to (Yin, 2003) we decided structured interviews would be a viable strategy for the assessment due to the characteristics of our research: almost nonexistent data, availability of experts, availability of similar surveys for comparison and specific closed questions.

We began each interview by means of open questions to drive the experts into the background. In this first contact we asked the experts to study and discuss our findings from the literature (basically the Fig. 10 without the column of Venezuelan industries). Then we asked them a questionnaire similar to that used in the survey on the SMEs. At that time each one knew nothing about the SMEs' answers or the other experts' opinions. Afterwards we added

**Table 3**  
Main statistical characteristics of the survey.

Eligible companies: small and medium sized industries, i.e. companies that produce goods and/or industrial services, of the following districts:	Aragua: 480 industries with 408 SMEs. Capital: 980/935 Carabobo: 823/790 Miranda: 1100/1012 Total eligible SMEs: 3145.
Industrial sectors:	Food, chemical, textile, wood, paper, building, plastic and metal
Acceptable interviews	54 out of 75, 21 were discarded for not obtaining the minimum quality required)
Industries in the sample	54 in number proportional to the size of the district and the size of the industrial sector.
Type-I error (sample of 54 SMEs)	10%
Power (sample of 54 SMEs)	86%

together the six lists of answers and made a document comparing them with the aggregation of SMEs' answers. This was followed by a group discussion on the comparisons of answers. Finally, the group, using guided consensus, agreed on a final assessment of the eco-efficiency development in Venezuelan SMEs. Also on a list of causes for the current status and for the differences among experts' and company managers' eco-efficiency assessments.

#### 4. Survey data

##### 4.1. General findings

The sixteen sections of the questionnaire, corresponding to eco-efficiency practices or tools, are:

1. Knowledge or consideration of the environmental aspects of the processes/products.
2. Green marketing.
3. Department for the protection of the environment.
4. Allocation of budgetary resources to minimize pollution.
5. Personnel training in environmental care.
6. Use of environmental management systems.
7. Knowledge of the environmental legal framework.
8. Pollution control.
9. Pollution prevention.
10. Environmental impact assessment of the product life cycle.
11. Reduction of energy and water consumption or selection of renewable resources in the production process.
12. Reduction of materials consumption or selection of renewable resources in the production process.
13. Recycling or reuse of materials and waste.
14. Eco-design practices.
15. Environmental management of packaging materials.
16. Maximizing the environmental efficiency of product transportation and delivery.

As can be seen in Fig. 1, the common eco-efficiency practices adopted by the surveyed companies are “Environmental concern in

products/processes”, and “Environmental management of packaging materials”. However the interviewed experts did not completely agree with the survey results. The lower index of environmental practices adopted in the SMEs correspond to “Green Marketing”, “Department for the Protection of the Environment”, “Product Life cycle analysis”, “Reduction in Energy consumption” and “Reduction in materials consumption”.

The surveyed SMEs usually adopt those environmental practices which are easy to implement, involve little time or financial investment, and produce short-term visible and predictable benefits. This consideration coincides with the phenomenon reported in the studies of Spain (Capuz et al., 2003), Canada (Coté et al., 2006) and Holland (van Hemel and Cramer, 2002), known as “picking the low hanging fruits”.

To analyze the level of eco-performance of each industrial sector, in the graph of Fig. 1, the Y-axis shows the number of companies that declared to adopt practices in the 16 eco-efficiency topics of the questionnaire. The Food sector presents the highest index of companies that declare to adopt eco-efficiency practices, followed in decreasing order, by the Chemical, Textile, Metal, Paper, Construction, Plastic and Wood sectors.

In general, the level of eco-efficiency in SMEs is low. Even the most eco-efficient sector, i.e. the Food sector, presents rates lower than 50% in seven eco-efficiency items. That is, all sectors have, on average, companies that carry out less than half of the surveyed eco-efficiency practices.

##### 4.2. Partial findings of the survey

Following are the data obtained from the questionnaire conducted on the Venezuelan SMEs:

1. Consider environmental aspects of products/processes.

A total of 67% surveyed companies affirm to take into consideration the environmental aspects of their products and processes. However, the answers to the questions of how they develop the corresponding actions, contradict this affirmation.

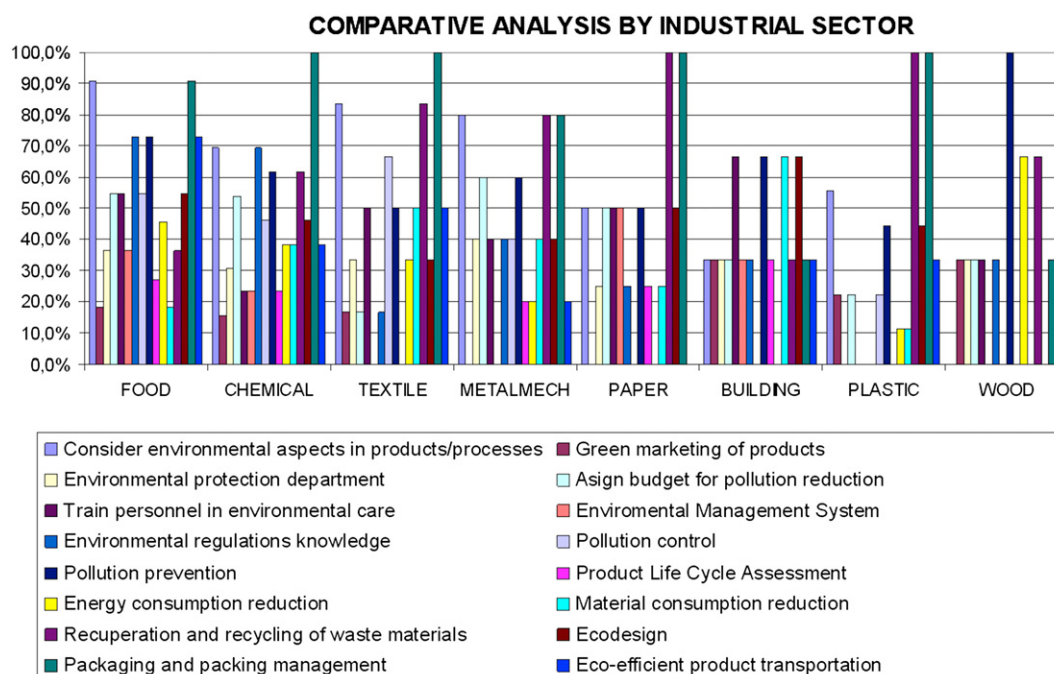


Fig. 1. Percentage by industrial sector and eco-efficiency item.



