IIIEE Master's Theses 2002:5

Guidelines for environmental due diligence of renewable technology investments

Gloria Argueta Raushill

the international institute for
industrial environmental economics
Lund University, Sweden

Lund University, Box 196, 221 00 Lund, Sweden. Telephone: +46 46 222 0200 Fax: +46 46 222 0210 Web: www.iiiee.org

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Guidelines for environmental due diligence of renewable energy technology investments

Gloria Argueta Raushill

Supervisors:

Jaakko Kuisma

Tareq Emtairah

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Gloria Argueta Raushill

Malmö, September 18, 2002

Abstract

This thesis is set in the context of project financing for renewable energy technologies (RETs). The research looks closely at the environmental review procedures of financial institutions, focusing on the practice of environmental due diligence. This practice originally emerged as an approach used by lenders or investors to manage environmental risks and liabilities stemming from an investment decision, and has lately evolved as a way for financial institutions to incorporate environmental and social considerations in their investment review process.

Although it has become increasingly popular, especially in developed countries, there is some way to go before environmental due diligence (EDD) is commonly regarded as 'business as usual'. This is particularly true for RET projects, which are still for the most part a relatively minor or new element of the business activity of financial institutions.

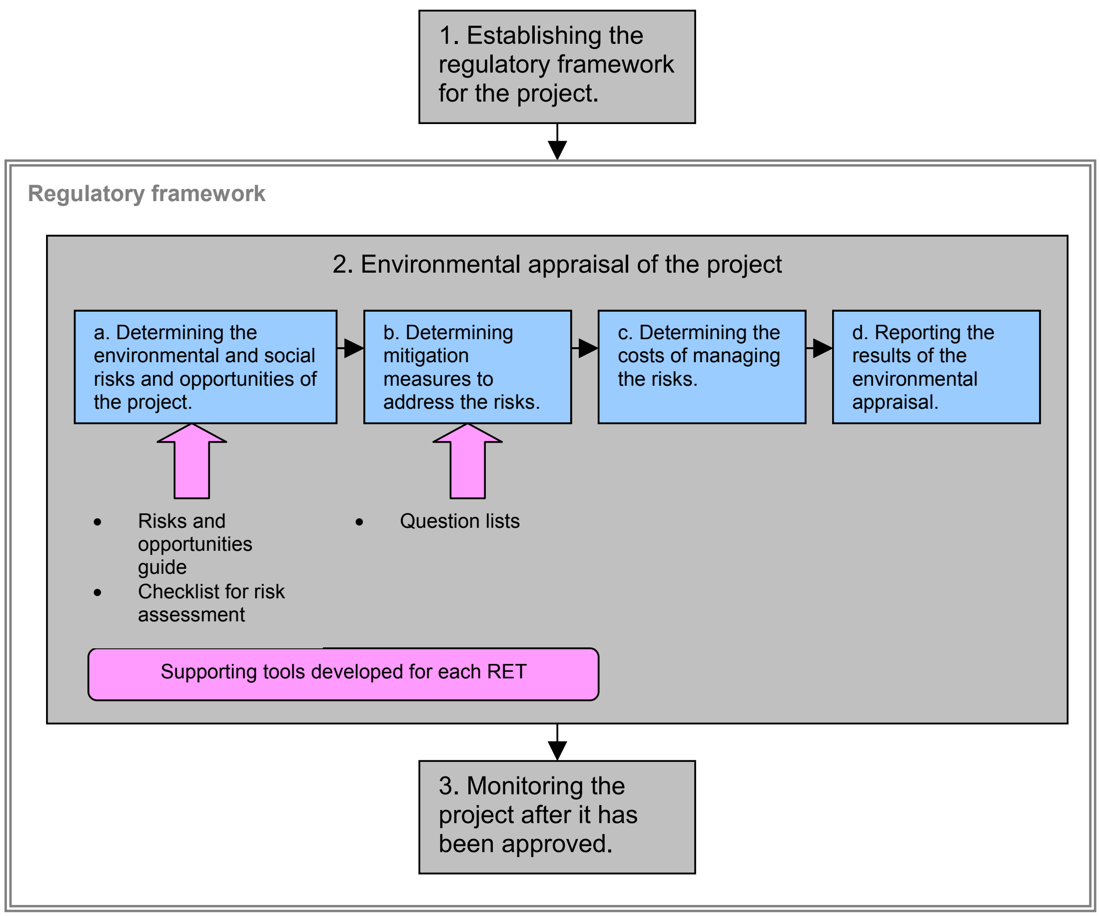
The thesis describes and analyses the current environmental review procedures followed by a number of financial institutions, and discusses possible drivers and barriers to the use of environmental due diligence procedures for RET investments. This analysis provides background information for developing an environmental due diligence procedure for RET investments, which may be followed by financial institutions when considering these type of projects. The procedure is exemplified for two different RETs: the thesis presents preliminary guidelines for energy crop technologies, which are one of the possible biomass energy conversion systems, and for wind energy technologies.

Executive Summary

This thesis is set in the context of RET project financing. The research looks closely at the environmental review procedures of financial institutions, focusing on the practice of environmental due diligence. This practice originally emerged as an approach used by lenders or investors to manage environmental risks and liabilities stemming from an investment decision, and has lately evolved as a way for financial institutions to incorporate environmental and social considerations in their investment review process.

Although it has become increasingly popular, especially in developed countries, there is some way to go before environmental due diligence (EDD) is commonly regarded as 'business as usual'. This is particularly true for RET projects. There is evidence suggesting that the review of renewable energy projects is still not a common activity for financial institutions and that there is a paucity of tools and procedures that could facilitate this process. Therefore, the overall purpose of the research was to develop guidelines for environmental due diligence, which may eventually be used by financial institutions when considering RET investments.

The preliminary EDD procedure presented in the document follows three stages, which are schematised in the following figure.



This procedure is exemplified for two different RETs: energy crop technologies, which are one of the possible biomass energy conversion systems, and wind energy technologies.

A number of steps were followed to provide the background information for developing the guidelines. First, it was necessary to review the environmental issues associated with the two RETs focused in the thesis. This review gives the overall topic of the guidelines. The second step was to look at the environmental review procedures of financial institutions. A total of nine financial institutions were contacted for this part of the work and their environmental review procedures were described and analyzed. An important element of the analytical work was to identify and discuss possible drivers and barriers to the use of environmental due diligence procedures for RET investments. This discussion was meant to provide a wider perspective of the practice of EDD, which had until this part focused mainly on the internal workings of financial institutions. The overall analysis of environmental review procedures provides information important for the design of the guidelines. The last step was to incorporate the information on environmental issues of RETs and environmental review procedures of financial institutions in order to produce the guidelines.

The analysis of environmental review procedures afforded valuable insights into some of factors that increase the potential for added value of the overall EDD procedure. These are basically four: the quality of the review; the use made by the financial institution of the information collected during the environmental review process; the way in which the institution follows up and monitors a project once it has been approved; and finally, the degree to which the EDD procedure reflects the financial institution's environmental and social policies. Although all of these factors are important, it is perhaps the latter that has the most potential for enhancing the added value of an environmental review procedure. If the EDD reflects the environmental and social commitment of a financial institution then there is a greater opportunity for incorporating ethical and social considerations that are unlikely to be contemplated in legislations, and for ensuring that high standards are followed no matter the status of environmental legislation, or its enforcement, in the country or region where a project is to be implemented.

From the research it was also possible to identify several difficulties that should be overcome in order to promote the use of a standard environmental due diligence guidelines for RET investments. Some of the difficulties were related to the differing outlooks of lenders and equity providers, which basically means that the objectives of their environmental due diligence procedures are different. Other difficulties were posed by the nature of renewable energy technologies. Since the environmental impacts that may be associated to a particular RET project are so dependant on the scale of the project and on site-specific characteristics, environmental issues relevant for one project may not be important or applicable to others. How to account for this in a general guideline is a difficult issue, especially if it is meant to provide a way for facilitating the process of reviewing RET investments. If the guideline is too detailed, it may discourage its implementation, but if it is too general, it may fail to point out critical environmental issues related to a RET project. Therefore, one of the most important issues in designing, developing and testing the guidelines will be to find a good medium point between these two possible extremes.

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1. Introduction

For many years the environmental community has advocated renewable energy sources as sustainable alternatives to fossil fuel based systems that have come to dominate the global energy sector. For instance, future scenarios for energy sustainability count on a much more widespread use of renewable energy technologies (RETs) to satisfy the demand for energy services in coming decades.[1] Yet in spite of this support, RETs have not managed to fulfil the expectations of increased contribution to global energy supply. At the end of the 20th century, renewable sources accounted for approximately 14% of the world primary energy consumption, against 80% supplied by fossil fuel sources. Excluding large hydro sources and traditional biomass, the percentage contributed by the so-called 'new renewables' accounted for barely 2.2% of world primary consumption.[2]

It is difficult to generalise about RETs. Indeed, assessing the economic, environmental, and social viability of the different technologies classified under this category (including biomass, geothermal, hydroelectric, solar and wind) is very much a case-by-case undertaking: different technologies are at different stages of development and are suitable for different locations and applications. Moreover, the viability of different RETs depends on relative costs and availabilities of alternative fuel sources, and these of course are location dependent. Nevertheless, a few common points may be raised. Once, significant technological breakthroughs have made the commercialisation of RETs ever more clear and present, e.g. by bringing down the unit costs of such technologies. Two, the production of renewable energy has the potential to provide economic development and employment opportunities, especially in rural areas that otherwise have few opportunities for economic development. Three, constraints and barriers to the extensive use of RETs abound. Regulatory obstacles, environmental concerns, and the changing rules and conditions taking place in the energy sector due to privatisation, restructuring and liberalisation, are but a few of the potential barriers discussed in related literature.

Without discounting the importance of the problems that were mentioned in the preceding paragraph, this document will focus on a constraint that has been widely acknowledged as the most significant challenge faced by RET projects: that of overcoming financial constraints. While a substantive amount of academic studies have been dedicated to the technical, policy and market barriers to RET development, financial barriers have received comparatively little attention.

The following background section is divided in three parts. The first gives a closer look at the subject of RET project finance. The second part then focuses on an area within this subject that is often underplayed: that of looking at ways to ensure the environmental soundness of RET projects. The third background section introduces the main theoretical concepts of this project.

1.1 Background

1.1.1 RET project financing: The role of the financial sector

As stated previously, financial constraints have been widely regarded as the main problems facing RET project development. For instance, the United Nations Development Programme, in its World Energy Assessment (2000), stated that the greatest challenge to RETs is financial.[3] Indeed, in the short to

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[1] United Nations Development Program (UNDP).(2000). *World energy assessment: Energy and the challenge of sustainability.* New York: UNDP. pp. 18-26

[2] UNDP. (2000). *World energy assessment. Table 1: World primary energy consumption, 1998.* p. 6

[3] UNDP. (2000). *World energy assessment.* p. 14

medium term, RETs are projected to have financial life cycle costs that will generally exceed those of conventional alternatives.[4]

Many changes are required if this projection is to be altered in favour of RETs. For instance, pricing policies should internalise the externalities of energy production with conventional technologies and/or remove subsidies that artificially reduce the price of fossil fuels. These changes highlight the importance of a suitable policy framework if RETs are to compete successfully in the short to medium term. However, the actions of the financial sector are no less important if RETs are to overcome financial constraints in the same time period. This importance is more clearly understood when it is considered that the reality in many countries is that governmental expenditure is decreasing while the private sector is becoming progressively entrusted with achieving public sector policies, and international investment, particularly from private sources, is appearing as an ever more important and influential presence especially in developing countries.[5]

If the conditions mentioned in the previous paragraph are increasingly depictive of reality, what are then the prospects for project financing of RETs? The answer to this question is not an easy one, and there are many dimensions and perspectives to be taken in account. Without intending an in-depth analysis of this issue, some of the discussions found in specialist literature will be briefly presented.[6]

On one hand, it has been argued that traditional practices of financial institutions routinely "encourage short term goals, undervalue environmental resources, discount the future, and favour accounting and reporting systems that do not reflect environmental risks and opportunities"[7]. Although once again generalizations are difficult, it can be argued that investments in sustainable development by their very nature are at conflict with these practices: As sustainable development is concerned with the importance of the future, investments may require long-payback times and may reduce present earnings in favour of future potentials.

In the particular case of RETs, problems to obtain finance arise because many renewable energy systems are capital intensive and require larger upfront investments and longer repayment periods than conventional technologies. The associated risk of RETs can be also an investment deterrent, since renewable energy projects generally present high resource and technology risks. Another issue is the fact that due to technical constraints, RETs are usually small-scale ventures. This characteristic may play unfavourably in several respects. First, small-scale implies low gross returns in absolute terms, even if the rate of return of the investment may be attractive in relative terms. Second, financial institutions may also favour large-scale projects either because these usually have lower transaction costs in relative terms than small-scale projects or simply because larger-scale projects may be better equipped to comply with their lending standards (for example, the IFC requires project developers to have sound credit and to have done extensive project preparation, obligations that may not be feasible for small and medium sized RET enterprises in developing countries). Another factor to be considered is that lending institutions have generally little experience in evaluating applications that have an RET component. Thus, RET projects may be evaluated on the basis of the structure and financing element

[4] Piscitello, Scott, Bogach, Susan. (1997). *Financial incentives for renewable energy development*. World Bank discussion paper No. 391. p. 3

[5] Forsyth, Tim (1999). *International investment and climate change: Energy technologies for developing countries*. London: The Royal Institute of International Affairs. pp. 3-9

[6] Unless otherwise noted, the main sources for the following paragraph are: Wohlgemuth, Norbert. (2001). *Directing investment to cleaner energy technologies: The role of financial institutions*. pp. 401-411, and Stuart Hodes, Glenn. (2001). *Sustainable finance for sustainable energy: The role of financial intermediaries*. pp. 412-420. In Jan Jaap Bouma, Marcel Jeucken, & Leon Klinkers.(2001). *Sustainable banking: The greening of finance*. Sheffield: Greenleaf Publishing.

[7] Schmidheiny, Stephan, Zorraquín, Federico J. L (1996). *Financing change: The financial community, eco-efficiency, and sustainable development*. Cambridge: Massachusetts Institute of Technology. p. 4

criteria that has been traditionally applied to conventional energy projects, such as thermal energy investments, as ill-suited as these may be.

On the other hand, various schemes have been devised throughout the years with the specific objective of promoting RET project development. Accordingly, it is possible to refer to the activities of such multilateral development institutions as the World Bank and the Inter American Development Bank, of multilateral organizations such as the United Nations, and of governmental institutions such as the United States Agency for International Development, institutions that have for many years considered renewable energy an official priority of international aid.

Development assistance efforts have been criticised on many respects, e.g. for lacking coordination, or failing to 'learn' from past experiences, but specially for concentrating on the dissemination of highly subsidized technologies (often entailing the purchase of equipment and other services from the donor country) rather than on the development of a market infrastructure and adequate human and managerial skills in the recipient country, without which the investments fail to become commercially viable and succeed in the long term. New initiatives, however, seem to have taken into account these criticisms and made a conscious effort to improve and modernize past attempts. [8] Examples of new initiatives include several schemes developed by the International Finance Corporation (IFC), the private sector division of the World Bank. One is the Renewable Energy and Energy Efficiency Fund (REEF), which offers debt and equity finance to investors in renewable energy, stipulating that 20 to 30% of lending should be for off-grid technology, in order to provide more opportunities for small entrepreneurs than previous schemes had afforded.[9] Another example is the RET/EE Investment Advisory Service, a UNEP initiative using Global Environmental Facility (GEF) funds, whose objective is to help financial institutions in the due diligence process for RET and energy efficient (EE) investments, making it more likely for these kinds of projects to go forward.[10]

While the examples mentioned above provide a more positive image of the ability of development assistance institutions to face the challenge of helping RETs overcome financial constraints, it must still be noted that in the past years official development assistance flows have continuously fallen in real terms, a trend that is expected to continue in the future.[11] This implies that the issue of finding adequate incentives to promote private sector investment in RETs is vital. In this sense, the potential of the Kyoto mechanisms, particularly the Joint Implementation and the Clean Development Mechanism, to provide just such incentives has been discussed and studied in specialist literature.[12] Other recent developments that may offer incentives for private sector investment in RETs are the appearance of 'green' products on the financial market, such as Socially Responsible Investments and ethical funds, and the growing influence of institutions such as Sustainable Asset Management (SAM), which specialize in providing what they have termed as 'sustainability driven investments'. Although these sustainability driven products and institutions may be construed as examples of the emergence of more sustainable financial practices, and therefore as potentially positive developments for RETs, their presence in the financial community is still marginal.

As mentioned before, drawing conclusions from the information provided up to this point is not an easy task. Admittedly, assessing the real prospects of RET project financing in the short to medium term is problematic to say the least, as positive considerations appear in direct juxtaposition to negative

[8] Martinot, Eric. (2001). *Renewable energy investment by the World Bank*. Energy Policy 29, pp.691-696

[9] Forsyth, Tim. (1999). *International investment and climate change*. pp. 64-66

[10] Wohlgemuth, Norbert. (2001). *Directing investment to cleaner energy technologies*. In Jan Jaap Bouma et al. (2001). *Sustainable banking*. pp.406-408

[11] Schmidheiny, Stephan, et al. (1996). *Financing change*. p. 6

[12] For an analysis of the potential of these mechanisms see, Forsyth, Tim. (1999). *International investment and climate change*. pp. 33-42, 232-249

ones, and little consensus exists as to which of these will ultimately carry more weight. However, recent studies have noted an increasing awareness that successful RET deployment requires governments, financial institutions and RET entrepreneurs to act in mutually reinforcing ways by coordinating and integrating their respective policies and objectives and giving due consideration to local market conditions.[13] While this realisation appears quite obvious, and in itself does not provide explicit solutions to the problem of providing adequate investment for RET initiatives, it is arguably a step in the right direction in the measure that past efforts to RET deployment have seemingly overlooked its importance.

1.1.2 Ensuring the environmental soundness of RET projects

Taking together the revived interest in RETs generated by the widely publicised debates surrounding the UN Framework Convention on Climate Change and the Kyoto Protocol and its mechanisms, and the rising awareness of the factors needed to successfully overcome financial constraints to RET development, it can be argued that current and future prospects for RET investment appear more favourable than in the past. But, can it also be argued that the result of increased investment in RETs will be environmentally friendly energy systems? Perhaps surprisingly, the answer to this question is "it depends". For one thing, investing in RETs does not guarantee the completion or success of the projects any more than it guarantees a continuance of efforts in RET deployment. This is a fairly evident reflection, and has been illustrated by the experience of official development agencies such as the World Bank, which in spite of having devoted considerable resources since the early 1990's to promote RET investment, by the year 2000 had still relatively little on the ground to show for this effort.[14]

A second reflection relates to the environmental issues associated with renewable energy technologies, which include deforestation, land use requirements, disposal of hazardous materials, visual impacts, and disruption of ecological and hydrological integrity. Because of the physical nature of RETs, these impacts are associated to the scale of deployment (i.e. the bigger the scale of a particular project, the larger its potential impact). Another point to take in account from an environmental perspective is the diffuse nature of renewable sources. The greater the diffuseness of an energy source, the greater the material requirements of the conversion process per unit of electricity produced, and the greater the energy inputs required to build and maintain the energy conversion system.[15] To give an idea of the problems that may be caused, the following table lists of some of the possible environmental impacts associated to different RETs. This subject is developed in Chapter 3 in more detail.

