

THE EIA ROLE IN THE QUALITY IMPROVEMENT OF PROJECTS IN THE CASE OF WIND FARMS

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Summary

Environmental Impact Assessment (EIA) has a potential important role in projects concept and design reconciling development and environmental protection.

This investigation analysed the contribution of EIA to the quality improvement of wind farm projects. In order to achieve this purpose a documented review of EIA studies and a perception analysis of EIA proponents relatively to the contribution of this instrument to the quality improvement of wind farm projects were proceeded.

The analysis shows that the wind farm companies do not seem to have the real perception of the contribution of EIA in the quality improvement of projects.

Key words: Environmental Impact Assessment, Environmental Impacts, Wind Farm Projects, Quality.

I Introduction

Renewable energies, including wind power, are crucial given the need to respond to the challenge of climate change and the need to reduce the dependence on fossil fuels; they are also a driving force behind economic, social and technological development. Nevertheless the environmental impacts of renewable energies can not be ignored. The construction and operation of wind power installations raises mainly issues of visual impact, noise and the potential effects on local ecology. In most cases these projects are subject to a detailed EIA.

The EIA role in the quality improvement of wind farms is the subject analyzed in this investigation and summarized in this paper which contains an introduction presenting the purpose and methodology of this investigation (I), the situation of the EIA of wind farm processes in Portugal (II), a description of the main environmental impacts of wind farms (III), the results of the review of EIA reports of wind farms and of the perception analysis of wind energy proponents regarding the EIA process (IV) and the conclusions of this investigation (V).

▪ Purpose and methodology

The general purpose of this investigation consists of verifying if EIA contributes to the quality improvement of wind farm projects. The specific objectives consist of identifying the project issues that are more positively influenced by the EIA process, considering the main environmental impacts associated with wind energy. In addition it was intended to analyse the perception of wind farms project proponents relatively to the contribution of that instrument to the quality improvement of wind farm projects.

The research was firstly based on a bibliographic research focused mainly on the following concepts: EIA, environmental impacts, wind power and wind farm projects. Various sources were used including: literature and reports on EIA, national and European legislation, EIA reports and other documents related to wind energy development, wind farms and its environmental impacts.

Based on the review of EIA reports of wind farms the main environmental impacts associated with the construction and exploration of a wind farm were identified, as well as the main mitigation measures adopted and the project issues referred. Two periods of observation were used to compare EIA reports and verify their progress.

A short questionnaire was sent to 18 wind energy sector companies in Portugal with the purpose of analysing their perception regarding the EIA process and its contribution in the quality improvement of wind farm projects. The responses received, albeit only representing 39% of the sample, are interpreted and analysed in this paper.

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II Environmental Impact Assessment of wind farm processes in Portugal

Environmental Impact Assessment can be defined as: the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made (IAIA/IEA, 1999).

According to the International Association for Impact Assessment (IAIA), the main objectives of EIA are:

- To ensure that environmental considerations are explicitly addressed and incorporated into the development decision making process;
- To anticipate and avoid, minimize or offset the adverse significant biophysical, social and other relevant effects of development proposals;
- To protect the productivity and capacity of natural systems and the ecological processes which maintain their functions; and
- To promote development that is sustainable and optimizes resource use and management opportunities.

The EIA report is the main product of EIA process and describes the project and its likely impacts upon the environment. The developer is responsible for preparing the EIA report.

The Law n.º 69/2000, May 3, with modifications introduced by Law n.º 197/2005, November 8, establishes the legal framework for EIA in Portugal.

EIA of wind farms processes are relatively recent in Portugal, emerging in 2000. According to i) number 3 of Law n.º 69/2000 (annexe II), May 3, with modifications introduced by Law n.º 197/2005, November 8, wind farms with more than 20 turbines or located in a distance smaller than 2km from other similar wind farms (general case) and wind farms with more than 10 turbines or located in a distance smaller than 2km from other similar wind farms (sensitive areas) should be subject to a formal EIA.