Those companies that answered affirmatively were asked for their reasons. Most of them declare to be “Environmentally concerned” (58.3%), 50% mention “Legal mandatory requirements” (50%), 33.3% “Market demands”, and 33.3% “Cost reductions” (See Fig. 2). Market pressure has a low influence, in terms of customer demands, competitors or company image. This conclusion is consistent with the results for other items, which reveals that market pressure is not an Eco-efficiency driving force in Venezuela.

## 2. Green marketing.

A total of 83% SMEs do not consider the environment in their marketing strategies. In practice, when the companies affirm to be sensitive to environmental issues their concern does not focus on environmental preservation and protection but on avoiding negative effects on their product or service. SMEs tend to avoid damaging their product image and sales, or administrative penalties, but they do not tend to promote a green image.

## 3. Department for the protection of the environment.

About 72% SMEs do not allocate budgetary resources to the protection of the environment; 15% SMEs have one person in charge of the environmental issues and only 4% SMEs possess a Department for the Protection of the Environment. This result confirms the perception that environmental concern is not proactive or permanent in SMEs. Rather it is triggered by punctual actions to comply with mandatory requirements.

## 4. Allocate resources to reduce pollution.

A total of 57% SMEs do not allocate any budgetary resources to reduce pollution; 20% invest less than 0.1% of their sales income; only 8% allocate more than 1% of their sales income to reduce pollution in their products and production processes. These results clearly indicate the little importance given by SMEs to eco-efficient practices.

## 5. Personnel training in environmental care.

About 35% SMEs affirm that their personnel have been trained in environmental issues. This answer combined with previous ones indicates that SMEs allocate few resources to environmental control actions.

## 6. Use of environmental management systems and tools.

About 7% SMEs apply an Environmental Management System (EMS) according to ISO standard 14000; 11% apply a self-developed EMS and 82% have no EMS system or tool. The SMEs that have implemented an EMS system generally operate with large companies that require from their suppliers to apply EMS tools. Among the companies with an EMS only 40% had particular environmental demands from their customers, or asked their suppliers particular environmental actions. And in fact, Fig. 3 shows that the few kinds of environmental agreements among industries with SMEs are actually more related to decreasing costs than to any environmental concern.

## 7. Knowledge of the environmental legal framework.

Venezuelan SMEs know the regulations that may directly affect them (see Fig. 4). In general, 75% declare to identify which are the hazardous substances used in their products and processes; 50% undergo periodical supervisions. However, less than half of the SMEs (42.6%) affirm to maintain an updated database of the environmental legislation. Generally SMEs are only concerned with those norms liable to non-compliance sanctions, but are not interested in those norms which may benefit them. That is, they do not know the environmental regulations that may involve incentives, access to subsidies, market opportunities, etc.

## 8. & 9. Pollution prevention and control.

Surprisingly, 48% of the surveyed SMEs affirm to prevent pollution, 24% control pollution and 13% adopt both practices. Only 15% admit that they do not control nor prevent pollution. However, as