Table 1: Possible environmental issues of renewable energy systems

Technology	**Possible environmental issues**
Biomass	Use of pesticides and fertilizers, significant land use, atmospheric emissions during conversion, smell
Hydroelectric	Disruption of ecological and hydrological integrity of a the region, water pollution
Geothermal	Noise, gaseous emissions, water pollution, ground subsidence, smell

13 See for instance, Martinot, Eric. (2001). *Renewable energy investment by the World Bank*. Energy Policy 29, pp.689-699, and Stuart Hodes, Glenn. (2001). *Sustainable finance for sustainable energy*. In Jan Jaap Bouma et al.(2001). *Sustainable banking*. pp. 412-420

14 Martinot, Eric. (2001). *Renewable energy investment by the World Bank*. Energy Policy 29, p.697

15 Jackson, Tim. (1993). *Renewable energy: Prospects for implementation*. Dorchester, UK: Stockholm Environment Institute. pp. 258-259

Solar	Land-use requirements, solvents use during cell manufacture, toxic materials hazards during production and disposal (PV)
Wind	Land-use requirements, visual impact, electromagnetic interference, noise

While the potential for environmental impacts do exist, the implicit assumption that is often made concerning RETs is that, if not actually benign, they are at least environmentally preferable to conventional sources. There are indeed sound arguments justifying this assumption. For instance, renewable energy sources are credited with having the potential to provide energy services with little or no emissions of air pollutants, a significant benefit considering that the burning of fossil fuels has been identified as the single most important anthropogenic source of greenhouse gas emissions, particularly of CO_2.[16] Consequently, the environmental impacts of RETs are often underestimated or neglected. That doing so may cause environmental problems, whose seriousness will of course depend on the specific conditions of a particular project, is a conclusion that intuitively follows. As Jackson (1993) put it:

"The principal colours of renewable energy are environmental. Without the supposed environmental advantages of the renewables, the case crumbles dramatically. For the long-term security of the environment it is therefore imperative that the case is water tight. "[17]

It may be argued that in the years since this assessment was made the developmental benefits of RET projects have emerged as their principal 'colours', but the point is still a valid one: If protecting the environment is one of the expected advantages of RET projects, then looking at ways to ensure their environmental soundness is crucial. This is the main theme of the research project. The following section develops this theme and provides the specific theoretical context of the research.

1.1.3 Environmental due diligence

The previous section argued in favour of ensuring the environmental soundness of RET projects rather than taking it at face value. This poses a practical role for the different actors involved in the implementation of an RET project. The main actors that have been mentioned previously in this document are governments, financial institutions and RET entrepreneurs. Governments, for example, provide the regulatory framework that must be complied by the enterprises wishing to operate in a particular country and are thus responsible for making environmental legislation as comprehensive as possible and for enforcing this legislation. RET entrepreneurs are responsible for designing, building and operating the project in an environmentally conscientious way. While these roles are very important, this thesis will focus on the part that financial institutions play in ensuring the environmental soundness of RET projects.

First, what can be the incentives for financial institutions to include environmental considerations in their investment decisions? According to Jeucken and Bouma (2001) the answer to this question is related to the growing awareness in the financial sector that the environment presents both risks and opportunities. On the risk side, the United States banking sector experienced an enormous growth of concern since the late 1980's, when under the CERCLA act[18] they became liable for the environmental pollution of their borrowers and could be forced to pay remediation costs. Thus, they became the first to incorporate environmental policies in their investment decisions, particularly regarding credit risks. On the opportunity side, European banks began to consider environmental policies in the mid-1990's, although here the focus was less on risk assessment and more on the development of new products,

[16] UNDP.(2000). *World energy assessment*. p. 6

[17] Jackson, Tim. (1993). *Renewable energy: Prospects for implementation.* p. 262

[18] CERCLA stands for Comprehensive Environmental Response, Compensation and Liability. This act was initiated in the U.S. in 1980.

such as environmentally friendly investment funds, that had the potential to provide them with competitive advantages. Today, as explained by Jeucken and Bouma, empirical evidence suggests that both environmental risk management and the development and offer of environmentally friendly products are becoming established elements of the environmental activities of banks, not only in the United States and Europe, but also in Asia, South America and Eastern Europe through the influence of environmental standards from multilateral development banks. [19]

Thus, as seen before, risk management has been an important incentive for financial institutions to consider environmental aspects in their investment review procedures. Banks have put in place a number of instruments for the purpose of risk management. One of these instruments is commonly termed a due diligence review. This term, as well as its practice, originates from the United States of America, and in general terms refers to the background work (investigation, analysis, and verification) done by a prudent entrepreneur, owner, executive, or lender when making a decision. The general intention of a due diligence review is to ensure that a projected investment does not carry financial, legal or environmental liabilities beyond those that are clearly defined in an investment proposal.[20] The environmental component of the due diligence procedure is referred to as environmental due diligence (EDD), and will be the review element on which this thesis will concentrate. Chapter 4 of the thesis develops the subjects of environmental risk management and EDD in more detail.

For many transactions EDD has become largely standardized, a factor that has been attributed as contributing to its growing popularity.[21] However, standardised EDD procedures are not available for all sectors, as will be seen in the following section.

1.2 Research partner

In the mid 1990's the United Nations Energy Programme (UNEP) partnered with the World Bank for the preparation of the Pollution Prevention and Abatement Handbook (PPAH). From the time of its official implementation in 1998 the handbook has been widely used by financial institutions as a global standard for ensuring the environmental soundness of projects in the different sectors included in its pages. [22] The RET sector was not covered in the PPAH, and the UNEP has since identified a paucity of EDD standardized procedures for the RET sector.

Consequently, the UNEP suggested and sponsored a six month research project to develop EDD guidelines for different RET technologies. This thesis will document the results of the first four months of the project.

1.3 Research purpose

The overall purpose of this thesis is to determine possible drivers and barriers to the use of EDD for RET investments, and use this information to fill the gap identified by the UNEP by proposing a set of EDD guidelines for each RET technology that may be used by financial institutions when considering these types of investments. The following section details the specific research questions and objectives that need to be addressed for the successful accomplishment of this purpose.

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[19] Jeucken, Marcel, Bouma, Jan Jaap. (2001). *The changing environment of banks*. In Jan Jaap Bouma et al.(2001). *Sustainable banking*. p. 24

[20] Corino, Carsten. (2000). Environmental due diligence. *European Environmental Law Review, 9, 4*. p 120

[21] N.A. (1996) Banks are expanding environmental due diligence activities. *Fairfield County Business Journal, 35, 17,* pp.7

[22] World Bank Pollution Prevention and Abatement Handbook. (1998). [Online]. Available: http://wbln0018.worldbank.org/essd/essd.nsf/DOCS/PPAH [July 28, 2002]

1.4 Research questions and objectives

The main research question for this thesis is the following:

- **What are possible drivers and barriers to the use of EDD for renewable energy investment projects?**

Secondary research questions, which correspond to the analysis of the EDD procedures, are:

- Are the environmental review procedures different depending on the type of institution (e.g. is the review procedure carried out by the World Bank different than that of a private bank)? If there are differences, how do they diverge? How do they converge?

- What aspects are considered in these review procedures?

- Are these procedures useful for ensuring the environmental soundness of renewable energy investments?

In order to answer these questions, the following research objectives have been determined:

a. To review the environmental issues associated with RETs.

b. To describe the environmental review procedures currently used by financial institutions when considering renewable energy investments.

c. To analyse current procedures, and the drivers and barriers to EDD use for RET investments.

d. To recommend a set of environmental due diligence guidelines for each RET.

The logical framework developed to accomplish the purpose and objectives of the project is developed in Chapter 2.

1.5 Scope

This thesis project touches two broad sectors of human activity: the energy sector and the financial sector. The specific areas of interest within these broad sectors are renewable energy technologies and financial institutions, respectively. Further refinements of this preliminary scope are presented below.

- Renewable energy technologies: There are six main renewable energy sources: biomass energy, wind energy, direct use of solar energy, small-scale hydropower, marine energy, and geothermal energy. Of the six, this thesis document will focus on biomass energy and wind energy technologies for the development of preliminary EDD guidelines. The specific technologies within these two categories that are followed through in the thesis are presented in Chapter 3. After the thesis deadline, the research project will continue with different biomass technologies (energy production with agricultural and forestry residues, and biogas), geothermal energy and solar energy technologies.

- Financial institutions: Since the research context of the thesis is RET project financing, only those financial institutions that perform project financing, either through lending or through equity capital, are addressed. This would include multilateral development agencies, private equity investors, and commercial banks.

1.6 Reader's guide

The following diagram illustrates the structure of the thesis document, providing a brief description of every thesis chapter, and of its aim. The purpose of the diagram is to provide a visual outline of the document that makes it easier for the reader to understand how the structure of the document corresponds to the research purpose, questions and objectives presented in the previous sections. In addition, each of the following chapters contains further details about its construction and development.

Chapter	Aim
Chapter 1: *Introduction*. This chapter presents the background and research parameters.	Provide basic information about the thesis work, and introduce the context and theory of the research.
Chapter 2: *Methodology*. This chapter presents the research design, approach and limitations.	Illustrate the logical framework of the thesis, describe the approach used for each research objective, and specify limitations of the research approach.
Chapter 3: *Environmental issues of RETs*. This chapter corresponds to objective a) of section 1.3.	Provide a review of the environmental issues associated with each RET according to a life-cycle perspective.
Chapter 4: *Environmental review procedures for RET projects*. This chapter corresponds to objectives b) and c) of section 1.3, and answers the secondary research questions.	Provide background of EDD, and describe and analyse current environmental review practices of selected financial institutions.
Chapter 5: *Drivers and barriers to EDD use for RET investments*. This chapter answers the key research question.	Identify and discuss possible drivers and barriers to the use of EDD for RET investments.
Chapter 6: *Guidelines for EDD of RET Investments*. This chapter corresponds to objective d) of section 1.3, and is the overall purpose of the research work.	Propose preliminary guidelines for EDD of each RET addressed in the thesis work.
Chapter 7: *Conclusions and recommendations*.	Provide conclusions and recommendations for the thesis work.

Figure 1: Reader's guide to the thesis document

2. Methodology

This research is an exploratory study that follows a qualitative approach. This approach is suitable because the project seeks to describe the environmental due diligence process of financial institutions, which is a relatively new business practice where little formal study has been undertaken, particularly concerning the practice in relation to RET investments. Therefore, a quantitative analysis was difficult because not much statistical data exists about this subject and the time available for the research project constrained the possibility of conducting a survey with a sample population that would be sufficiently representative to extrapolate results in a quantitative manner. In addition, the project seeks to identify the opinions and perceptions of individuals in relation to the barriers and drivers for EDD use, an objective that can also be determined through qualitative research.

The following two sections detail the way in which the research was designed in order to carry out the research purpose and objectives of the work, and explain the approach that was followed for each objective. The final section discusses some of the limitations of the research methodology and approach followed for this work.

2.1 Research design

To accomplish the research purpose, the first step was to devise a logical framework that could be used as a research plan and as a way to structure the thesis work. This framework is illustrated in the following figure.

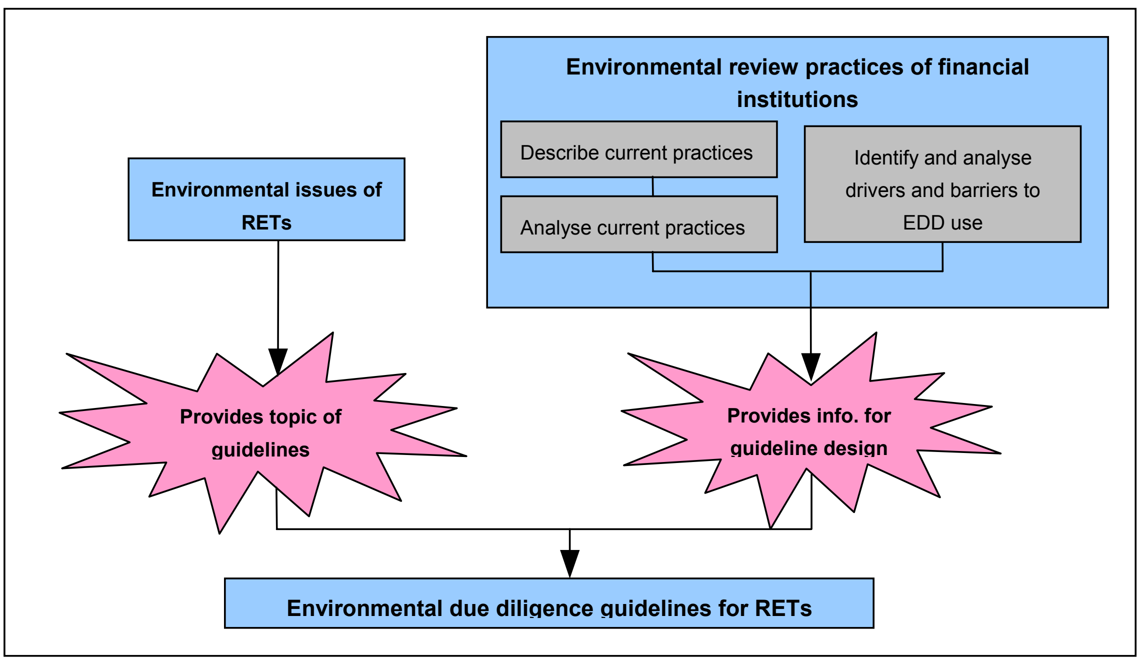

Figure 2: Logical framework of the research project

As shown in the figure, in order to develop environmental due diligence guidelines for each RET, there were two separate subjects that needed to be researched:

- Environmental issues of RETs: The intention of the guidelines are to provide a tool that will facilitate the process of environmental due diligence for RET investments and ensure that the main environmental issues of RETs are covered in an investment proposal and taken into account in the investment decision process. Therefore, reviewing the environmental issues associated with each RET provides the topic of the guidelines.

- Environmental review practices of financial institutions: As mentioned previously, the expected users of the guidelines are financial institutions interested in reviewing RET projects. Therefore, it is important to ensure that the guidelines are presented in a language and format that will be well accepted and understood by the expected audience. In order to do so, it was necessary to examine the current environmental review practices followed by financial institutions, particularly concerning their EDD procedures. The description and analysis of these procedures, as well as the identification of possible drivers and barriers to the use of EDD for RET projects, provide information necessary for the design of the guidelines.

Once the logical framework and structure of the thesis had been decided, it was necessary to determine the approach that would be followed in order to carry out the objectives that had been set for the thesis. This approach is explained in the following section.

2.2 Research approach

The research approach for each of the objectives identified for the thesis is outlined in the following paragraphs.

a. Review of environmental issues associated with RETs: The research approach for this part of the work is based on a literature review of the environmental impacts of each technology. A number of sources were therefore examined in order to identify the recurring issues discussed in specialist literature, and use the descriptions of their possible impacts to estimate their relevance in environmental terms. In order to facilitate a systematic comparison of sources, the discussed issues were classified according to the life cycle stage of the technology in which they are likely to occur. This information was then summarized in a table to facilitate its use in later stages of the research. A second stage of analysis would be to determine which of the impacts had been addressed in environmental legislation, since an environmental due diligence procedure must be grounded on these. However, due to the fact that ultimately the legislative compliance of a particular investment project needs to be determined on a case-by-case basis, this analysis is only intended for illustrative purposes.

The information sources for this part were mainly specialist literature on renewable energy technologies, and Internet sources, particularly the homepages of energy agencies, renewable energy associations and equipment manufacturers. The discussion on environmental legislation is also primarily based on a literature review of secondary sources.

b. Description of current procedures used by financial institutions when reviewing renewable energy investments. As mentioned previously, there are currently no standardized environmental due diligence guidelines for the review of renewable energy investments. In addition, little formal research has been carried out with respect to the current procedures followed by financial institutions when reviewing these types of projects. To carry out this objective it was consequently decided to focus on a small number of financial institutions and describe their procedures using information obtained mostly through interviews.

The first step was to determine appropriate institutions that could be contacted for this purpose. The scope of financial institutions that could be approached was in a way predetermined by the fact that the institution should have project financing activities, either through equity capital or through lending. Additional criteria for the selection were: a) The institution should be interested in the financing of RET investments, b) The institution should have formal investment review procedures put in place and employ environmental criteria in their investment decisions, and c) The institution should be willing to cooperate and disclose information concerning their activities. The institutions interviewed for this document, including the contact persons and date of interview, are shown in Appendix 1.

The next step was to decide on the method to be used for data collection. In this case, since the approached financial institutions operated in different countries around the world, it was decided that phone and e-mail interviews would be used for this purpose.

The questionnaire that would be used as an interview guide was prepared based on the main and secondary research questions presented in section 1.3. The questions were designed according to the type of information that they should provide. For instance, questions about investment review procedures were specific and to the point. Questions about perceptions and opinions were more open ended, so that the subject would have further liberty to express personal opinions and views. This questionnaire is shown in Appendix 2.

The information sources for this part of the research were mostly primary data obtained from the interviews, and documentation contained in the web sites of the financial institutions featured in the thesis.

c. Approach for objectives c) Analysis of current procedures and of drivers and barriers to EDD use, and d) Recommendation of EDD guidelines for each RET. Objectives c) and d) of section 1.3 represent the analytical portion of the thesis. As discussed previously, these two objectives are interrelated, since the purpose of objective c) is to provide information necessary for the design of the guidelines.

The analysis involves two main points: the identification of drivers and barriers to EDD use, and the analysis of current environmental review procedures of financial institutions. Both of these are covered with a number of research questions: the first point corresponds to the key research question of the thesis, and the second point corresponds to the secondary research questions presented in section 1.3. Therefore, the approach to the analysis is basically to answer the pertinent questions using the information obtained through interviews and the review of relevant documents.

Finally, the guidelines for each RET incorporate the information on environmental issues and EDD procedures of financial institutions obtained as a result of the research.

2.3 Research limitations

The theoretical context of this research project is provided by the environmental due diligence instrument, which is a business practice rather than a scientific concept. As a result the academic value of the project is somewhat limited, although it has the potential for significant applied value.

Although different types of financial institutions were contacted at the start of the research work, most of the interviews that were eventually held took place with officials from development agencies, and therefore the results are based mostly on their procedures. Since development agencies usually operate under policies that require the promotion of environmentally sound and sustainable activities, their procedures on environmental risk management are generally on the leading edge of these practices in the financial world. From the point of view of obtaining information concerning 'best practices' in the sector, it is considered that the difficulty to examine private procedures did not hamper the results in a substantial way. However, in terms of portraying a more representative picture of the environmental review practices of the financial sector, it would have been desirable to obtain information from other types of financial institutions, e.g. commercial banks or export credit agencies. There was also no possibility to examine the environmental review documentation of an actual investment proposal at any of the institutions featured in the thesis, since in general the environmental reports filed during the review are confidential, as are any covenants, contracts or other legal documentation pertaining to an investment agreement between a financial institution and a project sponsor.

Time constraints are also important, since it will not be possible to follow up the results of the practical application of the guidelines. The limitation results from the fact that a follow up could provide important insights about how to improve the content and design of the guidelines.

3. The environmental issues of RET systems

As mentioned in Chapter 1, renewable energy sources are often credited with having the potential to provide energy services with little or no emissions of air pollutants, particularly CO_2.[23] Indeed, most RET facilities produce little or no emissions of greenhouse gases or other air pollutants, *during their operational stage* (notable exceptions being biomass and geothermal plants). However, emissions do arise from other stages in their life cycle. Moreover, the environmental impacts that may be associated to the different life cycle stages of a particular RET system are not limited to air pollutant emissions, but include a diverse range of issues, some with positive and others with negative environmental implications. Thus, it follows that a proper assessment of the environmental impacts that may result from the deployment of a RET project requires a careful consideration of the whole project's life cycle.