The article 8º of Law n.º 225/2007, May 31 orders that a favourable or conditionally favourable Environmental Impact Statement (EIS) implicates that some complementary procedures of approval or authorization may not be necessary in some cases and under determinate conditions.

The total number of EIA processes of wind farms that were initiated by APA (Environment Portuguese Agency) by June 2007 was 93; the number of follow up processes was 25.²

Based on the bibliographic research proceeded, few studies concerning EIA of wind farm projects in Portugal were found, excluding the Environmental Assessment Orientation Guide "Guia de Orientação para a Avaliação Ambiental" (Mendes *et al.*, 2002) and a study relative to the electric sector and the environment ("Estudo sobre o Sector Eléctrico e Ambiente") (Antunes *et al.*, 2000). Concerning to international documents few sources were also founded: the report Global Wind Energy Outlook 2006 (GREENPEACE/GWEC, 2006) and a document concerning Wind Energy and the Environment (EWEA, 2002).

III The environmental impacts of wind farms

Wind power is a clean and renewable energy technology that contributes to avoid greenhouse gases and other pollution agents. This energy option will have a large impact in Portugal on meeting EU Kyoto commitments and will contribute to sustainable development, economic growth and employment.

Wind farms are clusters of wind turbines used to produce electricity. When considering the installation of a wind farm, the single most important characteristic is the wind speed; therefore wind turbines are usually located in regions with high wind potential. World In 2006 world wind power capacity ended up reaching 72 628 MW and the European Union set a new installation record bringing its total installed capacity up to 48 042 MW (EUROSERV'ER, 2007). According to the INEGI (Institute of Mechanical Engineering and Industrial Management), wind power is doing well in Portugal with an installed capacity of 1 716.4 MW in 2006.

² Data available in Internet page: <http://www.iambiente.pt/APA/index.htm>. Last access: June 2007.

With the purpose of intensifying the exploitation of wind energy, Portugal reviewed the objectives established in 2003 and decided to increase its installed capacity target by 1950 MW to 5100 MW in 2012.

The main benefits of wind energy are to avoid the emissions from fossil fuel electricity generation and their impacts; nevertheless it is not free of impacts on the environment. The main impacts are summarized on Table 1, and are relative to soil / land use; water quality / water resources; ecology; noise; landscape and visual impacts; electromagnetic interference; social-economic issues and cultural heritage.

Table 1 - Main environmental impacts of wind power installations.

Soil / Land use	The main impact regarding land use results from the occupation of large areas during the construction phase (Mendes <i>et al.</i> , 2000). During operation and hence only a reduced percentage of the total area is occupied by the turbines, the land on which they are located would still be available for other uses (such as agriculture or livestock grazing). Soil exposition to erosion is also a significant impact on soil relative to construction phase.
Water quality / water resources	During the construction phase, surface water quality may be affected by an increase of solid particles charge due to land movements or eventual accidents caused by oils or fuels. No significant impacts on water quality are predictable, during the operational phase.
Ecology	Construction and exploration of wind farms may cause several negative impacts on flora and fauna mainly on birds. Birds can be affected by wind energy development through loss of habitat, disturbance to their breeding and foraging areas and by death or injury caused by the rotating turbine blades (GREENPEACE/GWEC, 2006). Bats are also endangered by collision with structures and loss of habitat. This can be avoided by careful sitting procedures.
Noise	Noise increase during construction is caused by the installation of the turbines at the wind farm site including the execution of access tracks. During operation, the dominant issue is aerodynamic noise from the turbines.
Landscape and visual impacts	Visual impacts are mainly visual intrusion of the turbines and associated equipment in the landscape; however, this impact is a highly subjective issue.
Electromagnetic interference	The moving blades can affect radio waves and microwaves used for communication purposes.
Social-economic issues	There are a lot of positive wind farm impacts associated mainly with economic growth; employment benefits and local economic effects (due to the sharing of economic benefits with local communities).
Cultural heritage	Wind farm construction may eventually affect cultural heritage elements located in the wind farm site causing their damage during the construction and operational phases. However, during the operational phase cultural heritage elements may also be divulged (positive impact).