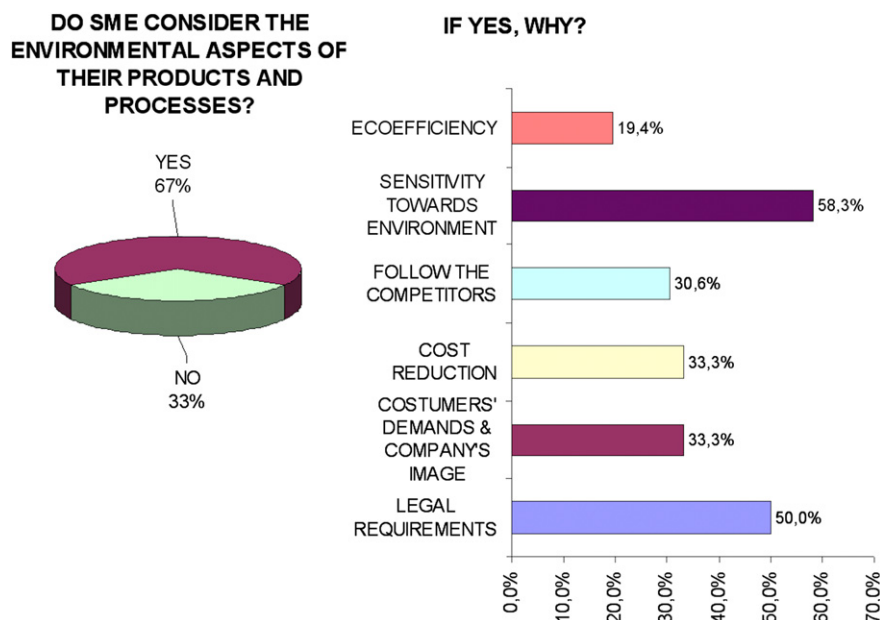
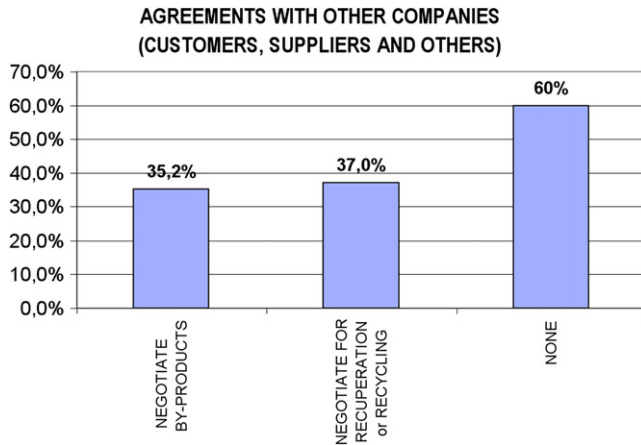
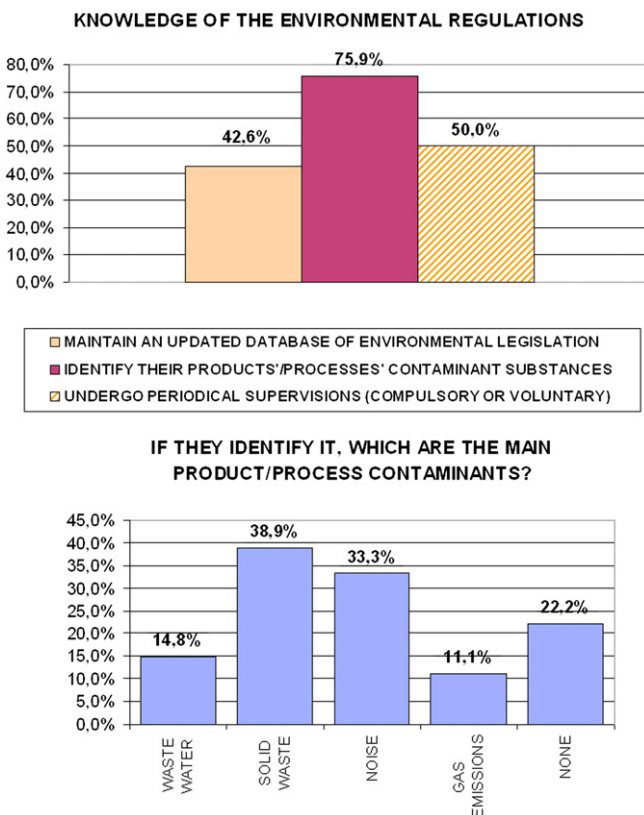


Fig. 2. Reasons for considering Environmental issues.

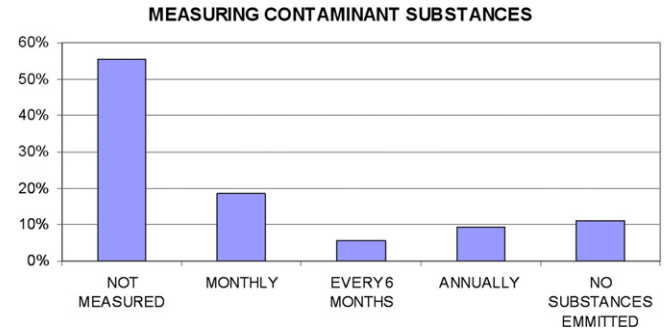


**Fig. 3.** Answers to the question “If any, what kind of environmental actions do you agree with other companies (suppliers, customers and others)”.

shown in Fig. 5, 55.6% SMEs do not measure their levels of pollution and 11% say that they do not emit any kind of pollutants. From the 34.3% SMEs that measure the emission of pollutants, 9.3% does it on an annual basis, 6% every six months and 19% more frequently. Pollution cannot be properly controlled or prevented unless the levels of pollution are measured on a regular basis, so that the results of both questions are contradictory. The number of companies that prevent and/or control pollution is inconsistent with the questions above and below in the questionnaire. This reveals certain misunderstanding of the concept of pollution control and prevention. SMEs are also reluctant to admit that they do not properly manage the environmental issues.



**Fig. 4.** Knowledge of the environmental regulation.



**Fig. 5.** Frequency of measurement of contaminant substances.

#### 10. Environmental impact assessment of product life cycle.

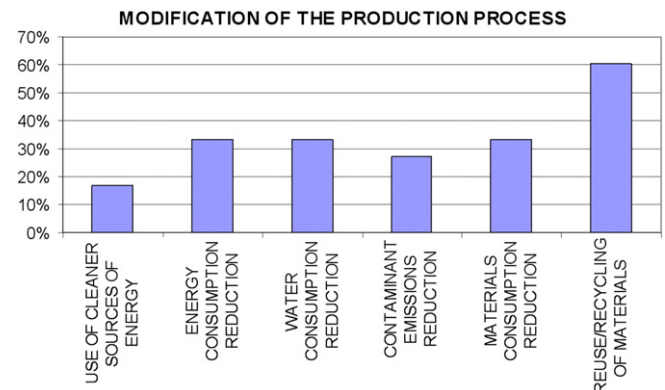
Only 17% SMEs answered positively to this item. Most SME managers did not know the concept of Product Life Cycle and were given additional explanation during the interview.

#### 11. & 12. Modify the production process. Reduce energy, water and materials consumption. Select low impact or renewable resources.

A total of 11.1% SMEs do not adopt any of these practices. Among those SMEs that adopt one or more practices, 60% recycle or reuse materials (see Fig. 6); 33% reduce energy consumption, 33% reduce water consumption, and 33% reduce materials consumption. Very few SMEs select renewable resources or try to reduce the emissions of polluting substances. The conclusion is that the environmental practices implemented in the SMEs are almost entirely related to short-term economic benefits.

#### 13. Recycling or reuse of materials and waste.

With regard to waste management, 46% SMEs use recycled raw materials, 41% recover defective products, 20% recycle their waste and 32% do not undertake any action (see Fig. 7). In Venezuela, like in many other developing countries, there is an important market of recycled raw materials (especially packaging materials), due to the very low cost of the workforce (mostly from the informal sector) and the relatively high prices of raw materials. In developed countries, however, the situation is the opposite and selective waste disposal and recycling is subsidized by the government or through taxes on waste generation.