The life cycle of a RET system can be defined as the chain of processes required to manufacture the technology, implement and operate the energy system and decommission and dispose of the equipment at the end of the project's life cycle.[24] These stages include a number of different processes and have associated energy and material inputs and outputs. Figure 3 illustrates a typical life cycle for a renewable energy project [25]:

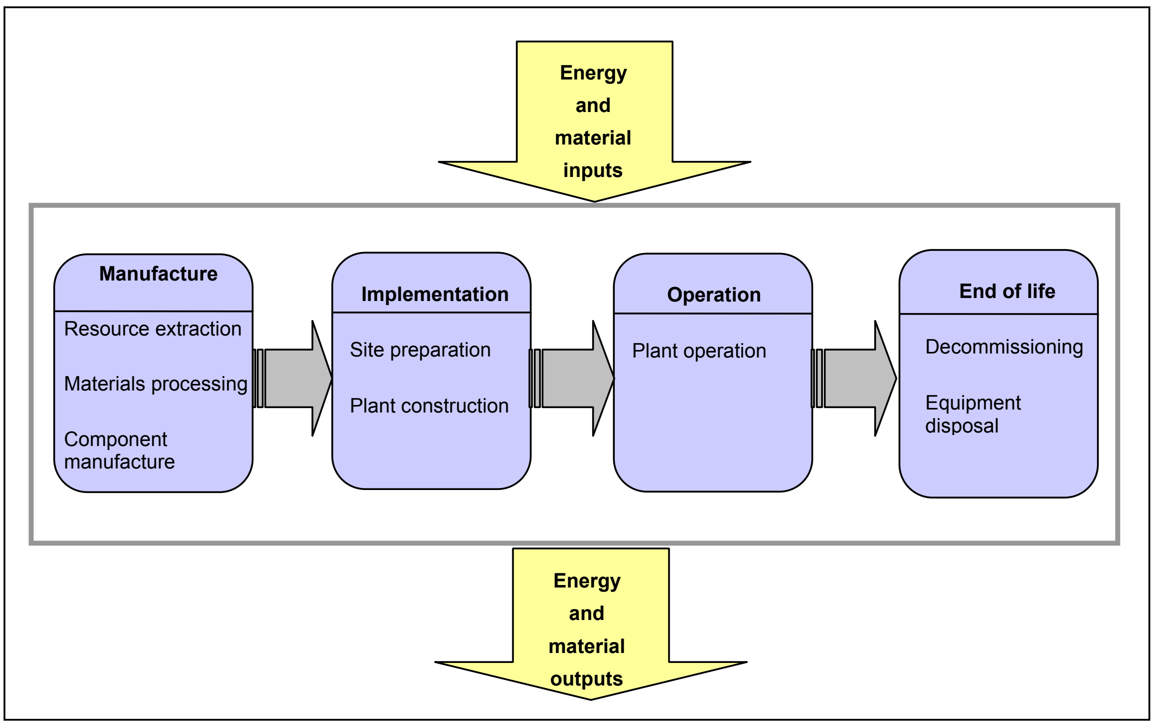

Figure 3: Typical life cycle stages of a renewable energy project

Each of the processes shown above comprehends a number of different activities, the exact nature of which will of course depend on the technology itself.

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[23] UNDP.(2000). *World energy assessment*. p. 14

[24] International Energy Agency (IEA). (1998). *Benign energy? The environmental implications of renewables.* [Online] Available: http://www.iea.org/pubs/studies/files/benign/full/00-bene.htm [July 24, 2002]

[25] For biomass energy systems, additional activities concerning the fuel production, collection, transportation and storage must also be considered in the implementation and operational stages.

The review of environmental issues has the objective of providing a background for the eventual development of the environmental due diligence guidelines for each technology. The research approach followed for fulfilling this objective is detailed in Chapter 2, section 2.2 of this document.

Sections 3.1 to 3.2 will summarise the main environmental impacts related to biomass and wind energy systems. Each section is divided in two parts. The first part provides a brief overview of the conversion technologies currently available for the production of energy from each renewable source. The second part summarizes the main environmental issues associated to each of the four life cycle stages shown in Figure 3. The background research for the summaries of the environmental issues of biomass energy systems and wind energy systems is presented in Appendix 3 and Appendix 4, respectively. Finally Section 3.3 will provide a brief discussion of the environmental issues of RETs in relation to environmental legislation.

3.1 Biomass energy systems

In the context of energy production, biomass is a broadly inclusive term used to designate all forms of organic material produced by photosynthesis, that may be used for energy or fuel, such as wood, herbaceous plant matter, agricultural crops, agricultural and agro-industrial residues, aquatic vegetation, animal excrement, and municipal solid waste. Thus, the resource base of biomass is diverse and plentiful. In terms of conversion mechanisms, there are two main processes that can be used to convert biomass material into energy or fuel: thermochemical or biochemical. However, there are many different technologies that may be classified within these two main categories. Examples of the former are direct combustion, pyrolysis, and distillation. The latter includes processes such as anaerobic digestion, and fermentation.[26]

From these brief sentences, it can be inferred that the term 'biomass energy system' actually applies to a large number of alternative conversion pathways, with different feedstocks, technologies, and end products. It can also be inferred that to generalize about biomass energy systems can be very difficult. In the case of this thesis, generalization was also not very helpful, as the environmental issues related to a particular system, e.g. based on the combustion of agricultural residues for electricity production, would not only probably differ from those of a system based on the fermentation of agricultural residues for ethanol production, but also from those of a combustion based system for electricity production with a different feedstock, such as municipal solid waste. Therefore this document will concentrate on the conversion of energy crops (plantations of suitable fast growing vegetation) for energy production. Dedicated plantations have been cited in specialist literature as one of the largest potential sources of biomass in the future, particularly as agricultural and forest residues, the most common feedstocks for industrial biomass energy production today, cannot be expected to cover increasing demand for biomass fuels in the future. [27]

It is planned that the research project after the thesis will continue with biomass energy systems based on forestry and agricultural residues, and the production of biogas.

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[26] Siddayao, Corazon M. (1993). *Financing renewable sources of energy: Do environmental reasons justify the economic cost of doing so?* Washington: Economic Development Institute of the World Bank. p 30.

[27] Hall, David O., Rosillo-Calle, Frank, Williams, Robert, Woods, Jeremy. (1993). *Biomass for energy: supply prospects*. In Thomas B. Johansson, Henry Kelly, Amulya K. N Reddy, & Robert H. Williams. (1993). *Renewable energy: Sources for fuel and electricity.* Washington: Islands Press. pp.595

3.1.1 Overview of energy crop technologies

There are numerous plants that are suitable for growing as energy crops [28]:

- Fast growing hardwood trees, such as willow, poplar and eucalyptus. Trees may be grown on a short rotation basis, which allows harvesting every 2 to 6 years (depending on the species) for a period of 20 to 30 years. Trees are planted very densely, and then allowed to grow for one year before being cut back almost to ground level to increase the number of shoots which may be subsequently harvested every few years.

- Fast growing herbaceous plants.

- Annual and perennial grasses such as fibre sorghum, switchgrass, miscanthus, kenaf and cynara. Annual grasses must be re-sown each year, while perennial grasses may be harvested annually for several years before replanting is necessary.

The choice of a crop species for a particular location depends on factors such as geographical and climatic conditions, amount of rainfall or other water supply, annual temperature profile, and soil condition and nutrients.

Harvesting of short rotation energy crops typically takes place in the winter, when the crop is dormant and there will be less loss of nutrients. At harvest, woody biomass contains considerable moisture and it must be dried before combustion. Annual and perennial grasses, which are harvested at the end of winter, contain less moisture, and drying is not required. The moisture content determines the storage requirements of the harvested crop. Details of the drying process may vary depending on the crop, the climate and the technology used for combustion. In dry climates the crop may be dried during the period between harvesting and collection and storage. Some drying will occur naturally during storage and this can be enhanced by forced draught ventilation. If the crop is stored at the combustion plant, then waste heat can be used to accelerate and enhance the drying process (e.g. by warming the ventilation air). Crops are often chipped prior to combustion and this may take place when the crop is harvested or after storage.

The moisture content also influences the energy density (calorific value) of the biomass fuel. As mentioned previously, energy crops contain considerable moisture at harvest. In contrast, the moisture content of most bituminous coals ranges from 2 to 12%. This means that the energy density of an energy crop at the point of production will be considerably less than that of a solid fossil fuel such as coal, and that the biomass fuel will require more preparation and handling than the fossil fuel.[29] Less concentrated energy also means that biomass fuels are less economic to transport over long distances than fossil fuels. On average, the energy used to transport biomass over land is about 0.5 megajoules per tonne-kilometre, depending on the infrastructure and vehicle type. Therefore, land transport of biomass can become a significant penalty for distances of more than 100 kilometres. [30]

There are two main technological schemes for the conversion of energy crops into electricity:

a. Direct combustion systems: Most of the components of a direct combustion system plant are the same as in a conventional fossil fuel fired thermal plant. The main exception is the boiler, as biomass has a

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[28] Unless otherwise noted, the main source for the following section is: IEA. (1998). *Benign energy? Appendix H: Energy crops.* [Online]. Available: http://www.iea.org/pubs/studies/files/benign/pubs/append3h.doc [July 26,2002]

[29] Hall, David O. et al. (1993). *Biomass for energy: supply prospects*. In Thomas B. Johansson, et al. (1993). *Renewable energy: Sources for fuel and electricity*. pp.596-597

[30] Borjesson, P. (1996). Emission of $C0_2$ from biomass production and transportation in agriculture and forestry. *Energy Conversion and Management 37*, pp. 6-8

lower energy density and requires a boiler designed to cope with the higher moisture content of the fuel.[31] Almost all biomass schemes installed to date operate on a steam-Rankine cycle; the biomass is burnt in a boiler producing pressurized steam, which is expanded through a turbine to produce electricity. In the production of power only, a fully condensing turbine is used, while in the production of electricity and heat a condensing-extraction turbine or a backpressure turbine is used. Figure 4 shows a schematic representation of a biomass-fired condensing steam turbine cycle for the production of power only.

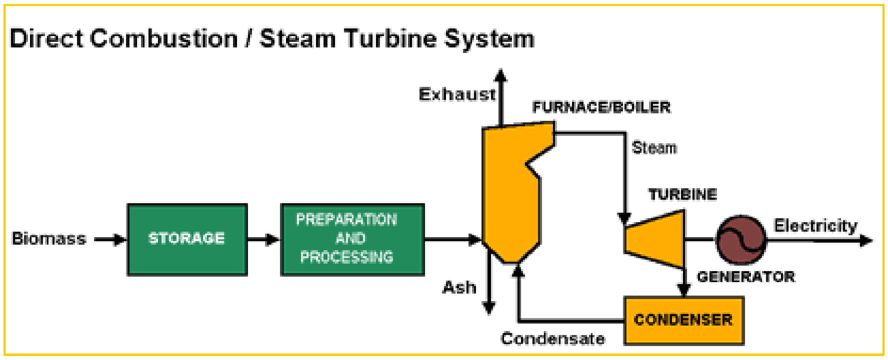

Figure 4: Direct combustion/ Steam turbine system. Source: Distributed Energy Resources (DER)

Many of these schemes have been installed where there is a large source of low cost waste material (e.g. bark at paper and pulp mills, wood waste in the timber industry), and often have a low generating efficiency (typically less than 20%). However, as interest has increased in growing biomass specifically for energy production, more efficient modern steam based combustion plants (with generating efficiencies of about 30%) have become available.[32]

A co-firing scheme, in which the biomass fuel is used in combination with another fossil fuel such as coal, is another possible option for direct combustion systems. This type of scheme has been gaining attention as an affordable way for conventional power plants to achieve some of the benefits of renewable energy systems. Conversely, a co-firing scheme has more potential environmental impacts than a biomass based scheme. However, the costs of combination schemes are usually lower than those of independent schemes, and therefore they have more possibilities for accelerated market penetration.[33] Fluidised bed technologies, developed originally for coal, can be readily utilised for co-firing schemes. In this type of technology a stream of hot air is blown into a boiler to suspend the fuel mixture (which in the case of co-firing would be composed of coal or peat, biomass and an inert bed media), offering the possibility of a cleaner, efficient combustion.[34] Fluidised bed systems have the advantage of being readily applicable to a wide range of fuels, from very moist fuels, like wood bark, to high-grade fossil fuels.[35]

[31] Ahmed, Kulsum. (1994). *Renewable energy technologies. A review of the status and cost of selected technologies*. Washington: World Bank Energy Series. p. 13

[32] Williams, Robert H., Larson, Eric D. (1993). *Advanced gasification-based biomass power generation.* In Thomas B. Johansson et al. (1993). *Renewable energy*. pp. 731-732

[33] European Commission. (1999). *Renewable energy systems. New solutions in energy supply*. Belgium: Directorate General for Energy. pp. 21-22

[34] Johansson, Allan, Kisch, Peter, Kuisma, Jaakko, Kumra, Shisher, Mirata, Murat, Peck, Phillip, Rodhe, Håkan, Thidell, Åke (2001). *IIIEE introduction to environmental technology.* Lund, Sweden: IIIEE. pp. 23

[35] National Technology Agency TEKES (2002). *Growing power: Advanced solutions for bioenergy technology from Finland.* Helsinki, Finland: TEKES. p.10

b. Gasification systems: In gasification systems, biomass is converted to producer gas by partial combustion in a gasifier or to biogas by anaerobic digestion. The producer gas is comprised mainly of carbon monoxide, hydrogen, methane and carbon dioxide; biogas is mainly a mixture of methane and carbon dioxide. Either of these gases may then be burnt in gas engines or gas turbines.[36]

Gasification systems based on gas engines have been demonstrated and are now becoming available commercially. Typical generating efficiencies for such plants are 35%. Even higher efficiencies may be achieved by using the gas to power a gas turbine, as shown in figure 5. In a simple gas turbine, compressed gas is ignited and the hot gases rotate a gas turbine, generating electricity.

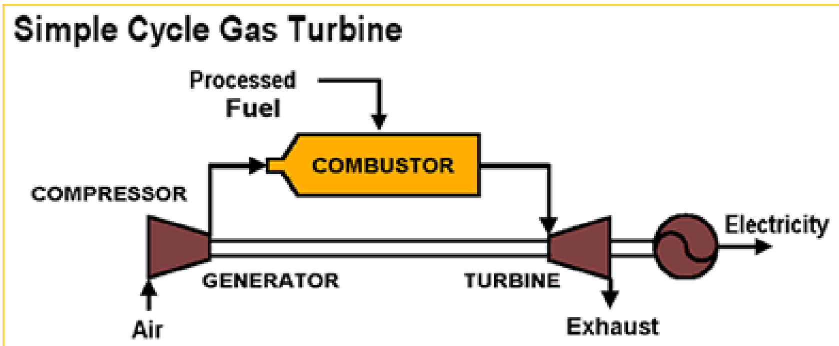

Figure 5: Simple cycle gas turbine. Source: Distributed Energy Resources (DER)

Another possible configuration is a combined cycle unit in which the exhaust gases from the turbine are used to produce steam to run a steam turbine and a heat recovery steam generator (HRSG), as shown in figure 6.

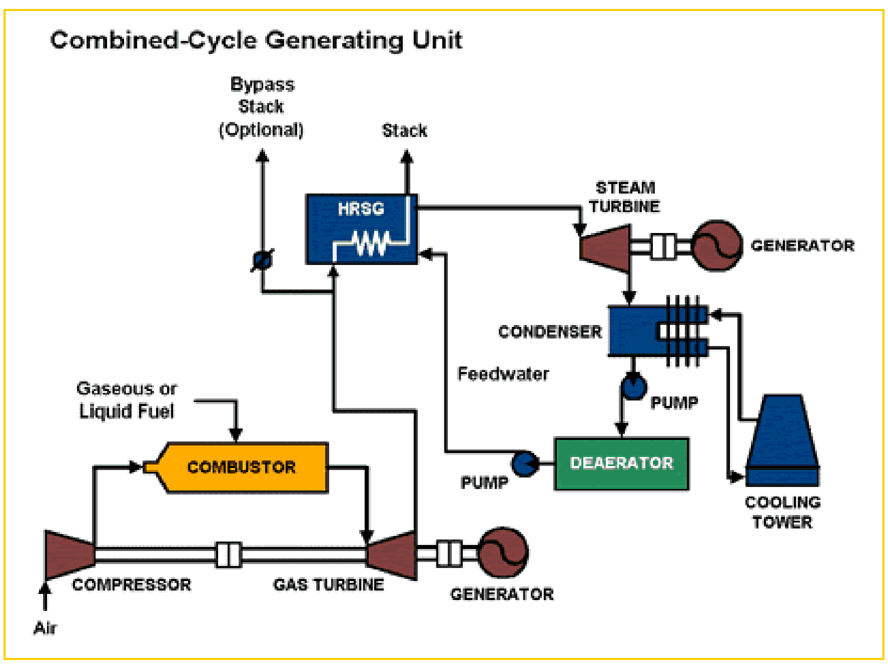

Figure 6: Combined cycle generating unit. Source: Distributed Energy Resources (DER)

[36] Ahmed, Kulsum. (1994). *Renewable energy technologies.* pp. 13-14

In these systems, the gas must be cleaned before it enters the turbine to remove particulates, tars and alkali compounds (formed primarily from potassium and sodium in the feedstock).[37]

In general, gasification systems are less technologically and commercially mature than direct combustion ones. However, gasification is considered one of the most promising future technologies, given its potential to enable the substitution of cheaper fuels like wood residues for expensive fossil fuels.[38]

The preceding paragraphs have mainly discussed the use of energy crop technologies for the production of electricity only. However, one of the most important applications of biomass fuels is actually the production of combined heat and power (CHP). CHP technologies generate electricity and provide steam for industrial processes or district heating. Large-scale CHP production requires abundant sources of biomass, and until now has been typically operated in conjunction with pulp and paper mills, or sawmills. However, ongoing research and development has been directed to the development of small-scale CHP (up to 5 MW) for biomass fuels.[39] Typically large-scale biomass fuelled CHP rely on direct combustion systems such as fluidised bed technologies. In terms of fuelling options, the co-firing schemes discussed previously for electricity production may also be used for CHP, offering a solution to biomass only options that are hampered by limitations in the supply and/or fuel quality. While most of the existing co-firing CHP schemes are based on direct combustion technologies, gasification systems may also be increasingly applied in the future for this kind of application.

The following section will summarise the main environmental issues discussed in specialist literature with respect to the life-cycle stages of energy crop systems. The summary of issues applies to the technologies reviewed in the previous paragraphs, except co-firing schemes because their life-cycle environmental issues are likely to be more similar to those of a conventional coal system than to those of a biomass based one.

3.1.2 Summary of the environmental issues of energy crop systems

The background research for the following summary is presented in Appendix 3. The main environmental issues associated to the deployment of an energy crop system arise during the implementation and operational stages of its life cycle. At these stages the most environmentally sensitive activities are the crop cultivation and harvesting, and the generation of electricity. Most of the potential impacts from these activities are location and technology dependent.

The potential issues from crop cultivation are the most numerous, and include soil effects, water use effects, air quality effects and biodiversity effects, which are commonly associated with intensive farming practices. However, the potential impacts on soil, water and biodiversity will frequently depend on the type of land use that is being replaced by the energy crop plantation. In general, if the plantation site is established on degraded land or land that was used for intensive arable agriculture, the effects of the crop cultivation activities may be positive. Finally, most of the impacts from crop cultivation may be reduced through careful site and crop selection, and sustainable crop management based on good farming practices.

The main issues associated with crop harvesting and the generation activities are atmospheric emissions. Harvesting activities produce atmospheric emissions due to the use of diesel fuelled farm

[37] Williams, Robert H., Larson, Eric D. (1993). *Advanced gasification-based biomass power generation.* In Thomas B. Johansson et al. (1993). *Renewable energy.* pp. 729-743

[38] TEKES (2002). *Growing power.* pp.29

[39] Unless otherwise noted the main source for the CHP discussion is :TEKES (2002). *Growing power.* pp.16-23

equipment. Manual harvesting practices could reduce emissions, but could lead to decreased production rates and increased costs. In relation to energy generation, it is possible to distinguish between greenhouse gas emissions and the emissions of acidifying gases, particulates, VOCs and other air pollutants. In relation to the emission of greenhouse gases, energy crop technologies have the potential for producing energy with zero net emissions of CO_2, provided that the crop is produced sustainably. Therefore, energy crop systems may lead to the reduction of greenhouse gas emissions from energy production if their deployment leads to the displacement of conventional systems. The emissions of other air pollutants depend mostly on the conversion technology implemented, with gasification systems producing lower emissions than direct combustion systems. In general, the emissions from gasification systems will be considerably lower than for conventional technologies and therefore there may be no need to install pollution abatement equipment. Direct combustion systems may also have lower emissions than conventional power plants, but their emission levels approximate those of best practice conventional systems. Pollution abatement equipment may be necessary, although this would depend on local ambient air quality standards and regulations.