IV Review of EIA reports of wind farms and perception analysis of wind energy proponents regarding the EIA process

IV 1 Review of EIA reports of wind farms

▪ Selection of the sample for the review of EIA reports

Six EIA reports of wind farms were reviewed, which represent 10 % of the total number of EIA reports of wind farms completed in Portugal (63) and 6 % of the total number of EIA reports of wind farms including those which processes are still in evaluation (93). The following criteria for review were considered: the date of the EIA decision; the type of decision (all projects were conditionally favourable) and the project phase when the EIA was conducted (previous study phase).

Two periods of observation were considered: the first corresponds to the initial period of EIA reports of wind farms in Portugal (years 2001-2002) and the second corresponds to the last processes conducted (years 2005-2006). Three projects of each period were selected, in order to verify their progress.

The selected number of EIA reports analysed was restricted by the temporal limitations of this investigation allowing only a general perception on the issues in study.

The project proponents, the authors of the preparation of the EIA reports and the EIA report date are presented on Table 2.

Table 2 - General data regarding analysed projects.

Project / Proponent	Preparation of the EIA reports	EIA report date
Pampilhosa da Serra wind farm (Parque da Pampilhosa da Serra - Energia Eólica, Lda.)	RES – Sistemas Energéticos, Lda.	January 2001
Cinfães wind farm project (Enernova Novas Energias, S.A.)	HIDRORUMO – Projecto e Gestão, S.A.	January 2001
Seixinhos wind farm (Energiekontor Portugal – Energia Eólica, Lda.)	PROTERMIA – Projectos Térmicos Industriais e de Ambiente, Lda.	September 2001
Chão Falcão II wind farm (Parque Eólico Chão Falcão, Lda. - Grupo Enersis)	PROCESL	November 2005
Sobrado wind farm (Energiekontor)	Ecominol	Mayo 2006
Negrelo and Guilhado wind farm (EDP)	EDP	February 2006

▪ Results

This documented review allows conclusions on some aspects associated with EIA reports analyzed: the main project aspects referred in the EIA reports; the main environmental impacts and mitigation measures and the informative content of conclusions, and to verify their progress.

The frequency of the analyzed project aspects referred in the studied EIA reports is presented on Table 3.

Table 3 – Frequency of project aspects referred on the analysed EIA reports.

Stages	Project aspect		Frequency
Construction stage	I.1	Infrastructures location minimizing environmental impacts	2
	I.2	Intervention area minimization	2
	I.3	Wind turbines number decrease	2
	I.4	Construction compound location considering environmental issues	2
	I.5	The preference for existing access tracks	3
	I.6	Study/analysis of alternatives	2
	I.7	Wind turbines drawing in order to minimize environmental impacts	2
	I.8	Landscape integration of the sub-station/control building	2
	I.9	Contractors activity control ¹	2
	I.10	Construction works inspection and introduction of proper laws	1
	I.11	Underground power cables along the access tracks	3
	I.12	Use of elevate profitability wind turbines (bigger power)	2
Operational stage	II.1	Automatic/non assisted functioning	2
Decommissioning stage	III.1	Integral removal of installed infrastructures	1
	III.2	Infrastructures use for utility public aims	2
	III.3	Temporal restriction of demolition activities	2
	III.4	Materials recycle/reuse	2
	III.5	Landscape recover	2

¹ Concerning to land movements / machines circulation / wastes deposition

Adopted scale:

1 - Project aspect referred with a frequency <3

2 - Project aspect referred with a frequency ≥3

3 - Project aspect referred in all analysed EIA reports

The preference for existing access tracks instead of opening new ones and the underground installations of power cables are the project aspects referred by all analysed EIA reports.