**Fig. 6.** Results to the question “Which changes in the Production Processes lead to environmental improvements?”.

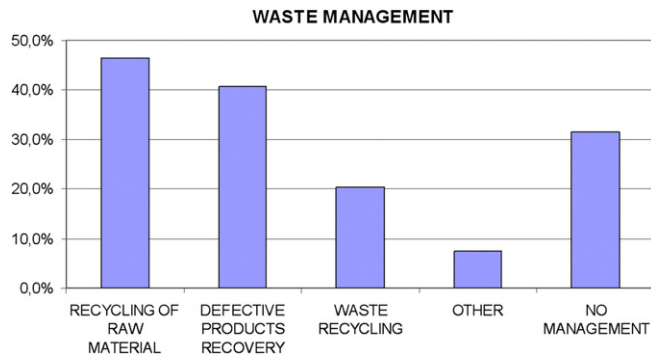


Fig. 7. Answers to the question "Is the generated waste recovered or recycled for reuse as raw material in the manufacturing or production processes?".

#### 14. Eco-design practices.

Similarly, many SMEs say that they adopt eco-design practices (44% vs. 56% which answer negatively to this question). But in practice, they adopt restricted eco-design practices (see Fig. 8) not based on the product life cycle analysis or on environmental impact assessment.

#### 15. Environmental management of packaging materials.

A total of 93% SMEs affirm to adopt practices to reduce packaging environmental impacts. Thus, 46% use recyclable packaging, 35% reusable packaging, 14% clean packaging and 5% packaging with added value for users. The reason for this is the existence of a recyclable-packaging market, but not due to environmental concern or awareness.

#### 16. Maximizing the environmental efficiency of product transportation and delivery.

A total of 41% SME environmentally manage the transportation of their products. However, the answers reveal that the complexity of this process is not fully understood. The surveyed managers usually refer to vehicle maintenance rather than to route planning, vehicle load optimization, etc.

#### 4.3. A comparison analysis with the experts' answers

As mentioned above, six experts in the fields of industry and the environment were interviewed using a questionnaire similar to the questionnaire used in the survey of the SMEs, though adapted so that the experts could estimate the percentage of SMEs that implement each environmental item of the questionnaire. Fig. 9 shows the comparison of the data. The radial lines represent the number of SMEs that adopt Eco-efficiency practices. The lines also show the average rates of the experts' estimations. For example, the radial line of eco-design shows that 44% SMEs affirm to adopt eco-design practices but the experts estimate that only 10% SME actually do so.

The experts' opinion is significantly more critical with lower rates than those obtained in the SME survey. This is partially due to the fact that the experts' opinion is not affected by managerial strategies and policies, and partially because they have a full understanding of the items of the survey. Of the 16 comparison axes, there are coincidences in issues such as "Knowledge of the environmental regulations", "Reduction of energy and water consumption or selection of renewable resources", "Reduction of materials consumption or selection of low impact resources" and "Pollution control". More differences are observed in all other issues, especially in "Pollution prevention", "Packaging management", "Eco-design", and "Environmental concern in products/processes".

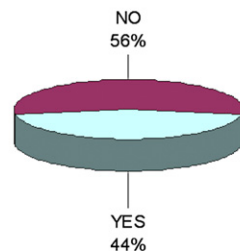
At a second group discussion, the experts were asked about the differences between their estimations and those of the SME managers. The experts' opinions can be summarized as follows:

The SMEs consider that "Environmental improvement of products and processes" or "Pollution prevention and control" mean to comply with environmental regulations. A company will not easily acknowledge its non-compliance with the mandatory regulation and therefore will tend to affirm that it improves its products and services not to be under legal suspicion. Anyway, hardly ever their environmental objectives and goals go beyond the mandatory requirements of the environmental regulations.

Those environmental actions not regulated by law are aimed at reducing costs and avoiding sanctions or damage of the company image.

SMEs affirm to take into consideration environmental issues in their products and production processes, though these actions are not undertaken with rigor and comprehensively. They have no

#### DOES YOUR COMPANY ECODESIGN?



#### IF YES, WHAT ACTION OF ECODESIGN?

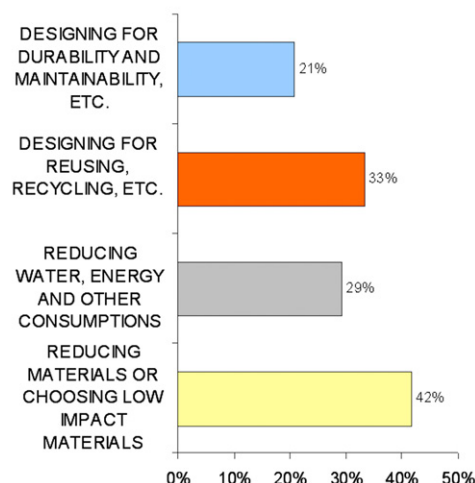


Fig. 8. SMEs' Eco-design practices.