Table 2: Potential issues, impacts, and remediation measures for energy crop systems

Potential issue	Potential Impact	Remediation measures
MANUFACTURE STAGE		
Not considered	–	–
IMPLEMENTATION STAGE		
Atmospheric emissions from crop cultivation due to use of diesel fuelled farm equipment	• Global warming • Public health • Acid deposition	–
Emissions of minerals (nitrogen, phosphate and potassium) to soil and water from fertilizer use for crop cultivation	• Nitrification of surface and groundwater (impairment of drinking water quality) • Phosphate saturation of soils (soil biodiversity effects) • Eutrophication • Increase of heavy metal flux to soils (soil biodiversity effects)	Implementation of good farming practices: Dosage according to nutrient demands of crops Attention to chemical and bacteriological content of sewage sludge if it is used as fertilizer Use ash from combustion or gasification as fertilizer
Emissions of pesticides and herbicides to soil and water due to crop cultivation	• Public health • Contamination of surface and groundwater (impairment of drinking water quality) • Biodiversity effects	Implementation of good farming practices: Ground spraying preferable to air spraying Reducing pesticide use by means of alternative methods such as integrated pest management (IPM)
Water use	• Ground water depletion	Consider rainfall conditions, and availability of water sources in plantation site when choosing the crop (e.g. avoid high water dependent crops such as eucalyptus in arid or semi-arid areas)

Potential issue	Potential impact	Remediation measures
IMPLEMENTATION STAGE (Continued)		
Soil effects	• Soil erosion (increased water turbidity leading to impacts on aquatic life or impairment of drinking water quality; stream scouring; silting; increased concentrations of nutrients and/or other chemicals in water) Or • Soil stabilisation	Establish plantations in degraded land sites Implementation of good farming practices: No tillage, or tillage following contour lines in erosion prone areas Maintenance of terraces Winter covers and ground cover vegetation strips between rows of crops
Biodiversity effects attributable to the crop plantation	• Loss of biodiversity Or • Increase of biodiversity	Implementation of good farming practices Avoid establishment of plantations in sites such as natural forests or other ecologically diverse areas; establish plantations in degraded lands or excess agricultural land Exercise caution when introducing non native or genetically modified species
Visual impact	• Effects on visual amenity due to plantation site	Use of guidelines for plantation development: Avoid straight edges, follow natural topography, promote species diversity in plantation
OPERATION STAGE		
Atmospheric emissions from harvesting of crops due to use of diesel fuelled farm equipment	• Global warming • Public health • Acid deposition	–
Emissions of greenhouse gases during the generation stage	• Avoided greenhouse gas emissions from deployment, provided sustainable cultivation practices are employed	–
Emissions of acidifying gases, particulates, VOCs and other air pollutants during the generation stage	• Public health • Acid deposition	Effluent treatment and removal of undesirable constituents from exhaust gases
Solid waste (ash) from energy generation process	• Waste disposal problems	Use ash as fertilizer for crop plantation
END OF LIFE STAGE		
Not considered provided good decommissioning practices are followed	–	–

3.2 Wind energy systems

Winds develop when solar radiation reaches the Earth's highly varied surfaces unevenly, creating temperature, density and pressure differences. Tropical regions have a net gain of heat due to solar radiation, while Polar Regions are subjected to a net loss. Therefore, the Earth's atmosphere has to circulate in order to transport heat from the tropics towards the poles. This effect is intensified by the Earth's rotation, which further contributes to the semi-permanent, planetary scale atmospheric circulation patterns that we call wind.[40]

Human beings have harnessed the kinetic energy of the wind for centuries for transportation, water pumping, grain grinding and other purposes. Before the industrial revolution wind energy was widely used as a source of power, but it was later displaced by fossil fuels. Today, it is making a comeback, rapidly becoming a competitive electricity generation technology, with widespread use in North America, Europe and the Indian subcontinent.[41] The following section will present an overview of the technologies currently developed for the production of electricity with wind energy.

3.2.1 Overview of wind turbine technologies

Modern wind turbines extract energy form the wind stream by transforming the wind's linear kinetic energy to the rotational motion needed to turn an electrical generator. This is accomplished by a rotor that has a number of blades attached to a hub. Thus, wind flowing over the blade's surface generates the forces that cause the rotor to turn. [42]

Wind turbines may have either a large number of blades or from one to three blades. Wind turbines with large numbers of blades have what appears to be a solid disc covered with blades and are described as high-solidity devices. In contrast, the swept area of wind turbines with few blades is largely void and only a very small fraction appears to be 'solid' and consequently they are referred to as low-solidity devices. Theoretically, the more blades a wind turbine rotor has, the more efficient it is. In practice however, large numbers of blades interfere with each other, and as a result high-solidity wind turbines tend to be less efficient than low solidity wind turbines. Therefore, multi-bladed turbines are generally used for water pumping while low solidity devices have been applied for electricity generation.

Of the low solidity devices, three-blade machines are heavier than the one- and two-bladed options, but have a higher energy capture. One- and two-bladed designs have the advantage of being lighter, which translates into lower transmission costs, but as mentioned before, they have a lower energy capture than three-bladed machines. This means that they require higher rotational speeds to yield the same energy output of a three-bladed machine, a disadvantage in terms of noise and visual intrusion (this disadvantage applies to a greater extent to one-blade machines). In addition, their rotor requires a more complex design, since the geometry of the blades does not result in a good balance for the rotor. Most of the wind turbines in operation have either three or two blades, with the former number being the more common rotor design. The following illustration shows the main components of a wind turbine.

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[40] UNDP. (2000). *World energy assessment*. p. 163

[41] UNDP. (2000). *World energy assessment*. pp. 230-231

[42] Unless otherwise noted, the main source for this section is: Cavallo, Alfred J., Hock, Susan M., Smith, Don R. (1993). *Wind energy: Technology and economics*. In Thomas B. Johansson et al. (1993). *Renewable energy*. pp. 124-146, with complementary details from: Danish Wind Industry Association. (2001). [Online]. Available: http://www.windpower.org/tour/design/concepts.htm [July 27, 2002]

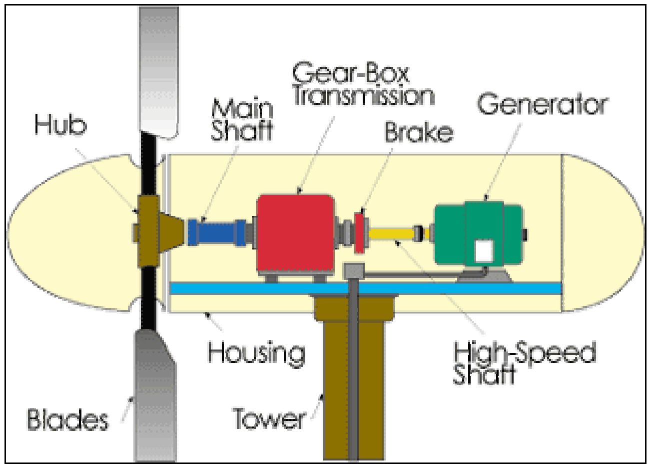

Figure 7: Components of a wind turbine. Source: Iowa Energy Centre (IEC)

There are two fundamentally different types of wind turbine structures: the horizontal axis wind turbine (HAWT), which has the axis of rotation of its rotor parallel to the wind stream, and the vertical axis wind turbine (VAWT), which has the axis of rotation of its rotor perpendicular to the wind stream. Figure 8 shows a schematic representation of the two basic wind turbine configurations.

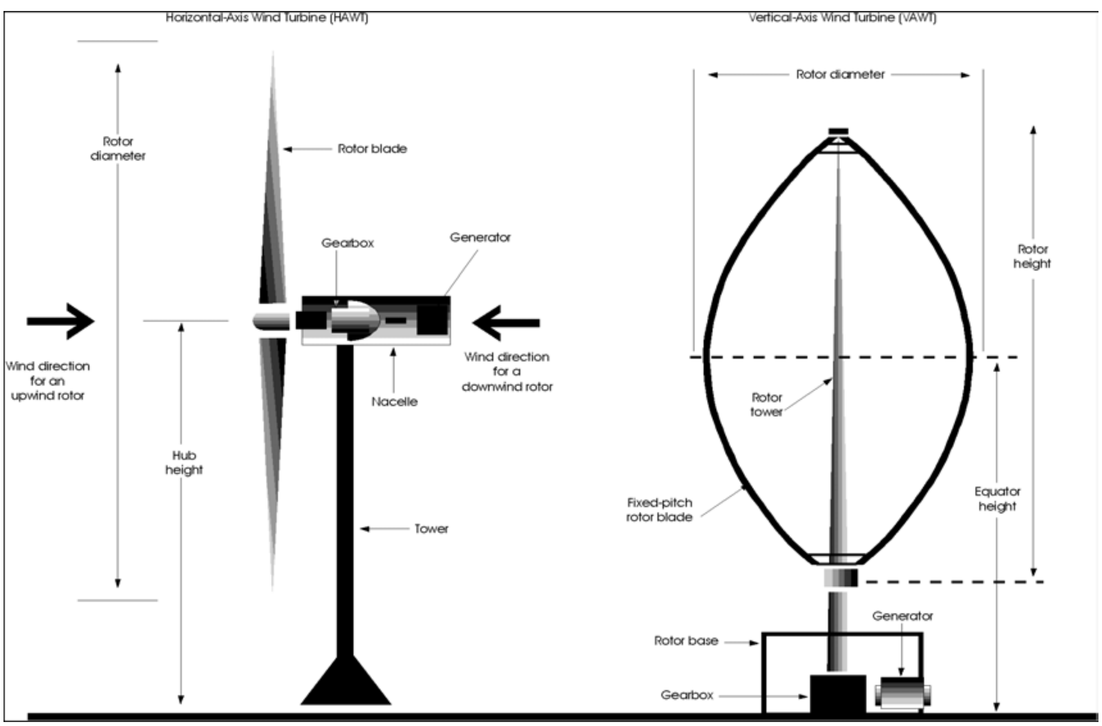

Figure 8: Two basic wind turbine configurations. Source: Cavallo, Hock and Smith (1993)

Horizontal axis wind turbine structures usually consist of steel towers, either of tubular or lattice construction, mounted on concrete foundations, with glass reinforced or wood epoxy turbine blades. HAWTs are suitable for both upwind and downwind applications. Upwind designs have the rotor facing the wind. The main advantage of upwind designs is that they avoid the wind shade behind the tower.[43] Their main drawback is that the rotor needs to be rather inflexible, and placed at some distance from the tower. In addition an upwind machine needs a special mechanism, known as the yaw, to keep the rotor facing the wind. Downwind designs have the rotor on the lee side of the wind. Their key advantage is that the rotor may be more flexible than for upwind designs, an advantage both in terms of weight, since the rotor may be lighter than for upwind designs, but also in terms of the structural dynamics of the machine, as the blades will bend at high wind speeds, thereby reducing the stress on the tower. Their main drawback is an inherent fluctuation in the wind power caused when the rotor passes through the wind shade of the tower, although other problems mentioned include objectionable noise levels and increased stress on the blades. By far, most HAWTs in operation have an upwind design.

VAWTs, also called Darrieus turbines, have their gearbox and generator at ground level, which simplifies routine maintenance. Additionally, VAWTs do not require special mechanisms to turn in the wind, and since their rotor blades operate under almost pure tension, these can be constructed of relatively light and inexpensive extruded aluminium. The main problems associated with these turbines are their inability to take advantage of higher wind velocity and lower turbulence at higher elevations. In addition, the wind speed on the lower part of the rotor of a vertical axis turbine is usually very low, since this configuration typically does not include a tower and wind speeds are generally lower close to the ground. Currently, VAWTs are not at the same level of commercial development as HAWTs, although they are thought to have scope for lower electricity generation costs in the future, particularly for larger capacity turbines.

An additional technological distinction may be made between onshore, or land, wind turbine designs and offshore ones, which have been recently attracting increasing attention. In terms of technology, offshore wind turbines require larger sized turbines, typically in the megawatt range, different installation concepts, particularly regarding the foundation of the turbine, as well as novel features for the electricity conversion and transport systems, corrosion protection, and integration with external conditions in terms of both wind and wave loading.[44] Offshore applications have not yet reached the same level of technological maturity as land applications, but so far the experience of prototype offshore wind farms (i.e. groups of wind turbines with a common electrical output) such as the Vindeby wind farm in the Baltic Sea off the coast of Denmark, has been promising.[45]

The following section will summarise the environmental issues related to the wind conversion technologies that have been reviewed up to this point, focusing on horizontal axis wind turbines for onshore applications, since vertical axis configurations and offshore applications have not yet reached comparable levels of commercial maturity, as explained in the previous paragraphs.

3.2.2 Summary of the environmental issues of wind energy systems

The background research for the information provided in the following table is presented in Appendix 4. It should be noted that the following discussion applies mainly to on-grid wind energy systems. Off-grid systems, typically small-scale wind farms (sometimes even a single turbine) are widely acknowledged to present few, if any, environmental problems.

The environmental issues that have been generally associated to wind energy systems arise mainly from their operational stage. However, results from studies performed on a life-cycle basis have generally concluded that the impacts related to the manufacture stage are much more significant for this type of

[43] When a rotor passes through the wind shade of the tower, the power from the wind turbine drops slightly.

[44] UNDP. (2000). *World energy assessment*. p. 232

[45] Danish Wind Industry Association. (2001). [Online].

system than for energy systems that produce emissions during their generation stage, and therefore should not be discounted.

During their operational stage, wind energy systems produce no atmospheric emissions. Thus, their main environmental benefit is the potential to displace or avoid the emissions of greenhouse and acidifying gases, particulates and other air pollutants that are associated to conventional electricity generation. This potential remains valid even when taking into account the emissions associated to the manufacture stage.

The main environmental problems related to the operational stage of wind energy systems are noise and visual intrusion, although other sensitive issues are related to their land use requirements and impact on avian life. In general, these problems may be considerably mitigated or avoided through a careful assessment of the potential site location, and by promoting a greater involvement of the local community.

Table 3: Potential issues, impacts, and remediation measures for wind energy systems

Potential issue	Potential impact	Remediation measures
MANUFACTURE STAGE		
Atmospheric emissions from processing and manufacture of materials and components for the wind turbine	• Global warming • Public health • Acidification	–
IMPLEMENTATION STAGE		
Atmospheric emissions from the processing of materials needed for the foundation of the turbines (e.g. concrete and steel) and from the engineering works of site preparation	• Global warming • Public health • Acidification	–
Other: Impacts of construction activities on terrestrial ecosystems Occupational accidents	• Permanent ecosystem disruption due to increased human intrusion • Occupational health	Provided that the construction activities do not take place in areas with fragile ecosystems and that sensible construction practices are followed, these impacts are of temporary nature and not likely to pose significant problems
OPERATIONAL STAGE		
Visual intrusion	• Effects on visual amenity due to wind farm development (objective and perceived impacts)	Avoid site location in areas of scenic interest Promote local community participation and involvement with wind farm development (e.g. for site location decisions) Give due consideration to attractive screening options such as tree plantations near the development, and to the colour selection, tower structure and physical layout of turbines

Potential issue	Potential impact	Remediation measures
OPERATIONAL STAGE (Continued)		
Noise	• Effects on noise amenity due to mechanical and aerodynamic noise from turbine operation	Appropriate development siting (e.g. away from areas of high population or particular land topography) Locate turbines at sufficient distance from houses or other noise sensitive properties Manufacture and assemble turbines to a high standard, to ensure that they operate within their design levels Control noise levels by the application of statutory or recommended noise limits at the nearest noise sensitive property Promote local community participation and involvement with development
Land use and habitat damage	• Opportunity loss of agricultural production • Ecosystem disruption • Loss/change of recreational amenities	Appropriate development siting (e.g. avoid potentially fragile ecosystem areas, or areas of high conservation or archaeological value)
Bird strike and disturbance	• Behavioural disruptions • Loss of habitat • Collisions with rotating turbine blades	Appropriate development siting (e.g. avoid ecologically sensitive areas, areas with high avian migratory patterns or other ornithologically valuable areas)
Emission of greenhouse gases, acidifying gases and other air pollutants	• Avoided air pollutant emissions from global deployment	–
Other: Electromagnetic interference (EMI) Accidents	• Interference in a range of communication systems including television signals, microwave links, VHF Omni-directional Ranging and Instrument Landing System • Public and occupational health	Interference problems on TV signals may be mitigated using signal amplifiers, active deflectors, relay transmitters or cable television. For the other types of interference, guidelines have been prepared to help developers avoid this type of problems. Public and occupational accidents are extremely unlikely and therefore not discussed in specialist literature
END OF LIFE STAGE		
Not considered provided good decommissioning practices are followed.	–	–

3.3 Environmental issues of RETs and environmental legislation

The previous sections have discussed the potential environmental issues that may be associated with the different life cycle stages of energy crop and wind energy systems. Whether any of these issues can result in potential environmental risks or liabilities for project developers and/or financiers will depend, among other things, on the environmental legislation of the country where the project will be implemented.[46]

Today environmental legislation and regulations around the world are remarkably similar in form, even when comparing those of developed and developing countries. The content of the laws will of course vary, influenced by factors such as the specific biological and ecological characteristics or the political strategy of a country. However, many of the noteworthy distinctions between developed and developing countries take place because of differences in the degree of governmental enforcement, rather than from the environmental regime per se.

In general, environmental laws and regulations are designed with the objective of conserving and managing environmental resources, protecting native species or ecosystems, and minimizing public health risks due to environmental degradation and pollution. Thus, some of the key issues embodied in environmental legislation include:

- Air quality
- Water quality and use
- Soil protection and land use
- Biodiversity
- Waste

Other themes frequently covered in environmental legislation are sustainable development, climate change, and ozone layer protection.

This document will not discuss all the possible environmental regimes to which an RET project may be subjected, since this must be established on a case-by-case basis. However, specific examples of relevant legislations in the European Union (EU) and its relation to the RET systems focused in this document will be briefly discussed for illustrative purposes.

3.3.1 Environmental legislation in the EU

In the past thirty years the EU has developed a vast body of environmental legislation. At first, the Community approach to environmental action was vertical and sectoral, mainly concerned with the establishment of a legal framework for limiting pollution by introducing minimum standards, notably for water and air pollution, and waste management. In recent years, the approach has become increasingly horizontal, in the sense that the Community now seeks to integrate the environment into

[46] Other factors to consider are the liability regime, the influence of local and international environmental advocacy groups, and the culture and customs of the host country, among many others. The next chapter will discuss environmental risks and liabilities for financial institutions in more detail.

all the European Union policies. As a consequence of this objective, all Community institutions are now obliged to take account of environmental considerations in all their policies.[47]

The areas covered in EU environmental legislation include waste management, noise pollution, water pollution, air pollution, nature conservation, and natural and technological hazards. The number of legislative acts, including directives, regulations, decisions, and recommendations, concerned with these areas is considerable: the Community adopted 200 pieces of environmental legislation during its first four environmental action programmes alone, and many more have been adopted in the successive two (currently the Community is implementing its 6th Action Programme for the Environment, which sets priorities up to the year 2010), bringing the total number to about 300. This section does not intend to cover all possible legislative acts that may be applicable to an RET system, so just some of the key directives concerning energy crop and wind energy systems will be highlighted.

- **Air emissions**

The following figure illustrates the main directives concerning air quality included in EU legislation. Some of the directives that could be relevant to RET systems are shown in red.

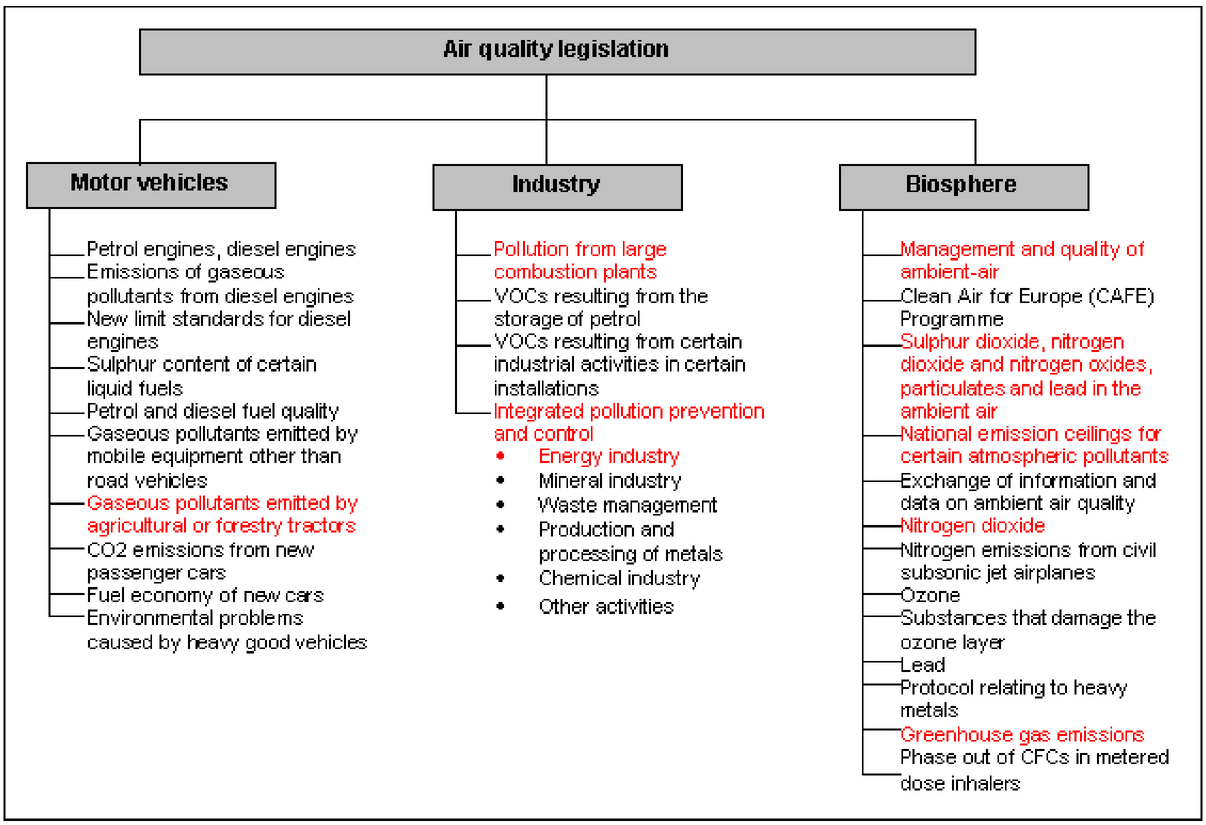

Figure 9: EU legislation on air quality.