Although it is not generally clear an increase of the analysed project aspects in the second period of study relatively to the first one, there are some aspects that are mostly referred in the period corresponding to more recent EIA reports mainly: construction compound location considering environmental issues and the study/analysis of alternatives.

Some environmental factors and impact indicators relatively to construction and operational stages were also selected. The frequency of environmental impacts on the analysed projects is presented on Table 4.

Table 4 - Frequency of environmental impacts on the analysed projects.

Stages	Environmental factor	Impact Indicator	Frequency
Construction stage	Soil / Land use	Soil exposition to erosion	3
		Classified REN areas affected	3
	Ecology	Destruction or damage of vegetation	3
		Habitat loss or damage	4
	Noise	Noise increase	4
		Road traffic increase	4
	Landscape and visual impacts	Presence of strange elements in landscape	4
		Change of landscape morphology	3
		Impact on landscape biophysical structure	3
		Visual disturbance	3
	Cultural heritage	Affectation of cultural heritage elements	2
	Socio-economic issues	Economic growth	3
		Employment opportunities	3
		Local profits / Local business increase	3
Road traffic/noise/dust emissions increase		3	
Operational stage	Ecology	Habitat reduction or disturbance	4
		Birds collision risk with turbines	3
		Impact on bats	2
	Noise	Noise increase	3
	Landscape and visual impacts	Impact on landscape biophysical structure	2
		Landscape damage / Visual intrusion	4
	Cultural heritage	Cultural heritage elements affectation	2
	Socio-economic issues	Reduction of the external dependence of energy	3
		Economic benefits with local communities	3
		Local profits	3
Life quality improvement in the long term		4	

■ – Positive Impact □ – Negative Impact

Adopted scale:

- 1 - Non existent environmental impact in any analyzed projects
- 2 - Existent environmental impact in <3 analyzed projects
- 3 - Existent environmental impact in ≥3 analyzed projects
- 4 - Existent environmental impact in all analyzed projects

It what concerns the environmental impact analysis, the mostly affected environmental factors identified in this review are: ecology and landscape (construction and operation stages), noise (construction stage) and socioeconomic issues (operational stage).

During construction, the most common impacts to all the reviewed EIA reports are: habitat loss or damage, noise and road traffic increase and presence of strange elements in landscape. In the operational stage these impacts are habitat reduction or disturbance, landscape damage / visual intrusion and life quality improvement in the long term.

Comparing both periods it is noted that some negative environmental impacts are referred fewer times in the second period: classified REN (National Ecological Reserve) areas affected (which can reveal a bigger concern with wind farms location), destruction or damage of vegetation and change of landscape morphology (all regarding construction phase); birds collision risk with turbines and noise increase (relative to operational phase). The reduction of reference to these impacts in the EIA reports of the second period is a positive aspect, indicating a bigger concern with wind farms location and a bigger awareness concerning

the impacts raised by this kind of undertaking. On the other side, some positive socioeconomic impacts occur in a bigger number in the second period, which could reveal more concern with this factor in the most recent processes.

According to the documented analysis, mitigation measures included in the Environmental Assessment Orientation Guide “Guia de Orientação para a Avaliação Ambiental” (Mendes *et al.*, 2002) are more frequently referred in the second period of EIA reports, which may reveal a positive influence of that guide on the EIA reports preparation.

The mitigation measures indicated by all analysed EIA reports are presented on Table 5.

Table 5 - Mitigation measures referred by all analysed EIA reports.

Project stage	Location of wind farms infrastructures regarding sensitive areas
	Preference to existing access tracks
	Underground installations of power cables
Construction stage	Establishment of limits to area of intervention
	Adequate removal and temporary deposit of excavation debris and wastes
	Wastes disposal in adequate local and conditions
	Recover of intervention areas

Some measures are only referred in the second period of EIA reports, such as: workers environmental information/sensibility and the guarantee of an efficient inspection during construction. The land signalling before opening access tracks and limitation with adequate borders, and the protection of especially sensitive areas are some of the mentioned measures referred more frequently in the newest EIA reports.