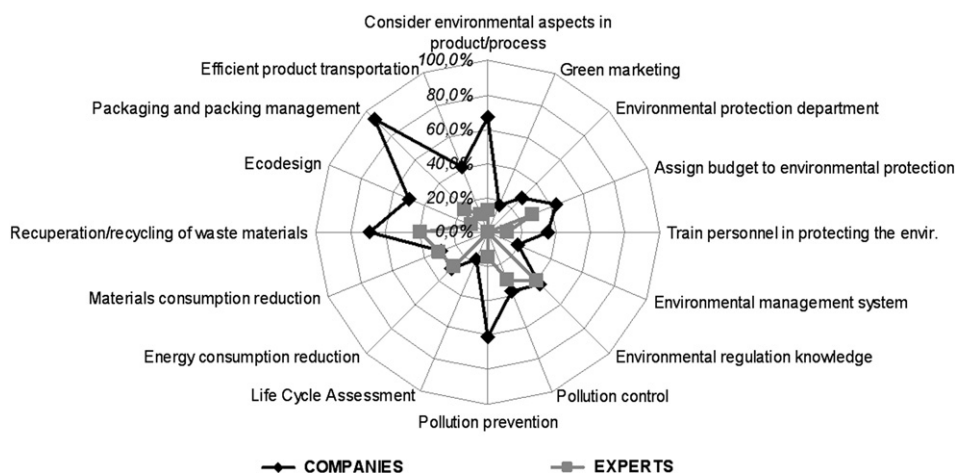


Fig. 9. Comparison graph of the SMEs and the Experts' opinion.

feedback of the effects of their actions, partly because it is not considered relevant and partly because there is no available feedback. As a result of this, companies are unaware of their environmental impacts or of their contribution to sustainable development, neither of the demand for cleaner products and services. They are also unaware of the existence of more eco-efficient alternative technologies or services, or of subsidies and incentives by the administration to improve eco-efficiency.

Consequently, training of personnel and resource allocation to environmental management are restricted to compliance with the mandatory norms. The strategy followed is to minimize costs and changes in the production process. Environmental protection is not part of the competitive or managerial strategies and policies of the company.

Generally, if a partial or punctual practice is adopted, the answer is as if a complete and comprehensive action had been undertaken. That is the case for packaging management. Only profitable packaging materials are eco-managed, and often suggested by people outside the company, in the informal sector. Similarly, regarding eco-design, any small action is considered as an eco-design practice, although not based on any known eco-design model or tool (e.g. LCA).

## 5. Comparison analysis of similar studies conducted in other countries

The literature was reviewed to compare the results of similar surveys conducted in other countries. The comparison criteria used are the same as the items of our survey on SMEs Eco-Efficiency (see Fig. 10). The table presents the studies with sufficient accurate data for the comparison analysis. The rest of the studies were used in the general comments. The cells show a qualitative scale for Fig. 11, depending on the survey data.

### 5.1. Discussion of results

Firstly, it is important to note the wide range of companies as well as processes and products analyzed. Secondly, the data of the survey could be considered optimistic. Generally the companies that answered the questionnaire are companies that adopt green practices or are environmentally concerned. The companies not concerned with the environment or aware of their negative environmental behaviour try not to get involved in surveys of this kind.

Regarding the questionnaire, when the questions refer to unknown concepts, not always the respondents acknowledged

their lack of knowledge. They tend to respond what they believe that may positively affect the company image. There is greater agreement in those environmental items which are fully understood by experts and respondents. However, there are more inconsistencies in the more complex issues.

Therefore, the results and conclusions of the analysis can only be indicative. However, these indicative conclusions can help to gain a better understanding of eco-efficiency performance in SMEs.

The surveys analyzed reveal that environmental concern and adoption of structured and comprehensive green practices depend on company size, i.e. the larger the company, the higher the level of eco-efficiency.

Similarly, there are differences in eco-efficiency performance among the industry sectors of a country. The surveys show that certain industrial sectors present higher levels of eco-efficiency than others. In Venezuela the industrial sectors with the highest index of eco-efficiency are the Food and Chemical industries (excluding the national oil extraction and processing industry). And the lowest eco-efficient levels correspond to the Plastic and Wood sectors.

In the surveys of the developed countries or regions, eco-efficiency driving forces (DFs) are both internal and external. However, in developing countries there are few internal DFs and only regulations and customer demands stimulate SMEs to improve eco-efficiency. The high index of SMEs that affirm to be "environmentally concerned" is motivated by the managers' responses rather than a real action of the SMEs. That is, even if aware, this is not the main reason for the adoption of eco-efficient practices in SMEs, but the external pressures exerted by their stakeholders. This result is similar in other surveys (Rivera and Delmas, 2004; Delmas and Toffel, 2004). Nevertheless, note that in fact, except in the surveys of Holland, Venezuela and Mexico, the rest of the studies report little or very little knowledge of the environmental regulations.

On average, few companies take into consideration environmental issues in their products and processes. In Venezuelan SMEs, it is also so, a situation that can be explained by the acute social problems that exist in the country so that eco-efficiency is not seen as a priority strategy or goal. Although market pressure is an influential external DF, the adoption of Green Marketing practices is scarce in the industries of the surveys analyzed, except in Holland. In Venezuela, SMEs also show a limited adoption of Green Marketing strategies.

Actions concerning environmental management in companies (environment protection department, budgetary allocation to environmental actions, training of personnel and environmental