Of the two RETs focused in this document, energy crop systems are the ones for which air quality legislation is more relevant, both during the implementation and generation stages.

As discussed before, the cultivation and harvesting activities of an energy crop facility rely on the use of diesel fuelled farm equipment. Although there have been several directives targeting atmospheric emissions from mobile sources that could be applicable for this equipment, one of the most relevant is

[47] The main source for the following section is: European Union. (2001). *Environmental legislation.* [Online]. Available: http://europa.eu.int/scadplus/leg/en/lvb/l28066.htm [August 15, 2002]

a proposal for a Parliament and council Directive that establishes emission standards applicable to the engines of tractors used for agriculture and forestry. The proposal lays down limit values for carbon monoxide, unburned hydrocarbons, nitrogen oxides and particulates, and contains detailed descriptions of the component type approval procedures for tractor engines, as well as the approval procedures for the tractors themselves. This proposal supplements Directive 77/537/EEC on action to be taken against pollutants emitted by diesel engines intended to power tractors. This Directive, which is also based on Framework Directive 74/150/EEC, had solely related to exhaust-gas opacity.

From an industrial perspective, the EU has established a series of legislation applicable to the energy sector. Two that could be especially relevant for energy crop technologies are Council Directive 88/609/EEC on the limitation of emissions of certain pollutants into the air from large combustion plants, and the Integrated Pollution Prevention and Control (IPPC) Directive 96/61/EEC. The first one establishes emission limit values for sulphur dioxide, nitrogen oxides and dust from combustion plants with a rated thermal input equal to or greater than 50 MW, irrespective of the type of fuel used. Another directive that also covers large combustion plants is the IPPC directive, which defines basic obligations to be met by industrial installations of several sectors, including the energy sector. These basic obligations cover a list of measures for preventing the pollution of water, air and soil by industrial effluent and other waste. These measures serve as the basis for drawing up operating licences or permits for industrial installations. The directive lays down a procedure for applying for, issuing and amending operating permits for industrial installations; and establishes the minimum requirements to be included in any such permit (compliance with the basic obligations, emission limit values for pollutants, monitoring discharges, minimisation of long-distance or transboundary pollution).

In addition, there are several directives concerning ambient air quality standards that could potentially affect an energy crop facility.[48] These include the Council Directive 96/62/EC on ambient air quality assessment and management, which defines basic principles to establish quality objectives for ambient air; draw up common methods and criteria for assessing air quality; and obtain and disseminate information on air quality. The directive establishes limit values and alert thresholds for benzene and carbon monoxide, and for polycyclic aromatic hydrocarbons, cadmium, arsenic, nickel and mercury. Other directives target sulphur dioxide, nitrogen dioxide, nitrogen oxides, lead, and particulates and establish emission ceilings for these pollutants. Although an energy crop facility is not a likely source of most of the pollutants targeted in these directives, the emission ceilings for nitrogen dioxide, nitrogen oxides and particulates could still be relevant.

The atmospheric emissions related to the manufacture and implementation stages of a wind energy system are not directly produced by the wind energy facility, which in itself does not produce any emissions during the generation activity. Therefore, under the current level of development of environmental responsibility, the wind energy facility would not hold legal responsibility for these emissions, other than those concerning compliance with construction and land use permits common to any industrial installation.[49]

- **Water emissions**

The EU has established a number of directives related to water quality and use. These are shown in Figure 10.

[48] The EU defines ambient air as outdoor air in the troposphere.

[49] Currently, the only cases for which there is a legal precedent of joint and shared responsibility for indirect activities, i.e. activities where there is no direct causal link between the operation of the industrial installation and the environmental violation, have been related to hazardous wastes. Thus, the atmospheric emissions caused by the extraction of resources necessary for the manufacture of components would not pose a direct legal risk for an energy production facility at this point in time. Pigretti, Maria Dolores (August 20, 2002). Telephone interview.

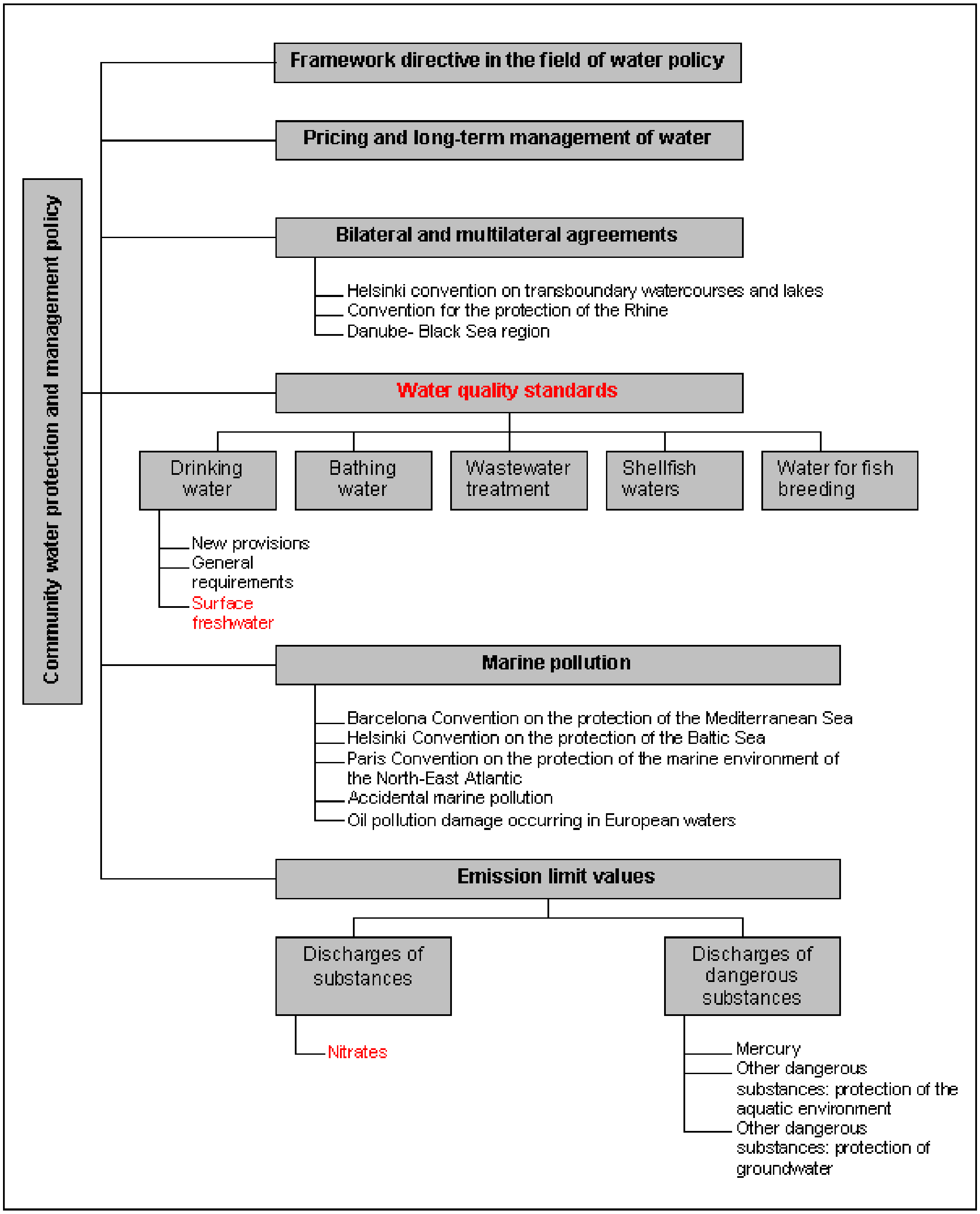

Figure 10: EU legislation on water

The legislation to control water emissions is more relevant to energy crop facilities, particularly due to the use of agrochemicals for the cultivation of the crop, which could end up being discharged in local water ways or leach into groundwater. Although the EU has established a number of directives concerning water quality standards, which could affect energy crop facilities, particularly those relating to drinking water standards, one of the most relevant pieces of legislation is Council Directive 91/676/EEC, which concerns the protection of waters against pollution caused by nitrates from agricultural sources. The directive targets nitrification of waterways owing to intensive livestock farming (chickens, pigs), and intensive crop growing involving chemical weed killers and fertilisation.

In addition to these directives, as mentioned in the section on air emissions the IPPC directive establishes emission limit values for pollutants discharged to air, water and soil from industrial sources, which could also be a relevant compliance requirement for energy crop facilities.

- **Noise pollution**

The main approach of the EC strategy concerning noise has been to adopt maximum permissible levels for noise from certain types of machine (lawn mowers, motorcycles or, more recently, aircraft and equipment used outdoors). In its 1996 Green Paper on Action against Noise, the Commission proposed extending this strategy by reducing noise emissions at source, stimulating exchanges of information and improving the consistency of Community programmes to combat noise. Recently, a proposal for a Directive was introduced, defining a Community approach on the management and evaluation of ambient noise in order to protect public health. The EU legislation on noise is shown in figure 11.

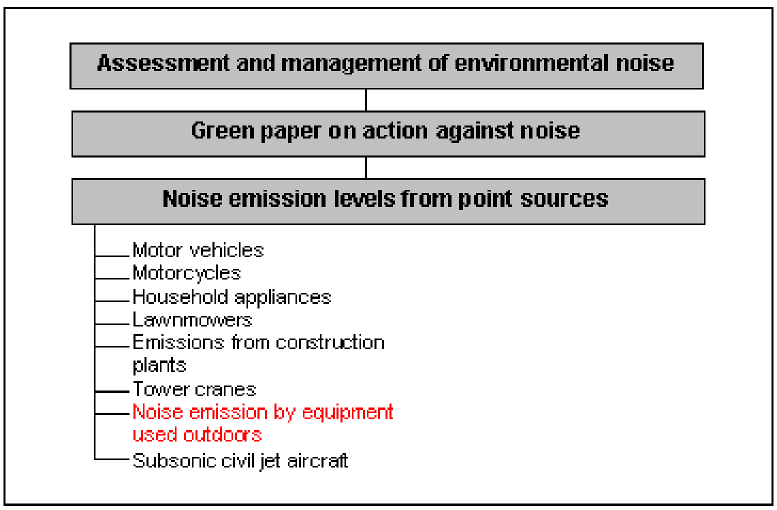

Figure 11: EU legislation on noise

Although noise pollution has been discussed as a potential environmental issue in relation to wind energy systems, so far the EU legislation on noise has not included wind turbines. However, it does set minimum noise emission standards and methods for measurement airborne noise emissions from power generators (defined as any device comprising an internal combustion engine driving a rotary electrical generator producing a continuous supply of electrical power) within the legislation for noise emission by equipment used outdoors, which could apply to energy crop systems using direct combustion technologies.

- **Protection of biodiversity and natural habitats**

The EU has established legislation providing a number of measures to conserve wildlife and natural habitats. This legislation is illustrated in Figure 12.

As mentioned in sections 3.1 and 3.2, biodiversity issues may be associated to both energy crop and wind energy systems.

In the case of energy crop technologies, one of the most relevant legislations is the recent Commission Communication concerning the Biodiversity Action Plan for Agriculture, which establishes actions to improve or maintain biodiversity status and prevent further biodiversity loss due to agricultural activities. Some of the priorities identified in this action plan that are particularly significant for energy crop systems are:

- Ensuring that intensive farming is kept at a level which is not harmful to biodiversity by establishing good agricultural practice, reducing the use of fertilisers, supporting non-intensive modes of production and establishing sustainable resource management. This could eventually set the permissible farming practices of an energy crop plantation.

- Establishing supporting measures related to maintaining local breeds and varieties and the diversity of varieties used in agriculture, which could also affect farming practices of an energy crop plantation.

- Preventing the spreading of non-native species, which could affect (e.g. limit) the choice of crops for a particular location.

In the case of wind energy systems, the discussion of potential biodiversity impacts highlighted two main issues. One is the potential impact of a wind farm development on avian life; the second is the potential impact on natural habitats. In relation to the first issue, the Community has adopted a number of directives to protect all bird species naturally living in the wild within the EU member states. The first legal act related to this issue was Council Directive 79/409/EEC, which has been amended several times, the most recent amendment being Commission Directive 97/49/EC. This directive prohibits the deliberate killing or capture of bird species covered by the Directive (however, the hunting of certain species is allowed on condition that the methods used comply with a number of principles). It also prohibits the destruction, damage or collection of their nests and eggs; and their deliberate disturbance or detention. With relation to the second issue, a relevant legislation is Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (amended by Council Directive 97/62/EC), which was established with the objective of conserving wild flora and fauna in the EU, and sets up a European ecological network known as 'Natura 2000'. The network comprises special areas of conservation designated by Member States in accordance with the provisions of the Directive, and special protection areas classified under Directive 79/409/CEE (conservation of wild birds), previously mentioned. Areas designated in this network are entitled to special conservation status, and Members states must guarantee that all measures are taken to prevent their deterioration.

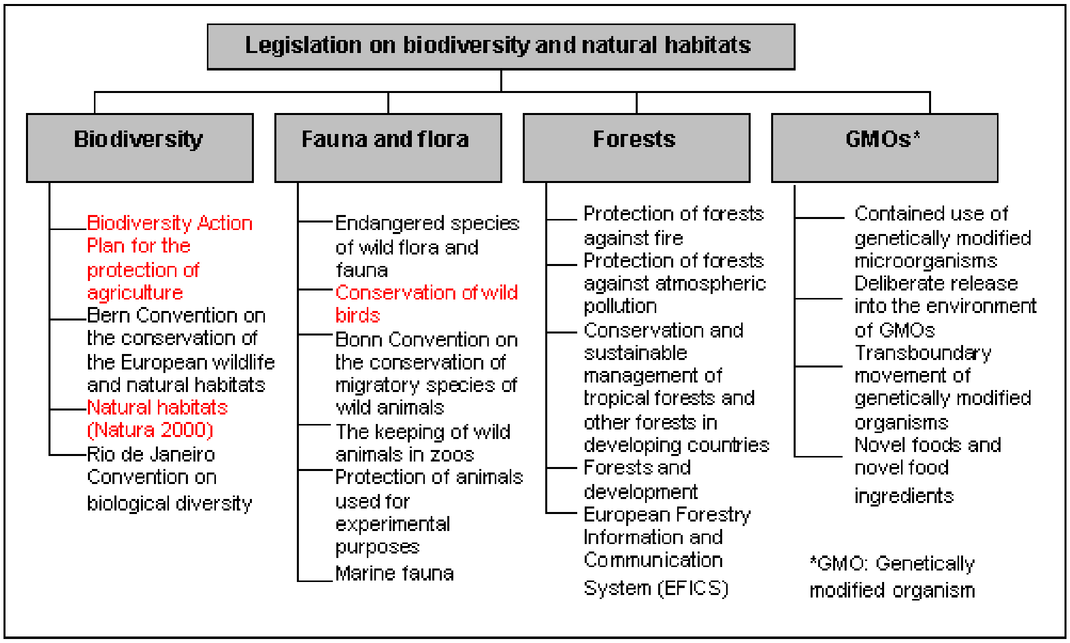

Figure 12: EU legislation for the protection of biodiversity and natural habitats

- **Other EU legislation**

On April 2002, the EU published a Communication entitled **"Towards a Thematic Strategy for Soil Protection"**.[50] This is the first step to develop a Community strategy for the protection of soil, with particular attention to preventing erosion, contamination, deterioration and desertification. Initially, the strategy aims to propose a series of environmental measures designed to prevent soil contamination, including legislation related to mining waste, sewage sludge and compost, and to promote the integration of soil protection concerns in major EU policies. In addition, the Commission will prepare the ground for a proposal for soil monitoring legislation to be made in 2004. These developments could eventually affect agricultural practices as well as site development practices in EU member states, and therefore could become potentially relevant for both energy crop and wind energy systems in coming years.

Another legal act that may affect RET systems in the future is the Community adoption of the **White Paper on Environmental Liability** on the year 2000.[51] This paper sets out the structure for a future EC environmental liability regime based on the polluter pays principle. The proposed regime would cover 'traditional damage', i.e. damage to persons and goods, as well as damage to sites due to contamination, and damage to nature and biological diversity in the Community. For the latter case, the liability regime would apply to areas and species covered by the Natura 2000 Network and the Wild Birds Directive, which were mentioned earlier in this section. The following figure illustrates the possible scope of the proposed EC environmental liability regime.

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[50] European Commission. (2002). *Towards a thematic strategy for soil protection.* [Online]. Available: http://europa.eu.int/eur-lex/en/com/pdf/2002/com2002_0179en01.pdf [August 15, 2002]

[51] European Commission. (2002). *White paper on environmental liability.* [Online]. Available: http://europa.eu.int/comm/environment/liability/el_full.pdf [August 15, 2002]

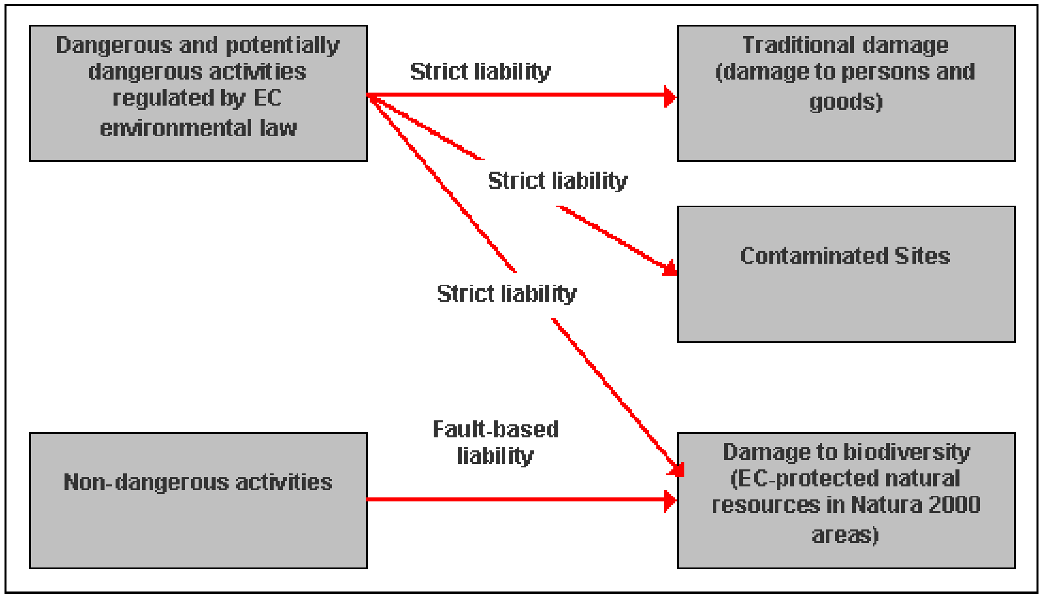

Figure 13: Proposed EC environmental liability regime

As seen on the figure, the White Paper establishes that the EC regime should be based on strict liability (this means that no fault by the polluter is required), when damage is caused by a hazardous activity; and on fault-based liability for damage to biodiversity in the protected Natura 2000 areas, if the damage is caused by a non-hazardous activity.[52] According to the proposal, the liable party should be the operator in control of the activity that caused the damage, and so far lending institutions that do not have operational control are exempted from liability.[53]

3.3.2 Environmental legislation in other countries

The previous section briefly discussed how some of the environmental legislation adopted or proposed at EU level could affect RET projects implemented in the region. In addition to EU level legislation, RET projects implemented in EU member countries must also comply with national and local level regulations.