With respect to EIA report conclusions, the second period EIA reports indicate that conclusions have been gradually more complete and informative mainly in what concerns the project environmental impacts. The legal justification of EIA reports, the more favourable alternative explanation and the reference to cumulative and residual impacts are some of the aspects focused in large scale in the second period of EIA reports.

IV 2 Perception analysis of wind energy companies regarding EIA process.

▪ Selection of the sample for perception analysis

In order to analyse the perception of EIA users relatively to the EIA process applied to wind farms and his contribution in the quality improvement of wind farm projects, 18 wind energy companies were selected to answer a short questionnaire structured in 4 sections. The first section intended to obtain general data about the company; the second refers to legal requisites; the third concerns EIA of wind farms and the last intended to assess the contribution of EIA to the quality improvement of wind farm projects. The inquiry answer rate was 39%, which correspond to 7 responses received.

The 18 companies were selected based on internet research³ and consultation of the proponents of EIA reports of wind farms in Portugal⁴.

▪ Results

The mainly results obtained through this questionnaire will be presented in the following diagrams.

³ Internet page: <http://www.markelink.com/directorios/Amb2007/titulos/4.200.htm>

⁴ Data available in Internet page: http://www.iambiente.pt/IPAMB_DPP/historico/index.asp

The majority of the companies inquired consider the EIA process efficient (72%) however, the long duration process is pointed as its main problem. Process duration and communication between all agents are referred as aspects to improve regarding EIA process.

Companies were requested to select the project aspects that can be improved with EIA. Access tracks definition, consideration of alternatives, landscape integration of wind farm infrastructures, waste management and landscape recovery were the most selected project aspects that can be improved with EIA (Fig. 1).

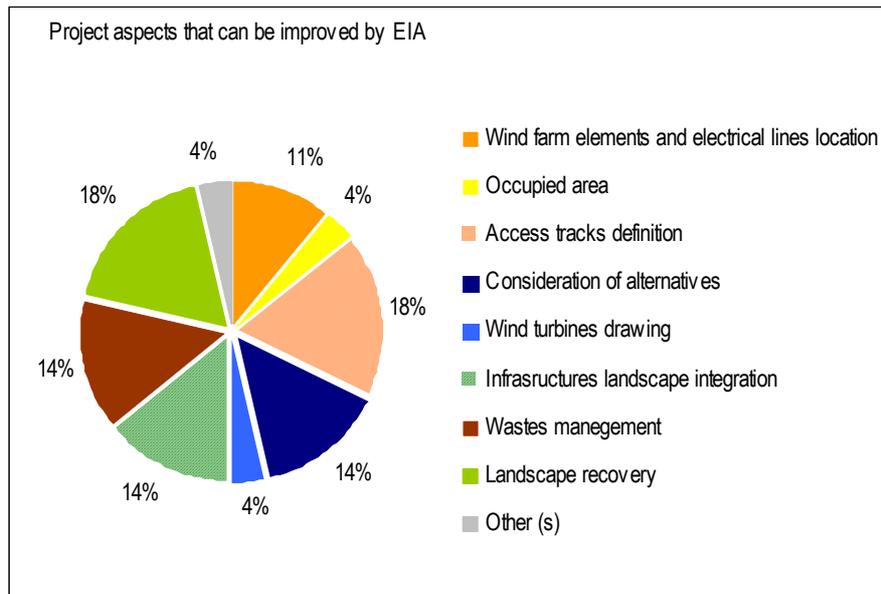


Fig. 1 - Project aspects that can be improved with EIA

Regarding environmental aspects usually considered in a wind energy project, flora and vegetation, fauna and cultural heritage, as well as land planning and noise were the most selected ones (Fig. 2).