SURVEYS → ACTIONS ↓	THE NETHERLANDS van Hemel & Cramer (2002)	FINLAND Erkko et al. (2006)	UNITED KINGDOM Netregs (2005 a, b)	VALENCIA (SPAIN) Capuz et al. (2003)	VENEZUELA [*]	JALISCO (MÉXICO) Guzmán (2005)
CONSIDER ENVIRONMENT IN PRODUCTS/PROCESSES	NOT STUDIED	HIGH	HIGH	MEDIUM	LOW	MEDIUM
ENVIRONMENTAL MARKETING	HIGH	NOT STUDIED	MEDIUM	LOW	VERY LOW	NOT STUDIED
ENVIRONMENTAL DEPARTMENT	NOT STUDIED	NOT STUDIED	MEDIUM	LOW	VERY LOW	LOW
BUDGET ASSIGNED TO ENVIRONMENT	NOT STUDIED	NOT STUDIED	NOT STUDIED	MEDIUM	LOW	LOW
TRAINING IN ENVIRONMENT	NOT STUDIED	NOT STUDIED	NOT STUDIED	LOW	LOW	MEDIUM
ENVIRONMENTAL MANAGEMENT SYSTEM	NOT STUDIED	NOT STUDIED	LOW	VERY LOW	VERY LOW	VERY LOW
ENVIRONMENTAL REGULATION KNOWLEDGE	HIGH	NOT STUDIED	VERY LOW	LOW	MEDIUM	MEDIUM
POLLUTION CONTROL	NOT STUDIED	MEDIUM	NOT STUDIED	HIGH	LOW	LOW
POLLUTION PREVENTION	MEDIUM	LOW	NOT STUDIED	VERY LOW	LOW	NOT STUDIED
LIFE CYCLE ASSESSMENT	NOT STUDIED	VERY LOW	NOT STUDIED	VERY LOW	VERY LOW	NOT STUDIED
ENERGY CONSUMPTION REDUCTION	HIGH	HIGH	VERY LOW	HIGH	LOW	NOT STUDIED
MATERIAL CONSUMPTION REDUCTION	HIGH	LOW	NOT STUDIED	HIGH	MEDIUM	NOT STUDIED
RECUPERATION AND RECYCLING OF WASTE MATERIALS	HIGH	MEDIUM	MEDIUM	HIGH	HIGH	MEDIUM
ECODESIGN	VERY LOW	NOT STUDIED	NOT STUDIED	LOW	VERY LOW	VERY LOW
PACKAGING AND PACKING MANAGEMENT	MEDIUM	NOT STUDIED	NOT STUDIED	HIGH	MEDIUM	LOW
EFFICIENCY IN TRANSPORT	NOT STUDIED	NOT STUDIED	NOT STUDIED	MEDIUM	VERY LOW	MEDIUM

van Hemel & Cramer (2002) 77 SMEs of the sectors: plastic, metal, textile, wood and electronics

Erkko et al. (2006) 40 Companies with EMAS of the sectors: chemical, paper, plastic and metal

Netregs (2005 a,b) 5.554 SMEs of every economic sector

Capuz et al. (2003) 146 SMEs of the sectors: plastic, metal, ceramics, wood, textile and food

[\*] 54 SMEs of the sectors: food, chemical, textile, wood, paper, building, plastic and metal

Survey conducted among venezuelan SMEs

Guzmán (2005) 96 SMEs of the wood sector

Fig. 10. Comparison analysis of Eco-efficiency performance in different countries.

management systems) get a low or very low rate in the surveys that analyze this issue. In Venezuela there is also a limited application of environmental management systems and tools.

The different surveys also indicate limited adoption of eco-design strategies in SMEs. eco-efficiency activities focus on production processes rather than on products. This situation is changing in Europe with the “new environmental approaches” but no changes are expected in the short-term in Latin-America unless more manufactured products are exported. Companies do not apply Life Cycle Assessment tools, i.e. this valuable tool is restricted to the academic community and large companies.

Reductions in Energy, water and materials consumption are the most common practices adopted by the companies analyzed in the

surveys. However, they do not declare to make use of renewable resources. Therefore, the former actions seem more motivated by cost savings than by environmental concern. Nevertheless, this trend is less noticeable in Venezuela because energy is cheap due to the abundance of energy resources, nationalization of the resources and low fuel-price policies. Also water and the common materials have a relatively speaking low cost.

In developed countries waste/materials recycling and recovery is legally regulated and mandatory (rather than triggered by environmental concern) through automated infrastructures and financed by the companies. In Latin-American countries, recycling is a profitable business that saves raw material expenses to companies, based on workforce rather than on automation.

% OF COMPANIES	QUALITATIVE SCALE
80-100%	VERY HIGH
60-79%	HIGH
40-59%	MEDIUM
20-39%	LOW
1-19%	VERY LOW
0%	NOT STUDIED

Fig. 11. Qualitative scale used in Fig. 10.

With regard to efficient environmental management of product transportation, the experts affirm that product transportation is through safer rather than more efficient routes. This is due to the very low price of fuel and the high insecurity existing in Venezuela.

Complementary to all the above, the work with the experts panel provided some other interesting findings. Experts affirm that, since Venezuelan public administration (PA) is increasingly playing a protagonist role in the market, both regulating, producing and purchasing, PA should be demanded a greater involvement in eco-efficiency development.

In fact, PA counts with policy tools suitable for eco-efficiency enhancement like: demand for green products and services, training and awareness campaigns, price policies (taxes, subsidies, etc) and command and control legislation.

Venezuelan PA has done very little, if anything, towards the development of instruments for a better price policy, redistributing taxes and subsidizing green products to improve SME competitiveness.

In relation to the development of a greener market, and according to our estimations, Venezuelan administration and nationalized companies account for more than 60% of the market. Under such conditions, a policy of green products has an enormous potential. Environmental assessment criteria should be included in tendering and supplier selection processes for the administration. This could generate a greater demand for green products and services and boost eco-efficiency.

Finally, incentive mechanisms for the adoption of environmental protection practices already implemented in developed countries could also contribute to the development of a more eco-efficient market. For example, reliable information mechanisms for users (eco-labels), awareness-raising campaigns through publicity, environmental education and training of citizens and professionals.

All these proposals have hardly been implemented in Venezuela. However, the experts coincide in affirming that they could raise social awareness in environmental issues, stimulate green marketing and facilitate access of SMEs with eco-efficient products to subsidies and credits.

## 6. Conclusions

To recapitulate, Venezuelan SMEs do not perceive their own environmental impacts as significant and therefore almost no resources are allocated to reduce environmental impact. Besides, SMEs do not believe that a better environmental performance can help them increase sales, improve competitiveness or motivate employees.

SMEs tend to be reluctant to changes, and reactive rather than proactive about environmental issues. SME environmental goals

usually tend to reduce direct costs and to avoid non-compliance sanctions or damage of the company image. Therefore, few companies apply environmental management systems or eco-efficiency tools. They have insufficient resources to benefit from eco-efficiency tools.