For instance, in Sweden the Miljöbalken legislation (Swedish Environmental Code) establishes broad environmental principles that must be complied by companies operating or wishing to operate in the country. The Environmental Code, which came into effect in 1999, demands companies to think about concepts such as sustainable development, protection of biodiversity, reusability and recyclability. Another important feature introduced in the Code is the concept of self-control, which basically refers to a company's duty to follow up its own activities and control the way that these activities affect the environment and health of the population.[54]

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[52] "Fault-based liability applies when an operator has acted wrongly intentionally, by negligence, or by insufficient care. Such an act (or omission) may involve non-compliance with legal rules or with the conditions of a permit, or may occur in any other form." European Commission. (2002). *White paper on environmental liability*. [Online].

[53] The issue of how the environmental liability regime of a country may become a risk for financial institutions is discussed in more detail in the following chapter.

[54] Miljöbalksutbildningen (1998). *Kompendium i miljöbalken och dess förordningar*. Stockholm: Tryckeri Balder AB. pp. 12-13.

However, the Environmental Code does not include specific details such as emission values or security routines. The Environmental Unit of the County Administrative Board, a local-level authority, generally controls these details. This local authority classifies industrial plants within its jurisdiction into A, B or C categories[55], mostly depending on the size of the facility, with A plants being the largest, and C plants being the smallest. Plants classified in the A category must obtain operational permits from the highest environmental authority in Sweden, the Swedish Environmental Court. In this case, it is the Environmental Court that will control legislative details. B plants obtain operational permits from the Board while C plants only need to inform local authorities about their intention to start operations.[56]

In the United States, the Environmental Protection Agency (EPA) is the federal environmental authority. The EPA establishes, coordinates, supervises and/or controls nation-wide environmental programmes in the United States. It also has the responsibility for authorizing or delegating primary responsibility for specific environmental programmes to the states' authorities. The legal basis for the programmes and actions of the EPA is established in a number of laws (over 30) enacted by the US Congress, of which approximately fifteen are the major ones. The major laws are listed in Table 4.[57] In addition to the requirements set in federal laws, industrial facilities wishing to operate in the United States must comply with environmental requirements at state and local levels. State or local level authorities normally issue operating permits, although most states usually follow EPA guidelines for pollution prevention and emission levels.[58]

Table 4: Major environmental laws in the United States

Environmental legislation in the United States		
1. Clean Air Act (CAA) 2. Clean Water Act (CWA) 3. Emergency Planning & Community Right-To-Know Act (EPCRA) 4. Endangered Species Act 5. Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)	6. Freedom of Information Act (FOIA) 7. National Environmental Policy Act (NEPA) 8. Occupational Safety and Health Act (OSHA) 9. Oil Pollution Act of 1990 (OPA) 10. Pollution Prevention Act (PPA)	11. Resource Conservation and Recovery Act (RCRA) 12. Safe Drinking Water Act (SDWA) 13. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 14. Superfund Amendments and Reauthorisation Act 15. Toxic Substances Control Act (TSCA)

As mentioned earlier, environmental legislation has also been enacted in developing countries. For instance in Latin America, countries such as Argentina, Chile and Brazil have tightened their environmental legislations in order to include environmental liability and public participation. In 1993 Argentina enacted a strict hazardous waste law that imposes criminal liability on plant operators, and in 1994 the Argentinean constitution was amended to create specific environmental rights, which have

55 These categories are defined in the Environmental Code.

56 Raushill, Christopher. (August 19, 2002). Personal interview

57 For more information about the environmental legislation in the United States see: US EPA. (2002). *Laws and regulations.* [Online]. Available: http://www.epa.gov/epahome/laws.htm [August 21, 2002]

58 US EPA. (1997). *Compliance sector notebook project : Power generation.* [Online]. Available: http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/power2pt1.pdf. [August 21, 2002].

been enforced by private litigants. In Chile, a framework environmental law enacted in 1994 and environmental impact regulations promulgated in 1997 have opened project reviews and approvals to public scrutiny. Finally, in Brazil an environmental crimes law implemented in 1999 has substantially strengthened the hand of government regulators.[59]

3.3.3 Significance of legislative trends for financial institutions

Recent developments in the evolution of environmental legislation have practical implications for the businesses and industries, which must operate in accordance to the regulatory framework of a country. Some of these developments are discussed in the following paragraphs:

- Environmental laws have become increasingly integrated. There are basically three ways in which this integration can take place. One is the internal integration of legislation or procedures, whereby various different environmental acts are brought together (e.g. harmonised or co-ordinated) into one document. Examples of this type of integration are the Environmental Management Act in the Netherlands and the Swedish Environmental Code. The second way is external integration, i.e. the requirement that environmental considerations be integrated into the definition and implementation of other sectoral policies. Finally, the third way is exemplified by the Integrated Pollution Prevention and Control Directive of the EU, mentioned in section 3.3.1. This notion of integration is founded in the idea that in order to set emission limit values efficiently, the effects of industrial operations on all environmental media should be taken into account at the same time.[60]

- In response to mounting international political and public pressure, governments in developed and developing countries have been enacting more environmental legislation. While governmental enforcement of these regulations remains highly unpredictable, particularly in developing countries, the public has become an increasingly important instigator and enforcer of environmental measures.

- A related point is the mounting stringency of environmental standards for industrial facilities, not only in developed countries but also in developing nations. In this respect, measures such as the IPPC directive, which mandates a different perspective for the setting of emission limit values, the increasing use of life cycle analyses in the implementation of environmental policies, and the rising enactment of environmental liability regimes, often based on strict liability rules, have potential financial consequences for businesses operating under these new conditions.

For financial institutions, the significance of these legislative developments is perhaps not as straightforward as for the industrial sector. However, in the measure that financial institutions provide the capital for industrial operations, they can, and in fact have, become impacted by them. Examples include the famous 'US versus Fleet Factors Corporation' case, where a bank was held responsible for the first time for the environmental pollution of its client [61]; and the case of Banco de Colombia, a Colombian private bank, that was held responsible by the environmental ministry of this country for the cleanup of a 108-acre site contaminated with agrochemicals that the bank had received in payment of a loan.[62]

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[59] Gracer, Jeffrey B.(2000). *Green risks on the rise*. Latin Finance. [Online]. Available: http://www.redlisted.com/whats_new_latin.html. [August 19, 2002]

[60] Faure, Michael G. (2001). *Environmental law and economics*. Institute for Transnational Legal Research. Maastricht University. pp. 283-285

[61] Jeucken, Marcel, Bouma, Jan Jaap. (2001). *The changing environment of banks*. In Jan Jaap Bouma et al.(2001). *Sustainable banking*. p. 24

[62] Gracer, Jeffrey B.(2000). *Green risks on the rise*. Latin Finance. [Online].

The expanding scope of environmental regulations also implies that while in the past only the most polluting industrial activities were affected by the requirements imposed by these regulations, this may no longer be the case. For instance, in the UK approximately 7,000 companies are caught in the net of the new Pollution Prevention Act, as compared to 2,000 under previous environmental legislation. In practical terms this has meant that almost all companies in the UK must now comply with environmental permitting in some area.[63] Even the financial sector itself has been affected in some countries by the widening scope of legislation, as is the case in the Netherlands, where the Policy Document on Environment and Economy lays out a strategy by which the financial services sector becomes directly involved in the achievement of environmental targets set out for several sectors of the Dutch economy, including agriculture, industry, transportation, and consumers. [64]

The impacts of stricter, wider environmental legislations represent different types of risks for financial institutions. For example, environmental opposition can increase project completion risk; major fines can impair a borrower's ability to repay; and foreclosure on contaminated property can create a risk of environmental liability, all of which can affect the financial status of a lender or investor. Another type of risk occurs when a financial institution becomes publicly associated to an environmentally controversial activity or company, negatively affecting its reputation. The case of the Bio-Bio River provides a good example of this type of risk.[65]

[63] Mc Curry, Patrick. (2000). The greening of due diligence. *European Venture Capital Journal*. p.2

[64] Jeucken, Marcel, Bouma, Jan Jaap. (2001). *The changing environment of banks*. In Jan Jaap Bouma et al.(2001). *Sustainable banking*. p. 36

[65] La Franchi, Howard (1998). *Indians, environmentalists vow rough water for Chile dam*. Christian Science Monitor. [Online]. Available: http://www.csmonitor.com/durable/1998/05/21/fp7s1-csm.htm, and Brown, Aleta (1998). *Anthropologists slam World Bank for indigenous rights abuses in Chile*. International Rivers Network. [Online]. Available: http://www.irn.org/programs/biobio/pr980402.html [August 29, 2002]

Box 1: Example of reputation risks for a financial institution

The IFC and the Ralco Dam development

The Bio-Bio River flows from the Cordillera of the Andes all the way to the Pacific Ocean. Over one million people use the resources of the Bio-Bio for drinking and irrigation water, recreation, and fisheries. The river has also been a prominent feature of Chile's national energy plans for several decades. As many as six hydroelectric dams were projected to harness the river's hydroelectric potential ever since the 1973-1990 dictatorship. In 1992, ENDESA, the largest private electric company in Chile, began construction of the first of these dams, the Pangue, a 450 MW development. The International Finance Corporation (IFC), the private sector arm of the World Bank, provided nearly $175 million for this development, including direct loans and brokered funds from several European public and private sources. The dam was completed in 1996, and is now operating upstream from where ENDESA announced plans to construct a second, larger, development, the 570 MW Ralco dam. This second development met strong opposition from environmental and Indigenous rights groups, arising from the fact that the Ralco dam was sited in the upper Bio-Bio, ancestral home to the Pehuenche group of Mapuche Indians. The dam was projected to flood over 70 km^2 of the river valley, inundating rare temperate rainforest in Southern Chile and its wildlife, and forcing the relocation of approximately 100 Pehuenche families. Despite massive public outcry from national and international environmentalists, human rights groups, and even whitewater rafters (the Bio-Bio is renowned for its rafting and kayaking), claiming that the development was contrary to recently enacted environmental and indigenous rights legislations, in 1997 the Ralco dam project was approved by the Chilean's government environmental office.

The IFC was not directly involved with the Ralco dam project financing, but it nevertheless came under heavy fire from the project's critics. The charges levelled at the institution ranged from human rights abuses to collusion in the withholding of information vital to the survival of the Pehuenche indigenous people and the breaking of its own policies on indigenous people and resettlement. The IFC was also criticised for allegedly misleading investors to the Pangue dam project who had voiced concerns about the project's environmental impact, by asserting that this was the only development planned for this river, in spite of having information about the plans to operate the Pangue dam in conjunction with the Ralco dam. Whether these charges were true or not, the IFC's institutional integrity, and its image as a financer of sustainable development, was negatively affected by this case.

To conclude this section, examples of tightening environmental legislations can be found all over the world. While the media and public attention continue to focus on global environmental problems, it is possible to infer that the trends in environmental legislation previously discussed will continue, and that they will keep on affecting both the industries and the providers of capital for industrial activities in various ways. As the scope of this legislations widens, as environmental liability becomes more common, and as public acceptability becomes an ever more important determinant of an enterprise's viability, it becomes crucial for financial institutions to pay due consideration of all applicable environmental requirements.

The following chapter provides further details about environmental risks and the practice of environmental risk management in the context of financial institutions.

4. Environmental review procedures for RET projects

This chapter will focus on the current environmental investment review procedures performed by financial institutions when reviewing RET projects. Section 4.1 will briefly address the environmental risk management of financial institutions in order to provide a common understanding of the terminology, concepts and practices related to this subject. Section 4.2 will proceed to describe the practices of the financial institutions approached for this research work according to the information obtained through the interviews and the examination of relevant documentation contained in their websites. Finally, section 4.3 will analyse the environmental investment review procedures, addressing the secondary research questions that were presented in section 1.3.

4.1 Environmental risk management of financial institutions

Environmental risk management (ERM) is a relatively new practice of financial institutions. Initially, it originated as a response to the increasing accountability of financial institutions for operations that have adverse effects on the environment. However, not only are the processes, systems and techniques of ERM continuously evolving, but also many new efforts are driven by strong institutional commitments to sustainability rather than by fear of potential exposures and defensive action against environmental risks and liabilities.[66] The following sections will take a closer look at this practice.

4.1.1 What are environmental risks?

Risks can be defined as the potentialities that stand between the ambitions and goals of an individual or organization and the realisation of those ambitions and goals. Some risks may help to achieve goals (in which case they are normally referred to as opportunities) and others may frustrate their accomplishment. However, whenever a risk is taken it is with the expectation of gaining something in return.

In the context of financial activities, risks are always present when the actual yield of an investment turns out to be different (either higher or lower) from the expected return. Thus, when this divergence from the actual yield and the expected outcome occurs because of environmental related reasons (e.g. an investment's impacts on the natural environment or environmental conditions that pose technical challenges), the risk can be referred to as an environmental risk.[67]

There are various types of environmental risks that financial institutions may face due to their lending or equity investment activities: [68]

- Impacts on asset values: The value of an asset may be drastically reduced due to contamination or environmental obsolescence of equipment. Conversely, the value of an asset may be increased due to the implementation of cleaner technologies and/or material and energy efficient practices and designs, which may reduce costs; or by favourable market reactions to an 'environmentally friendly' public image, which may increase income. A way in which this type of risk may affect a financial institution is if, for example, the institution is making a secured loan and holding the impacted asset as a form of security for loan repayment.

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[66] Barannik, Andrei D. (2001). *Providers of financial services and environmental risk management. Current experience.* In Jan Jaap Bouma et al. (2001). *Sustainable banking.* pp.247-249

[67] Figge, Frank (1998). *Systematisation of economic risks through global environmental problems-A threat to financial markets?* Zurich: Sarasin Basic Report. p. 5

[68] *European Bank for Reconstruction and Development (EBRD) environmental risk management manual.* [Online]. Available. http://www.ebrd.com/enviro/index.htm [August 8, 2002]

- Inability of borrowers to repay loans: Increasing environmental costs may affect the ability of a borrower to service debt. Examples of such costs include fines, penalties, cleanup costs, and legislation and permit compliance. This type of environmental risk is usually known as a credit risk, and may be further subdivided into financial risk and business risk. Financial risks arise from the possibility of late payment or non-payment of interest and principal due to lack of liquidity while business risks arise from the possibility of late payment due to circumstances relating to the customer's business activities and management. For example, a company's operations may be halted or its operating permits withdrawn because it is unable to comply with environmental standards.[69]

- Lender or investor liability: Environmental liability has the objective of making the causer of an environmental damage pay for its remediation. Depending on the liability regime of the host country, financiers face a range of different possible liability risks. Under joint and several liability, lenders and investors can be held liable for the reasonably foreseeable costs associated with an environmental violation caused by the current owner or operator of a site. Under strict (no-fault) liability, lenders can be held liable for an environmental violation even if the violation was not reasonably foreseeable. Under retroactive liability, lenders can be held liable for environmental violations on the project site or on surrounding sites, even though the violations occurred prior to the current owner taking over the site. Under direct liability, a lending institution can be held liable for an environmental infraction in a project that it helped to finance. Finally, under indirect liability, although it is the borrower that is held liable for an environmental infraction, he may pass on some of the compliance costs to a lending institution.[70]

- Reputation impacts: If a lender or investor becomes publicly associated with a company with poor environmental performance, this may affect his own public image, market position and future businesses in negative ways. In the same way, public association with a company with positive environmental image may lead to favourable impacts on the same aspects.

The degree of exposure of a financial institution to risks such as the ones presented above will depend on several factors, some related to the character of the environmental risk per se, and others to the character of the customer. Thus, when performing an assessment of the environmental risks posed by a particular project, in addition to their policies, financial institutions must take into account criteria related to both.

In terms of the character of environmental risks, factors that could be taken into account include probability of occurrence, magnitude, duration, sensitivity and irreversibility, social distribution of risks and benefits (e.g. whether the particular environmental impact is negative or positive), and relevance to legal mandates. In terms of the character of a customer, factors that could be taken into account include the client's capabilities (both managerial and technical), value and capital, commitment to meet environmental financial obligations, previous and current environmental performance, and the quality of any proposed securities or collateral.

Other factors that determine the financial institution's exposure to the risks are the size and type of the transaction, the term or duration of the transaction, and in the case of lending transactions, the terms and conditions of the loan.[71]

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[69] Red Listed.com (2001). *Environmental risk management and FAQ*. [Online]. Available: http://www.redlisted.com/methodology_faq.html#4 [August 8, 2000]

[70] Red Listed.com (2001). *Environmental risk management and FAQ*. [Online].

[71] Barannik, Andrei D. (2001). *Providers of financial services and environmental risk management.*. In Jan Jaap Bouma et al. (2001). *Sustainable banking*. pp. 255-256

4.1.2 How are environmental risks managed?

In simple terms, risk management can be put as all the things that need to be done in order to ensure that the future is sufficiently certain. Human beings commonly try to manage the risks that we face in our daily life to a greater or lesser extent, depending on our personality and experience. Our institutions are no different, but in their case the process of risk management normally takes a more professional character. In the particular instance of ERM, it may be defined as the " consistent and systematic process of managing an organisation's risk exposures to achieve its goals effectively and efficiently, and in a manner consistent with public interest, environmental dimensions, human health and safety, and the law. "[72]

A standard process of ERM entails several steps, which are schematised in the following diagram.

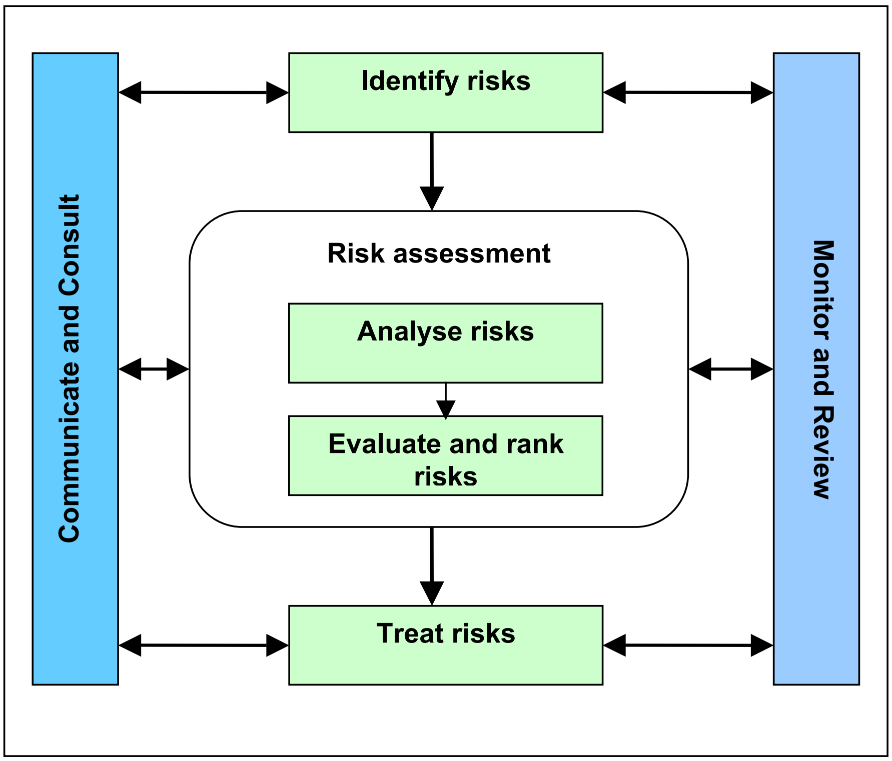

Figure 14: The ERM process. Adapted from: New Zealand Society for Risk Management (2001)

- Risk identification. The first step is to identify the environmental risks to which the organization is, or may be, exposed. This step is conceptually straightforward, but complex in practice.