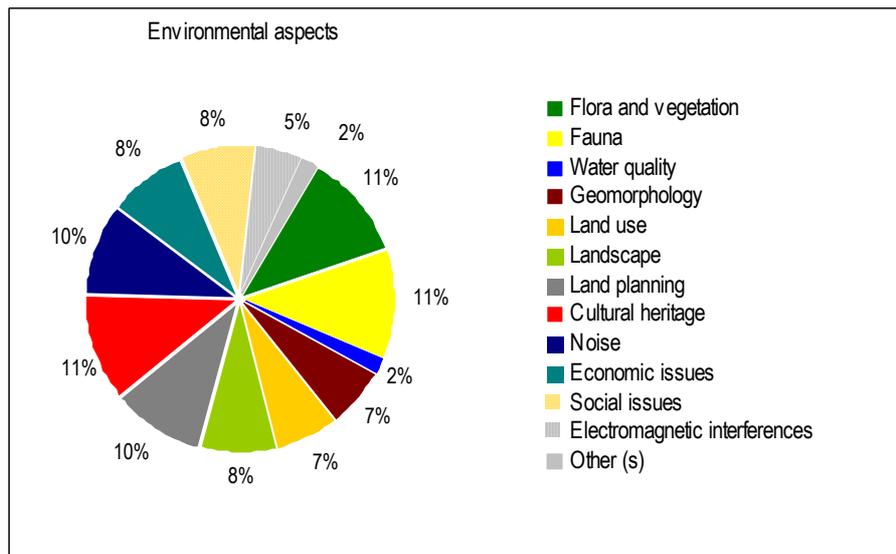


Fig. 2 - Environmental issues to be considered in a wind farm project

On the subject of mitigation measures, the ones usually adopted and most referred includes: waste disposal, definition of environmental restrictions and access plan, sensitive protection areas and environmental rehabilitation (Fig. 3).

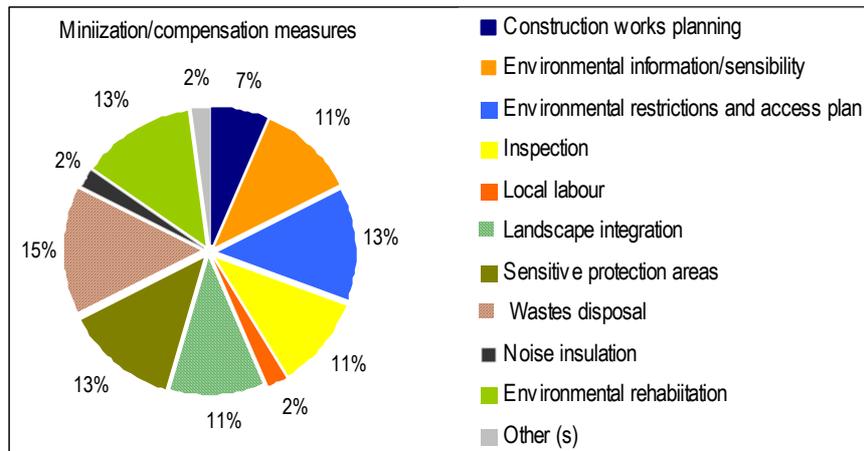


Fig. 3 - Mitigation measures usually adopted

According to inquired companies, the monitoring plans generally adopted are relative to fauna; flora, vegetation and habitat; and noise (Fig. 4). Another plan usually adopted is the environmental management and rehabilitation plan of affected areas.