Eco-efficiency driving forces are similar in all regions, particularly market pressure and governmental intervention in the form of economic taxes or legal requirements. Environmental regulation is similar in all countries analyzed. However its level of influence depends on the enforcement regime rather than on the knowledge of the regulations. In Venezuela there are no efficient enforcement mechanisms to control SMEs compliance with the environmental regulations and thus it is not a very important stimulus, despite being the most influential DF. On the other hand, if the SMEs of countries with weak enforcement regimes export their products to countries with tighter environmental regulations, this can enhance the implementation of green actions. Unfortunately, Venezuelan SMEs export very few products.

In countries with a degraded environment, public local opinion and global pressure are highly influential. In Latin-American countries, particularly in Venezuela, with a less degraded nature, global campaigns for the protection of the environment do not find the same echo. Because of this and of the acute social problems affecting the country, the protection of the environment is not seen a factor as significant as in developed countries.

Finally, based on the responses of the experts and the reviewed studies, certain proposals can be defined for enhancing eco-efficiency in Venezuelan SMEs. For this, among the stakeholders that can motivate Venezuelan SMEs to adopt eco-efficiency practices, customers and unions generally do not demand for green products. Green associations and mass media are only influential in the case of important threatening environmental impacts caused by large companies, but they do not care about SME eco-efficiency. Product supply chains (both customers and suppliers) and competitors generally have similar low levels of eco-efficiency. Therefore, the only stakeholders that exert some influence and are effectively enhancing the adoption of eco-efficiency are business associations and public administrations (PA).

As a result of its political situation, in Venezuela public administration is the only stakeholder with capacity and responsibility to assume leadership in the promotion of eco-efficiency in SMEs. Leadership comes not only from public administrations but also from market pressure through nationalized companies. Experts affirm various of the initiatives and policies applied in other countries, if truthfully applied and supported in Venezuela by the PA, could result in a noticeable improvement of SMEs' eco-efficiency and, thus, competitiveness.

## Appendix

Briefly, the 6 consulted experts' profiles are:

1st. Researcher and associate professor in the field of the environment. Has been awarded with an important national award for his environmental activities (Premio Nacional de Ciencias Sociales CONICIT 2001).

2nd. Expert in eco-efficiency and cleaner production and a member of the "World Network of Clean Production" and the "Clean Production Network within the agreement Andres Bello for Latin-America and the Caribbean".

3rd. President of the environmental NGO VITALIS, a technical consultant of the "World Bank Project-INPARQUES" on environmental education, and the President of the "South-American Water Association (GWP-South-America)". Leader of the aforementioned VITALIS' survey (Díaz et al., 2006).

4th. Industrial consultant in quality and environmental management and advisor of the National agency for the Development of Innovation and Cleaner Production Methodologies.  
 5th. President of a governmental body that addresses enterprises towards eco-efficiency and cleaner production: FONDOIN.  
 6th. Honour member of the “National Academy of Engineering and Habitat, ex-Minister for the Environment and ex-Minister for Civil Works, and ex-president of different world entities related to the environment.