- Risk assessment: This step includes two different processes: First, the analysis of the identified risks in order to determine their characteristics (e.g. probability of occurrence, magnitude, duration, etc.). Second, the evaluation of the analysed risks in accordance to the institution's policies, in order to determine their ranking (e.g. low, medium or high sensitivity scales). Without this step, it is difficult for the financial institution to communicate the nature of the risks or to decide the appropriate risk treatment procedure.

[72] Barannik, Andrei D. (2001). *Providers of financial services and environmental risk management.*. In Jan Jaap Bouma et al. (2001). *Sustainable banking*. pp. 257

- Risk treatment. The last step of the process is to determine the risk management procedure that will be followed by the institution. This should be based on the financial institution's risk tolerance and control techniques. The feasibility of alternative management scenarios may be evaluated in order to certify that not only are the risk management procedures keeping the expected returns within acceptable risk tolerance levels, but that they are doing so at the lowest possible cost (efficiency test).

Throughout the performance of the different steps, the responsible ERM unit should keep a continuous flow of communication and consultation not only at an internal level (within the institution) but also at external levels, i.e. with the customers and other stakeholders. Similarly, the assumptions and models used in the different process steps should be continuously monitored and evaluated. These precautions should help keep the ERM process relevant and consensual, and avoid problems such as evaluating risks on the basis of outdated assumptions.

4.1.3 Instruments for environmental risk management

According to Figge (1998), all the instruments available for risk management can be classified under one of the following categories:

- Information: The role of information instruments is to reduce the uncertainty that exists prior to making a decision, by improving the quality of available information. In other words, this instruments help to reduce pre-investment risks.[73]

- Diversification: The idea behind diversification instruments may be simply expressed as "avoiding to put all your eggs in one basket". What this means is that the risk of an investment portfolio is spread among different asset classes that should not be interdependent (i.e. systematic), so that even if one type of asset shows unfavourable results, the overall investment returns of the whole portfolio may still be compensated by favourable returns in other asset classes. This is a post-investment instrument.

- Reserve accumulation: Reserves are the portions of assets set aside to cover possible losses. The reserves must be built up to a level that matches the risk that they are supposed to be covering. This is also a post-investment instrument.

Figge (1998) argues that environmental risks should be managed primarily through information and reserve accumulation instruments because of what he terms their " double systematic " nature, which makes it impossible for them to be eliminated through diversification instruments.[74]

In this document we are primarily concerned with ERM instruments that are used by financial institutions in the period prior to the actual investment or loan decision, or in other words with information instruments.[75] Specific tools in this category include the following:

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[73] Information instruments may also be used after an investment decision is made, for instance in the case that there is an opportunity to 'rethink' about an investment decision that has already been made. This can occur for share buying and selling and real estate acquisitions.

[74] Figge explains the double systematic nature of environmental risks as systematisation that occurs not only across a portfolio of assets, but also across consecutive periods, which means that the risk will not be eliminated through diversification even when considering a long period of time. For more details, see: Figge, Frank (1998). *Systematisation of economic risks through global environmental problems.* pp. 13-14

[75] The main source for the following paragraphs is: Barannik, Andrei D. (2001). *Providers of financial services and environmental risk management.*. In Jan Jaap Bouma et al. (2001). *Sustainable banking.* pp. 258-260

- Environmental audit: This entails a thorough, documented, periodic and objective investigation into the current environmental conditions of a specific customer and his proposal, with the objective of determining the existence of any past pollution, current environmental concerns, the quality of environmental management and the status of compliance with regulatory requirements, including those for health and safety, as well as to identify ways and means of improving overall environmental performance. Environmental audits provide a picture of an organization at a specific moment in time.

- Environmental assessment (EA): EA covers a number of instruments designed for specific purposes, including environmental impact assessment (EIA), and risk and hazard assessment, among others. EA helps to identify ways and means of evaluating and mitigating future environmental consequences and risks (including health, safety and social), as well as enhancing environmental benefits. EA usually include the proposal of an environmental action plan (EAP), in order to ensure that the mitigating measures identified are carried out during the project's life cycle.

Generally environmental audits are performed for existing operations, while environmental assessments may be applied both to existing and proposed operations. Traditionally these instruments have been primarily used by the project sponsor (i.e. the individual or corporation seeking financial support or insurance). However, they have been increasingly utilised, and contracted to external consulting firms, by the financial institutions themselves.[76]

In addition to the information instruments that have just been mentioned, financial institutions have developed a number of strategies to transfer environmental risks and financial exposure associated with their core business. These strategies include contractual provisions, environmental insurance, and guarantees. These strategies cannot be classified into any of the three categories of instruments previously mentioned, although they are likely to reduce the uncertainty related to potential investments. Therefore, they will not be examined in this document.[77]

4.1.4 How does environmental due diligence fit in with ERM?

Environmental due diligence is a practical expression of a financial institution's ERM investment policy.[78] It can be defined as a detailed, comprehensive and systematic review of a proposed investment that has two main objectives:

- To ensure that the environmental aspects of an investment proposal are taken into account alongside economic and social issues during the investment decision process.

- To ensure that the proposed investment does not carry environmental liabilities beyond those that have been clearly defined in an investment proposal.

EDD may take place both before and after the investment decision is made.

The overall purpose of a pre-investment EDD is to provide a sound base for a financial institution's investment decision-making by improving the quality and quantity of information available for the decision process.

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[76] Barannik, Andrei D. (2001). *Providers of financial services and environmental risk management.*. In Jan Jaap Bouma et al. (2001). *Sustainable banking*. p. 260

[77] For a brief introduction to these strategies see: Barannik, Andrei D. (2001). *Providers of financial services and environmental risk management.*. In Jan Jaap Bouma et al. (2001). *Sustainable banking*. pp. 258-259

[78] The information for this section was derived from a variety of sources, including literature review and interviews. The two main sources are: Barannik, Andrei D. (2001). *Providers of financial services and environmental risk management.*. In Jan Jaap Bouma et al. (2001). *Sustainable banking*. pp. 260-262, and Hübschen, Emma (July 14, 2002) Telephone interview

Generally, the EDD procedure of a financial institution begins at the operational level, with a formal or informal screening of the environmental risks of both the proposed investment and of its applicant. Many financial institutions rely on internal checklists or questionnaires, environmental risk handbooks, and due diligence manuals that outline and interpret corporate environmental policies and procedures. The objective of the initial screening is to help identify important environmental data that may be missing as well as potential 'red flags', i.e. environmental risks (and opportunities) or liabilities that may require further investigation, mitigation and allocation (e.g. apportioning the risk between the project developer and the financial institution).

The criteria for identifying missing data and potential red flags should always be based on applicable environmental legislations, regulations and standards. In this sense, a crucial part of the EDD process is the establishment of the legal framework that applies to the proposed investment at international, national and local levels. While an investment decision will ultimately depend on a financial institution's own policies, these should never substitute or replace international, national and local regulations during the EDD process. For instance, a bank may routinely require EIA for certain types of investments as part of its due diligence procedure. However, some countries have legislated mandatory EIA for specific sectors, and thus if a proposed investment falls under a legislated category then EIA must be performed regardless of whether the category was contemplated in the bank's policies or not. In addition, the actual performance of the EIA in this case would have to be in accordance to the legislation, and only after that to the bank's standards.

Environmental standards and regulations are also used to identify past and present environmental liabilities, as well as those that might be imposed in the future due to changing environmental legislations (e.g. in European Union countries in account of EC legal standardization requirements). Ideally, the legislation will point out what measures are necessary for the mitigation or prevention of environmental risks and liabilities, although in practice this may not always be the case and the financial institution may have to rely on well recognized 'best practice' measures such as those recommended by the World Bank or other similar institutions.

Later stages of the EDD process usually become increasingly detailed and include site visits and public consultations, although the specific steps of the EDD will depend on factors such as the ERM policies of the financial institution, the type of project and its environmental sensitivity, and the country in which the operation will be implemented, among others.[79] The final result of a pre-investment EDD is a report that incorporates the main findings of the whole review process, including those of the project's EIA, environmental audit, or other environmental investigation; highlighting regulatory compliance issue such as permitting and mitigation measures; the adequacy of proposed environmental action plans (EAPs); and requirements for legal documentation that has not already been included in environmental covenants or treaties. In addition, references to environmental standards and regulations have to be included in the legal documentation, and in such cases the environmental covenants will specify conditions to ensure compliance with all applicable standards, regulations and laws. [80] Where applicable, the EDD final report will also include the remediation costs of potential environmental liabilities, for instance the clean up costs of polluted sites or the cost of non-compliance fines and penalties.[81]

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[79] Public consultation has become increasingly important as a determinant of the public acceptability of a proposed investment. In 1999, the IFC published a Good Practice Guide for Public Consultation and Disclosure, which is increasingly used by financial institutions for this purpose. Public consultation has also become more important in developing countries. For instance, in Latin America, countries such as Chile have enacted legislations that open project reviews and approval to public scrutiny.

[80] EBRD. (1996). *Environmental procedures*. [Online]. Available: http://www.ebrd.com/enviro/index.htm [August 8, 2002] p. 13

[81] For activities such as corporate buyouts and acquisitions, the calculation of the cost of potential liabilities is one of the most important components of the report, and one of the main differences between an EDD review process and other

Once an investment is cleared, the project sponsor and the financial institution have signed the necessary legal documentation and disbursement has been made, the post-investment EDD procedures include project monitoring, supervision, and evaluation to ensure compliance with environmental conditions and agreements.

The following figure summarises the information provided in the preceding paragraphs, and illustrates a general EDD procedure.

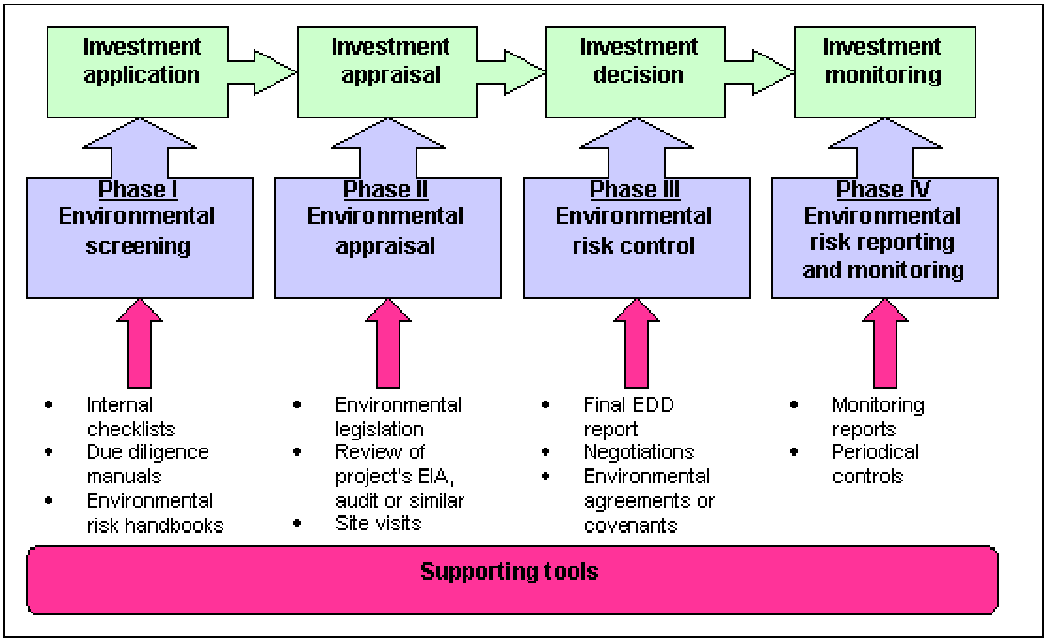

Figure 15: Phases of an environmental due diligence procedure. Adapted from: IFC ERM in lending and investing

Other questions that might be asked in relation to EDD are where in the investment review process is it taking place and who is responsible for its performance. While there is no universal answer to these questions, as will be illustrated in section 4.2, some common points may be discussed.

Ideally the EDD should start near the beginning of the planning and decision making process, since early identification of missing data and potential risks and liabilities enhances the opportunities for sound investigation of the issues and increases the potential value of the EDD as a decision support process. Some institutions carry out a pre-screening of investment applications, in order to 'sieve out' the ones that clearly do not comply with their ERM requirements or policies, and thus perform EDD only for those investments that pass this initial stage.

In terms of who is responsible for carrying out the EDD review process, this will in the first place depend on whether the EDD review is carried in-house or if it is contracted to an external consultant. In turn this will depend primarily on the size of the firm and on its investment philosophy, although generally a financial institution will assign the overall responsibility for the EDD review process to an in-house unit, regardless of whether the actual performance of the EDD is contracted to an external firm. In the case of in-house reviews, the EDD may be carried out by a dedicated individual or team within the financial institution's organization, e.g. 'EDD unit(s)', or it may be the responsibility of the

types of environmental appraisal procedures such as EIA. In these cases, the EDD report provides information about how environmental liabilities affect a proposed deal, and whether they could have an impact on pricing negotiations. For investment review procedures the possibility of pricing liabilities will depend on the type of project being analysed.

individual or team assessing the particular investment. In addition, different stages of the EDD may be the responsibility of different individuals or teams.

Having provided a brief background of ERM and EDD practices, the next section will describe the environmental review procedures implemented by some financial institutions for RET investments.

4.2 Description of environmental review procedures for RETs

The following sections will describe the environmental review procedures followed by selected financial institutions. It must also be noted that the description of the International Finance Corporation (IFC) procedures will be done in more detail than those of other financial institutions. The reason is that many financial institutions (including some contacted for the thesis) apply IFC-based procedures and guidelines in their own review processes, and therefore many of these have become de-facto standardized EDD tools in the financial world. All financial institutions featured in the thesis are briefly described in Appendix 1. [82]

4.2.1 Environmental review procedure of the International Finance Corporation (IFC) [83]

The International Finance Corporation (IFC) is a member of the World Bank Group, which also includes the International Bank for Reconstruction and Development, the International Development Association, and the Multilateral Investment Guarantee Agency.[84]

Objective

The IFC's environmental and social review procedure has two main objectives:

a. Outline the process by which the organization determines the adequacy of the project sponsor's environmental assessment for a proposed project.

b. Work with the project sponsor to address environmental and social issues and opportunities associated with the project.

The overall purpose of the environmental and social review is to ensure that the project complies with applicable IFC environmental and social polices and meets the applicable guidelines. In sectors where no appropriate IFC policies or guidelines exist, IFC applies internationally recognized standards. However, the IFC stresses that it is the project sponsor's duty to ensure compliance with host country requirements.

Policies and guidelines

The environmental review procedure for renewable energy technologies that is followed by the World Bank Group organizations is, in principle, no different from that applied to any other project in the

[82] For the thesis, three other financial institutions were contacted: the European Bank for Reconstruction and Development, the German Investment and Development Company, and the Interamerican Investment Corporation. Their environmental review procedures are not featured in the body of the thesis, because they were considered as similar to those of the IFC, particularly in the case of the latter two institutions. However, a summary of the three procedures is included in Appendix 5.

[83] Unless otherwise noted, the main source for this section is: IFC. (1998). *Environmental and social review procedure.* [Online]. Available: http://www.ifc.org/enviro/EnvSoc/ESRP/esrp.htm [August 17, 2002]

[84] International Finance Corporation (IFC). (2000). *Basic facts about IFC.* [Online]. Available: http://www.ifc.org/about/basicfacts/basicfacts.html [August 17,2002]

World Bank and is covered by the World Bank's policies. In the narrow sense of the term environment, the Group policies are covered by Operational Policy 4.01 (OP 4.01) on Environmental Assessment and its associated Bank Procedure. In a wider sense, the environment is covered by several safeguard policies, which include such issues as natural habitats, pest management, cultural heritage, and others.[85] Appendix 6 provides a brief description of the main World Bank operational policies that are applicable to IFC investment review procedures.

Besides these policies, the IFC follows the environmental, health and safety guidelines of the World Bank Group during its investment review procedure. These include the Pollution Prevention and Abatement Handbook (PPAH), the World Bank's Occupational Health and Safety Guidelines, and the Good Practice Manual for Public Consultation and Disclosure. In addition, the IFC is using its own environmental, health and safety guidelines for certain sectors that were not covered in the PPAH. Of particular relevance for RET projects are the guidelines prepared for geothermal projects, wind energy conversion systems, and plantations. These guidelines cover environmental aspects (e.g. acceptable techniques for dealing with emissions to air, water and soil, maximum admissible levels of pollutants in effluent emissions, maximum allowable ambient noise levels, and others), as well as work health and safety issues. For instance, the IFC plantation guidelines cover aspects such as land use, water use, use of pesticides, use of chemical fertilisers, liquid effluents and solid and liquid wastes. The work health and safety aspects of plantations include workplace noise, hazardous material handling and storage, and field application of pesticides. The environmental aspects included for wind energy conversion systems include project siting, erosion and sediment control, ambient noise, protection of wildlife habitat, visual resources, public safety, and hazards protection. [86]

Responsible unit

The IFC's Environment and Social Development Department (ESDD) is responsible for the environmental and social review, clearance and supervision of the proposed projects. The ESDD assesses whether each project will comply with applicable policies and meet the applicable guidelines, coordinates with the World Bank as necessary, and makes the Investment Department aware of any issues that are not in conformity with these requirements. Other people involved in the environmental review procedure include a technical specialist that provides support to the Investment Departments, the ESDD and the project sponsor on technical matters, including technical aspects of environmental performance, as appropriate; and a lawyer that provides support on legal matters, including drafting the environmental and social provisions in the project's legal documentation.

Environmental review stages

Each stage of the project's investment life cycle[87] has an environmental component. Thus, the IFC's EDD procedure covers the four main phases illustrated in Figure 15.

a. **Project identification and assignment of the project team**: At this stage, the responsible Investment Officer (IO) requests the assignment of the ESDD team specialists.

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[85] Spencer, Richard (Rspencer@worldbank.org). (July 17, 2002). *Investment due diligence process for RETs*. E-mail to Gloria Argueta (Gloria.Argueta@student.iiiee.lu.se)

[86] These guidelines can be accessed at: IFC. (2000). *Guidelines*. [Online]. Available: http://www.ifc.org/enviro/enviro/pollution/guidelines.htm [August 22, 2002]

[87] An investment's life cycle should not be confused with the life cycle stages of an RET project that were discussed in chapter 3. In the context of the financial institution, the life cycle of an investment refers to the different stages through which an investment goes through from the moment that its application is submitted for consideration, to the moment in which the investment ceases to be included in the financial institution's project portfolio (e.g. at the end of the loan term).

b. **Early review**: The purpose of the Early Review is for IFC to give a quick decision to a project sponsor on whether the Corporation is interested in engaging in the project. If sufficient information is available at this stage, the ESDD screens the project, assigns the project category and issues the Environmental and Social Information Memorandum (ESIM). If there is insufficient information to prepare an ESIM, the project team requests additional details from the sponsor. Based on the results of the early review stage, the IFC senior management assesses the appropriateness of the project as an investment for IFC and, if so, authorizes the project appraisal.

c. **Project appraisal**: This is the stage in which IFC staff conduct a detailed evaluation of the project in terms of business potential and environmental, social and technical concerns, and review information provided by the project sponsor.

During the appraisal process, the ESDD examines the project's potential positive and negative impacts, compares them with those of feasible alternatives (including the 'without project' scenario), and recommends any measures needed to (in order of preference) prevent, minimize, mitigate, or compensate for adverse impacts, and to improve the project's environmental performance.

The specific steps that need to be followed for an EA in this stage depend on the category in which the project has been classified during the screening process. An IFC project may be classified as A, B, C, or FI. The classification of a project in any of these categories depends on the type, location (e.g. proximity to or encroachment on environmentally sensitive areas, such as mangroves, wetlands, and rain forests), sensitivity (a potential impact is considered 'sensitive' if it may be irreversible, e.g. lead to loss of a major natural habitat; affect vulnerable groups or ethnic minorities; involve involuntary displacement and resettlement; or affect significant cultural heritage sites), and scale of the project (this needs to be judged by the environmental and social specialist in the project context; in general large-scale projects are categorized as A) as well as the nature and magnitude of its potential impacts. The IFC project categories and corresponding EA procedures are shown in Table 5.[88]

The length of time required for the environmental and social review depends on the completeness of the information provided by the project sponsor, the overall complexity of the project, and the potential project impacts on the physical, biological and human environment. During the review, data gaps or other deficiencies in the project sponsor's EA may be identified. In addition, questions or concerns about the environmental and social information may arise. In these cases, the project sponsor is contacted to seek clarification or additional information.