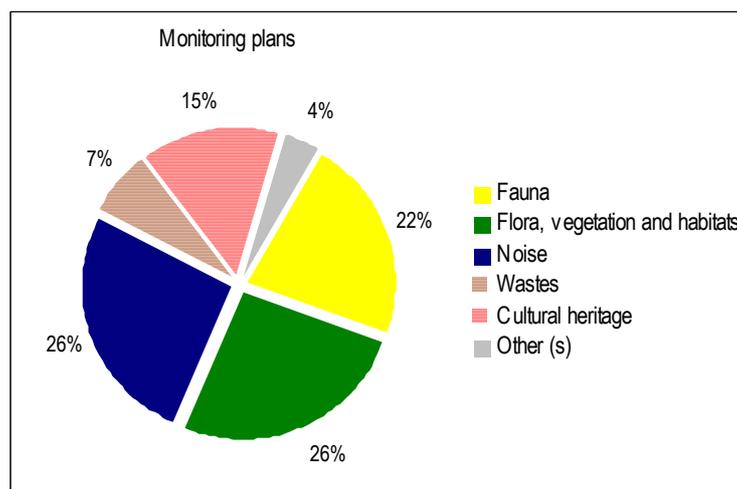


Fig. 4 - Monitoring plans generally adopted

- EIA contribution

According to the questionnaire results, contribution of EIA concerning technological improvements and certification against formal standards is reduced. EIA process seems to contribute to penalise projects regarding their location, however, one company recognises the EIA role on making wind farm projects and natural values more compatible.

Regarding risk analysis, the answers are very diverse and do not allow any conclusion relatively to the EIA contribution on this issue. One of the inquired companies refers EIA role in order to help the promoter consider critical environmental factors and predict the economic impact of compensatory measures or even the non viability of the project.

With respect to Environmental Management Systems (EMS), the answers are favourable or at least satisfactory, referring that the EIA process can positively contribute to the EMS adoption for this kind of projects.

The EIA long duration and the difficulty in establishing a balanced position between the promoter's interests and environmental interests are mentioned as the main difficulties resulting from EIA application, according to the inquired companies.

V Conclusions

This investigation intended to contribute to the assessment of whether EIA contributes to quality improvement of wind farm projects. In order to achieve this purpose it tried to identify the main project aspects which were more influenced by EIA, through the analysis of the content of EIA reports of wind farms and the perception of wind energy companies concerning the EIA process and its contribution in quality improvement of wind farm projects.

Results of this review indicate that more recent EIA reports generally analyze a larger number of project aspects than the old ones. Some negative environmental impacts are more frequent in old EIA, not occurring so frequently in the newest EIA reports, which can be a reflection of a bigger concern regarding wind farm installations location and a higher knowledge relatively to its environmental impacts. It also verifies a positive influence of the "Guia de Orientação para a Avaliação Ambiental" (Mendes *et al.*, 2002) on the newest EIA reports on the topic of mitigation measures.

Regarding the informative character of the EIA report conclusions it seems to be more informative assuming a higher utility to the decision maker.

Perception analysis of companies that are promoters of wind farms reveals that they have different perceptions regarding EIA contribution in the quality improvement of the projects.

According to responses obtained, EIA process is usually considered efficient; however, it has some problems concerning mainly its long duration. Wind energy companies seem to notice that various aspects of the projects can be improved with EIA process, nevertheless they don't seem to demonstrate having perception of EIA contribution to the quality improvement of the projects.

Besides the large number of points of view concerning this issue, EMS adoption in wind farms seems to be the aspect that joins more consensus on the topic of EIA contribution to the quality improvement of wind farm projects.

In order to turn economic and environmental interests compatible an effective collaboration between promoters and EIA authors and a bigger articulation between promoter's interests and EIA interests allowing a faster and more efficient process is needed.

It is though considered essential that promoters are aware of the effective need of considering environmental issues in the construction and development of wind power installations, and that EIA can contribute to the quality improvement of projects through the presentation of evidence of that improvement.

The promotion of explanations regarding the environmental impacts of wind farms and the mitigation measures to be adopted may lead to a bigger acceptance of EIA process and to a more responsible attitude from wind farms promoters. An update of the Environmental Assessment Orientation Guide "Guia de Orientação para a Avaliação Ambiental" (Mendes *et al.*, 2002) based on the currently existing knowledge, on more recent studies and international examples concerning wind power production and on the respective EIA would also be interesting to include and provide an orientated and informative character.

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