## References

- Byung-Wook, L., Seung-Tae, J., Jeong-Heui, K., 2006. Environmental accounting guidelines and corporate cases in Korea. Implications for developing countries. In: *Implementing Environmental Management Accounting: Status and Challenges*. Springer, Netherlands, pp. 239–255.
- Capuz, S., Gómez, T., Viñoles, R., López, R., Bastante, M., Vivancos, J., Ferrer, P., 2003. Situación actual y perspectivas del Ecodiseño en las PYMEs de la Comunidad Valenciana. Universidad Politécnica de Valencia, Valencia.
- Ciccozzi, E., Checkenya, R., Rodríguez, A.V., 2003. Recent experiences and challenges in promoting cleaner production investments in developing countries. *Journal of Cleaner Production* 11 (6), 629–638.
- Coté, R., Booth, A., Louis, B., 2006. Eco-efficiency and SMEs in Nova Scotia, Canada. *Journal of Cleaner Production* 14, 542–550.
- Conindustria, 2007. Encuesta de coyuntura trimestral Situación IV trimestre 2006- Perspectivas I trimestre. Downloaded from: <http://www.conindustria.org/web2005/coninceel/BoletCoyuntura76.pdf> (6.5.2007).
- Delmas, M., Toffel, M., 2004. Business Strategy and the Environment. Stakeholders and environmental management practices: an institutional framework 13, 209–222.
- Díaz, D., Febres, M., Martínez, Z., Frontado, Y., 2006. Balance de la Situación Ambiental. Evaluación del Sector. Downloaded from: <http://www.vitalis.net/Index4.htm> (2.11.2006).
- Erkko, S., Melanen, M., Mickwitz, P., 2005. Eco-efficiency in the Finnish EMAS reports – a buzz word? *Journal of Cleaner Production* 13, 799–813.
- European Commission. COMMISSION RECOMMENDATION of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises (notified under document number C(2003) 1422) (2003/361/EC). Official Journal of the European Union, 2003.
- Fuster, J., 2004. Evaluación Final del Programa Coninpyne Informe para Banco Interamericano de Desarrollo (BID). (ATM/ME-5942 /VE). ACE.
- Gómez-Navarro T. Propuesta metodológica para la mejora de la ecoeficiencia de los productos industriales a lo largo de su ciclo de vida. Aplicación a las PYME de la Comunidad Valenciana. Tesis Doctoral. Valencia: Universidad Politécnica de Valencia, 2004.
- Guzmán, L., 2005. Propuesta Metodológica para la Integración del Factor Ambiental en el Diseño de Productos y de Procesos, a Través del Sistema de Gestión, en la Industria del Mueble. Caso de Estudio: Sector del Mueble del Estado de Jalisco (México). Tesis Doctoral. Valencia: Universidad Politécnica de Valencia.
- Hilson, G., 2002. Eco-efficiency: improving environmental management strategy in the primary extraction industry. *Journal of Environmental Systems* 29 (1), 1–14.
- Hilton, M., 2001. Design for Sustainable Development. Success Factors. European Foundation for the Improvement of Living and Working Conditions, Dublin.
- Instituto Nacional de Estadística, 2003. Estadísticas Económicas. Downloaded from: [http://www.ine.gob.ve/industria/Indus\\_Man\\_2003.htm](http://www.ine.gob.ve/industria/Indus_Man_2003.htm) (10.2.2006).
- Instituto Nacional de Estadística, 2007. Estadísticas Económicas. Downloaded from: <http://www.ine.gob.ve/tripticos/IndicadoresEconomicos/C1IndicEcon.asp?periodo=200701> (12.3.2007).
- MacMillan, D., Marshall, K., 2006. The Delphi process – an expert-based approach to ecological modelling in data-poor environments. *Animal Conservation* 9, 11–19.
- Mendoza, J., Villegas, A., 2004. La producción más limpia y el consumo sustentable en Venezuela. Ministerio del Ambiente y los Recursos Naturales. Dirección General de Calidad Ambiental. Fondo Editorial Fondoambiente, Caracas.
- Mercado, A., Testa, P., 2001. Tecnología y ambiente: el desafío competitivo de la industria química y petroquímica venezolana. Fundación Polar-CENDES, Caracas.
- Netregs, 2005a. SME-nvironment England. A review of changing environmental attitudes and behaviours among small and medium-sized businesses in England. Downloaded from: [http://www.netregs.gov.uk/netregs/1169119/?lang=\\_e](http://www.netregs.gov.uk/netregs/1169119/?lang=_e) (1.10.2006).
- Netregs, 2005b. SME-nvironment, A review of changing environmental attitudes and behaviours among small and medium sized business in the UK. Downloaded from: [http://www.netregs.gov.uk/comillonesondata/acrobat/2005\\_uk\\_sumillonesary\\_1197319.pdf](http://www.netregs.gov.uk/comillonesondata/acrobat/2005_uk_sumillonesary_1197319.pdf) (1.10.2006).
- Okoli, C., Pawlowski, S., 2004. The Delphi method as a research tool: an example, design considerations and applications. *Information & Management* 42, 15–29.
- Otero, I., 2002. Desafíos y propuestas para la implantación más efectiva de instrumentos económicos en la gestión ambiental de América Latina y el Caribe. El caso de Venezuela. CEPAL, Serie Manuales No 18. Downloaded from: [www.eclac.cl/id.asp?di=11048](http://www.eclac.cl/id.asp?di=11048) (12.3.2008).
- Páez, T., 2001. Observatorio PYME: estudio de la pequeña y mediana empresa en Venezuela. Corporación Andina de Fomento, Caracas.
- Páez, T., Rodríguez, B., Itriago, D., Cuárez, M., 2004. Observatorio PYMEs y nuevas tendencias de la información y la comunicación. Ceatpro, Caracas.
- Rivera, J., Delmas, M., 2004. Business and environmental protection: an introduction. *Human Ecology Review* 11 (3).
- Safari, I., 2005. Economical Efficiency with Ecological Efficiency, Incorporating Eco-efficiency at SMEs. Finland: Turku Polytechnic. Downloaded from: [www.vito.be/erscp2005/documents/papers/PAPER086.PDF](http://www.vito.be/erscp2005/documents/papers/PAPER086.PDF) (1.5.2008).
- Sangwon, S., Kun Mo, L., Sangsun, H., 2008. Eco-efficiency for pollution prevention in small to medium-sized enterprises: a case from South Korea. *Journal of Industrial Ecology* 9 (4), 223–240.
- UNEP-WBCSD, 1998. Cleaner Production and Eco-efficiency: From Ideas to Action. UNEP, Geneva.
- UEAPME, 2007. Overview of the problems faced by micro and small businesses when applying the concept of eco-efficiency, including energy efficiency. Downloaded from: [www.ueapme.com/docs/pos\\_papers/2007/0710\\_Guido\\_problems\\_SME.pdf](http://www.ueapme.com/docs/pos_papers/2007/0710_Guido_problems_SME.pdf) (23.2.2008).
- van Berkel, R., 2006. Cleaner production and eco-efficiency initiatives in Western Australia 1996–2004. *Journal of Cleaner Production* 15 (8–9), 741–755.
- van Hemel, C., Cramer, J., 2002. Barriers and stimuli for ecodesign in SMEs. *Journal of Cleaner Production* 10, 439–453.
- Vernon, J., Stephen, E., Pinder, D., Kaja, C., 2003. The greening of tourism micro-business: Outcomes of focus group investigations in South East Cornwall. *Business Strategy and the Environment* 12, 49–69.
- Vettori, A., 2007. SMEs & Environmental Policy. EURADA. Dirección General de la Comisión Europea para el Ambiente. Downloaded from: [www.eurada.org/doc/EU%20Policy%20Update/Andrea%20Vettori.ppt](http://www.eurada.org/doc/EU%20Policy%20Update/Andrea%20Vettori.ppt) (2.5.2008).
- Viana, H., Cervilla, M., 1999. A Model for the Empirical Analysis of Technological Capabilities of Manufacturing Firms. *Management of Engineering and Technology*, PICMET'99; 1:310–325.
- Vives, A., Corral, A., Isusi, I., 2005. Responsabilidad Social de la Empresa en las PYMEs de Latinoamérica. Subdepartamento de Empresa Privada y Mercados Financieros. Banco Interamericano de Desarrollo (BID), Washington, DC.
- Woolman, T., Veshagh, A., 2007. Designing Support for Manufacturing SMEs Approaching Ecodesign and Cleaner Production. Learning from UK Survey Results. Warwick Manufacturing Group. University of Warwick, Warwick, UK.
- Yin, R.K., 2003. Case Study Research Design and Methods, 3rd ed. Sage Publications, New York.