Specific ESDD activities associated with the review process depend on the category of the project:

- Category A projects require a site visit by one or more ESDD staff or by an external consultant, in order to gain direct knowledge of the project, to meet with the project sponsor, and to discuss environmental and social concerns and information needs, explain public consultation and disclosure requirements, and determine the issues that must be addressed in the EA. In addition, the ESDD must perform a desk review of the EA report provided by the project sponsor and other relevant information provided by the project review team.

- Category B projects usually only require the desk review of relevant information, although site visits may be required for the more complex projects. Once the IFC has concluded reviewing the project sponsor's EA, the ESDD prepares a Environmental Review Summary (ERS) which contains a project description, the rationale for the project categorization, the list of key environmental, social, health and safety issues, details of the mitigation measures to bring the project into compliance with IFC's requirements, an outline of any outstanding issues and information on the project's monitoring and reporting program to ensure compliance.

[88] The project sponsor has the primary responsibility for carrying out the EA procedures shown in Table 6.

- Category C projects do not require further environmental review procedures beyond screening and categorization.

- Category FI projects require verification of the financial intermediary's capability and commitment to meeting IFC requirements.

Table 5: EA procedure for different IFC project categories

Category	Definition	Necessary EA procedure
A	Project that may have significant adverse environmental impacts that are sensitive, diverse or unprecedented, and that may affect an area broader than the sites or facilities subject to physical works.	• EIA • Environmental action plan (EAP) • Public consultation with relevant stakeholders including affected groups, NGOs and local authorities about the project's environmental and social aspects This consultation must take place at different project stages (at least twice). • Public disclosure.
B	Project that may have potential adverse impacts on human populations or environmentally important areas, but to a lesser degree than an A project (e.g. impacts may be site specific, mostly reversible, or with readily available mitigation measures).	• EA scope is usually narrower than for Category A projects: • EIA • Environmental action plan (EAP) • Public consultation with relevant stakeholders (only for special cases). The consultation only needs to take place once. • The information contained in the project's Environmental Review Summary (ERS) is subject to public disclosure.
C	Project likely to have minimal or no adverse environmental impacts.	Beyond environmental screening, no further EA action is required.
FI	Project that involves investment of IFC funds through a financial intermediary (FI) in subprojects that may result in adverse environmental impacts. Projects that are likely to have minimal or no adverse environmental impacts are always classified as C.	Depends on the type of project, and the financial intermediary's activities.

d. **Investment review meeting**: Prior to the Investment Review Meeting for the project and upon agreement that the project can comply with the applicable IFC policies and meet the applicable guidelines, the ESDD issues the Environmental and Social Clearance Memorandum (ESCM) to the Investment Department. The ESCM clears the project for Board consideration and details outstanding issues as well as the actions required to address those issues. Project monitoring and reporting requirements are also identified, as are other obligations of the project sponsor. This clearance does not certify the project's performance against host country requirements (as mentioned earlier, this is responsibility of the project sponsor).

e. If the IFC board approves the investment application, the post investment decision stages of the environmental review procedure include the update and revision of the EAP and of the ERS (the latter only for Category B projects) to reflect pertinent investment agreements; the monitoring and supervision of the project; and the project's environmental and social performance evaluation.

4.2.2 Environmental review procedures of the German Agency for Reconstruction (KfW)

The German Agency for Reconstruction- Kreditanstalt fur Wiederaufbau, or KfW, does not apply specific criteria or procedures for assessing the environmental impacts of renewable energies. Instead, the organization uses the standards that have been formulated in general terms for all projects to be financed within the scope of German Financial Cooperation.[89]

Those general standards are set by the German Ministry of Economic Cooperation and Development (BMZ), a governmental institution that provides considerable support to developing countries through activities administered by KfW.[90] Consequently, KfW is usually concerned in large-scale infrastructure development projects that cover several sectors, for instance road construction, or huge power plant developments.[91] In this sense, a renewable energy project would only be a small component of a typical KfW operation.

The main environmental requirement established in the BMZ standards is that the proposed projects undergo an EIA. In this context, the objective of the EIA is to ensure that the development cooperation projects generate no unacceptable environmental impacts, and that they follow the principles of ecological sustainability.[92] The standards and procedures for EIA have been compiled in an environmental handbook prepared by the BMZ, in cooperation with KfW and the German Agency for Technical Cooperation (GTZ). This handbook contains a number of environmental briefs that provide an overview of the environmental impacts and known environmental protection measures for different sectors. The purpose of these briefs is to serve as a working aid for the planning stage of a project, and also for the final evaluation by a financial institution. [93]

Renewable sources of energy are covered in the BMZ environmental handbook. The environmental brief for renewable energy projects deals with the environmental impacts and protective measures necessary for solar energy (heat and PV), energy from biomass (burning, gasification, biogas, and biofuels), wind energy, hydropower, and geothermal energy. The brief also contains notes on the analysis of the environmental impacts of the different renewable energy systems, a brief overview of the way in which a proposed renewable project could interact with other sectors (e.g. a project's possible impacts on agriculture, water supply, and transportation), and a summary assessment of the environmental relevance of renewable energy projects.[94]

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[89] Seifried, Rolf (Rolf.Seifried@kfw.de) (July 25, 2002). *Re: Environmental due diligence of renewable energy investments*. E-mail to Gloria Argueta (Gloria.Argueta@student.iiiee.lu.se)

[90] World Association of Industrial and Technological Research Associations (WAITRO). (2000). *BMZ brief.* [Online]. Available: http://waitro.dti.dk/Sources/bmz.htm [August 25, 2002]

[91] Weiler, Wolfgang (August 28, 2002). Telephone interview

[92] Seifried, Rolf (July 25, 2002). *Re: Environmental due diligence of renewable energy investments.*

[93] An electronic version of the complete environmental handbook is available at: http://www.gtz.de/uvp/publika/English/begin.htm [August 24, 2002]

[94] For more details see: BMZ (n.d). *Environmental Handbook: Documentation on monitoring and evaluating environmental impacts. Volume II: Agriculture, Mining/Energy, Trade/Industry.* [Online]. Available: http://www.gtz.de/uvp/publika/english/vol224.htm#43 [August 24, 2002]

4.2.3 Environmental review procedures of the Finnish Fund for Industrial Cooperation (Finnfund) [95]

To date Finnfund has not yet invested in the renewable energy sector, but the organization is currently in the process of reviewing and analysing a number of possible RET investment opportunities, particularly for biomass, solar PV, and wind conversion technologies.

The environmental review procedure at Finnfund is somewhat different from the ones that have been presented up to this point: the organization has not established a separate environmental due diligence process. Instead, it has a general investment due diligence procedure that includes environmental aspects. Another difference is that Finnfund is a relatively small organization, in terms of both money and human resources. Therefore their project cycle, investment requirements and investment ceilings (both participatory and monetary) are different than those of larger organizations. So far, their EDD procedure covers mainly Phase II of figure 15.

Finnfund has three basic requirements for project eligibility. First, it will normally only consider investment proposals that have a Finnish interest, e.g. involving a Finnish corporate partner, or with a Finnish company providing technology, operation or maintenance. The organization may also review a proposal involving no direct Finnish industry participation, but in this case the project has to be implemented in a target country of Finland's development aid. This covers the countries classified as 'developing countries' in the Development Aid Committee (DAC) of the Organization for Economic Cooperation and Development (OECD).[96] Second, Finnfund will normally not accept a project's development risk. Consequently, in order for a project to be considered for investment, its sponsor should be able to demonstrate that it is a bankable undertaking. A third requirement for eligibility is that the project concept conforms to the organization's policies, including its social and ethical mandates.

If a proposed investment complies with those general requirements, the first step of the review process is the financial due diligence. For this step, Finnfund will usually require a financial model of the project. The investment officer will perform sensitivity analyses of this model in order to ensure that the project's rate of return is acceptable to the organization. If the project passes this stage, it goes to next steps of the investment approval process, which include some environmental aspects, although these are not yet as established or formalised as their financial due diligence procedures.

Finnfund often participates as a co-financier with other financial institutions. These may be other development financial institutions, including multilateral development agencies, institutional investors, and/or export credit agencies (in which case, commercial banks are also involved), among other possibilities. Whenever co-financing is involved, the legal and environmental due diligence aspects take centre stage. This is particularly true for the renewable energy sector, since so far most of the RET investment proposals reviewed by Finnfund have concerned other financiers. In these cases, Finnfund will work closely with its co-financial partners in order to determine a single set of legal and environmental information that will be required of the project sponsor. This has the advantage of reducing the project transaction cost both for the financial institutions as well as for the project sponsor, who is then exempted from having to comply with different requirements from each of the financiers.

Finnfund will generally require an EIA of a proposed investment, especially for energy sector operations. The actual appraisal of the EIA and other EDD procedures are normally contracted to an external consultant since the organization does not have an in-house environmental specialist. Nevertheless Finnfund is working on formalizing and strengthening their in-house EDD. First of all,

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[95] Unless otherwise noted, the main source for this section is: Korhonen, Helena (July 29, 2002) Telephone interview

[96] Finnfund (n.d.) *Finnfund in brief*. [Online]. Available: http://www.finnfund.fi/ [August 24, 2002]

they are currently developing an internal EDD guideline for its investment review procedure. The draft is at an internal discussion and revision phase prior to its acceptance and implementation. The objective of this EDD guideline is to aid in the evaluation of the environmental aspects and impacts of an investment opportunity, including its social and ethical aspects, thereby providing support for the decision-making process. They have also been discussing the possibility of adding an environmental specialist to their staff.

4.2.4 Environmental review procedures of Sustainable Asset Management (SAM)[97]

SAM is the youngest financial institution featured in the thesis. Their main distinguishing characteristic from the institutions described so far is that it is a private company that has based its business strategy in the provision of sustainable-oriented financial services. One of these services is a private equity fund, which makes venture investments in technology companies that according to SAM "contribute to more sustainable use of resources".[98] Their equity fund focuses in three thematic areas: emerging energy, resource productivity and healthy nutrition. One of the areas of interest within the emerging energy theme is the renewable energy sector.[99] In this sector, the company has worked with wind energy, wave energy and solar PV.

Like Finnfund, SAM has not established a separate environmental due diligence procedure, but rather has a general investment due diligence that includes some environmental aspects, and which covers mainly Phase II of figure 15. Unlike Finnfund, SAM as a venture capital firm does participate in start-up businesses in selected cases. For example, one company in its private equity portfolio is Ocean Power Delivery, a Scottish early stage wave energy company, whose product is a snake-like floating device to be moored offshore in water depths of 30-100m that converts the waves' movement into electricity.[100]

The company has established a series of criteria for investment eligibility. These criteria include market criteria, potential rate of return, management capacity, technological potential and operational practices of the potential investment company.[101]

SAM's private equity team consists of 4 principals (team heads), specialised investment analysts, investment committee members, and staff. They all participate in different stages of SAM's investment review procedure, which comprises 5 main stages:

1. Review (resulting in a 1 page document)
2. Pre-screening (ca. 3 pages)
3. Preliminary Assessment (ca. 8 pages)
4. Due Diligence

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[97] Unless otherwise noted, the main source for this section is: Wüstenhagen, Rolf (rolf.wuestenhagen@sam-group.com) (July 18, 2002) *Re: Questionnaire for investment review procedures at SAM*. E-mail to Gloria Argueta (Gloria.Argueta@student.iiiee.lu.se)

[98] Sustainable Asset Management (SAM). (2001). *Private equity*. [Online]. Available: http://www.sam-group.com/e/priveq/priveq.cfm [August 26, 2002]

[99] SAM (2001). *Private equity*. [Online].

[100] SAM (2001). *Private equity*. [Online].

[101] SAM (2001). *Private equity*. [Online].

5. Investment application review, and deal structuring

Steps 1 and 2 are performed by the responsible investment analyst (with feedback from a principal), steps 3 and 4 involve all four principals and the investment committee, which also includes four outside experts. Step 1 is typically done based on the potential investment company's business plan, whereas in later stages, the private equity team will interact with the company and with other industry experts.

For its due diligence procedure, SAM has developed a checklist format, which covers a range of subjects including financial, legal, regulatory, managerial, and operational aspects. Environmental issues are not dealt with separately in this checklist. However, according to a company official, SAM's requirement that a potential investment has to provide some sort of sustainability added value, which is taken into account from the review phase on, ensures that potential environmental, health and safety issues are considered during the investment appraisal.[102]

4.2.5 Environmental review procedures of E&Co/Energyhouse[103]

E&Co/Energyhouse is a private development institution dedicated to the promotion of clean energy small and medium enterprises (SMEs) in developing countries. The institution provides both business development services and modest loan and equity investments.[104]

Since part of the company's business is providing project development services, E&Co will usually come on board an operation very early on, often before the development phase of a project has fully started. There are basically two ways in which the institution may become acquainted with a project proposal. One possibility is when a project sponsor participates in an E&Co supported training program, which is advertised by the institution through Internet or local partners. In order to qualify for attendance, the project sponsor is required to submit a three-page document describing his proposal. A second possibility is if the project sponsor decides to submit a project proposal directly to the company. Either way, the sponsor is asked to follow the established proposal submission format, which can also be accessed on the Internet or through local partners.[105]

Upon reception of a submission, an investment analyst will screen it against a very basic set of institutional criteria. These criteria cover aspects such as the project's potential to attract new sources of investment[106], social, environmental and technological elements, and potential risks of the operation (e.g. host country risks such as inflation, devaluation, taxation, and political uncertainty, and inherent market and regulatory risks such as competition, energy purchase/sale agreements, environmental and land regulations, and permitting). These criteria are formulated as questions. For example, for the social and environmental part, the investment analyst would have to answer questions such as "Does the energy enterprise or project improve the quality of life through the provision of energy services?" or " Will the project improve or protect the local, national, and global environment?" in relation to the investment. [107]

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[102] Wüstenhagen, Rolf (July 18, 2002). *Re: Questionnaire for investment review procedures at SAM*

[103] Unless otherwise noted, the main source for this section is: Lundgren, Annika (August 20, 2002) Telephone interview

[104] E&Co (n.d.). *Basic services*. [Online]. Available: http://www.energyhouse.com/investment_services.htm [August 26, 2002]

[105] The proposal is available at : http://www.energyhouse.com/investment_guide_structure.htm [August 26, 2002]

[106] E&Co refers to this as the project's potential to establish a 'pipeline' of projects for future investment by others.

[107] The full set of project eligibility criteria may be viewed at: http://www.energyhouse.com/investment_guide.htm [August 27, 2002]

Although all of the previous criteria are important in establishing the project's eligibility, two of the most fundamental points are the project's technological maturity, and what E&Co terms the "but for" question. In relation to the first point, the institution will normally not invest in projects that are not based on mature, sufficiently proven technologies. In this sense E&Co clearly differs from SAM in that it will usually not consider projects in which the technology is still undergoing an experimental phase.[108] The second point refers to the question of whether the project could receive finance from another source: "But for the participation of E&Co, would the project succeed?" Since E&Co is trying to fill a niche, if it considers that the project could receive finance from a traditional bank or from another development agency, it would generally not pursue the investment.

If a project passes the initial screening process, the next stages of project appraisal follow a standard investment due diligence procedure that covers issues such as general project information, and financial and technical issues. Similarly to Finnfund and SAM, E&Co has not established a separate EDD procedure, but rather follows a general due diligence that includes some environmental issues. For this purpose, the institution has developed a standard due diligence question list, which has a separate section covering general environmental and social impacts. Environmental risks are also highlighted in a section devoted to project risks and mitigation measures. In addition, the company has developed a format for risk analysis and due diligence that has separate sections for investment analysts and for project entrepreneurs. The format is designed as a checklist of basic, or 'starter', risk issues, and includes some environmental aspects.

4.2.6 Environmental review procedures of Triodos International Fund[109]

Triodos International Fund is a Netherlands-based private investment company, which is part of the Triodos Bank group. Triodos Bank promotes itself as a socially responsible institution that specialises on the financing of enterprises that add social, environmental, and cultural value. The Group has branch offices in the Netherlands, Belgium and the UK. It focuses in a number of different sectors, ranging from complimentary health services to organic food and farming and social businesses.[110] The renewable energy sector is also one of the Group's focal areas, and the bank has established or participates in a number of funds for the promotion of this type of project. This funds include the Dutch Wind Fund, launched in 1993, the UK Wind Fund, launched in 1995, and the Solar Development Group Fund, which is an international fund financed by the IFC Solar Development Group project, a partnership between the World Bank and a number of U.S. charitable foundations.[111]

Triodos International Fund is currently only active in wind energy systems in the Netherlands and in solar PV in developing countries. The investment review procedures for these two categories are different.

For wind energy systems, the investment review procedure is relatively simple. Triodos evaluates the project proposal using a standardized due diligence guideline that does not include environmental issues. However, the environmental impact aspects of wind projects are generally assessed during the formal procedures that a project sponsor must follow to obtain a wind farm or wind turbine permit in the Netherlands. Particularly in the case of large wind projects, the permitting procedures require

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[108] Although E&Co provides start-up capital, it does not consider itself a venture capital business. The company prefers to focus on proving the project's potential for commercial viability than on proving the technology.

[109] Unless otherwise noted, the main source for this section is: Schut, Hans (August 23, 2002) Telephone interview

[110] Triodos (n.d.). [Online]. Available: http://www.triodos.com/ [August 27, 2002]

[111] IFC Environment Division. (1999) *Solar Development Group.* [Online]. Available: http://www.ifc.org/enviro/How/Structure/EPU/Renewable/Photovoltaics/SDG/sdg.htm [August 28, 2002]

environmental impact studies of the development. Therefore, once a project sponsor has obtained a permit, Triodos considers itself satisfied with respect to the environmental aspects of the development.

Triodos' solar PV activities are mainly being financed through the Solar Development Group Fund, mentioned previously. The types of projects that are being managed through this fund are mostly small-scale PV, such as home systems. Triodos estimates that the potential environmental impacts of these projects can be generally considered as either positive or, if negative, negligible. Therefore, the bank does not follow environmental due diligence procedures during the investment review procedure, which basically focuses on the IFC and GEF as requirements for project eligibility (e.g. a project must be rural and commercially sustainable). [112]

4.3 Analysis of current RET environmental review procedures

The analysis of the environmental review procedures described in the previous section has the objective of providing information for the design of the preliminary guidelines for EDD for each of the technologies focused in this document. The discussion will focus on answering the three secondary research questions presented in Section 1.3. Each of these questions is analysed in the following sections.

4.3.1 Comparison of environmental review procedures between different institutions

The comparison of the environmental review procedures described in the previous section has the objective of identifying common and diverging points. These are discussed in turn.

Common points:

- All of the environmental review procedures examined included social aspects. These aspects ranged from basic worker health and safety issues to increasingly complex social questions, such as compliance with labour regulations, potential for improving the quality of life of end-users, indigenous peoples rights, and resettlements, among others. Besides social issues, some procedures included ethical and cultural aspects, such as child labour, forced labour, discrimination, and impacts on cultural properties.

- All the institutions contacted for the thesis supplemented their review procedures with some kind of due diligence aid. These could be sectoral guidelines, due diligence checklists, environmental handbooks, risk analysis checklists, and environmental and social question lists. The institutions had either developed their own due diligence aids and/or employed publicly available guidelines (e.g. 'best practices') from recognized institutions. For RET projects, the use of IFC guidelines was mentioned by several of the interviewees, including Finnfund, Triodos, the Interamerican Investment Corporation -IIC, and the German Investment and Development Company-DEG (the latter two institutions are featured in Appendix 5).

- Except for E&Co, which is exclusively dedicated to the promotion of clean energy projects and companies, none of the institutions featured in the thesis had developed specific environmental review procedures for reviewing potential RET investments.

[112] For more information about the Solar Development Group and IFC and GEF project requirements, please refer to: IFC Environment Division. (1999) *Solar Development Group.* [Online].

Diverging points:

- There were basically two different approaches for the environmental due diligence review: The contacted institutions have either established a separate environmental review procedure, or they have incorporated environmental and social issues into their general due diligence procedure. The first approach seems to result in a more formal process, in which EDD steps are integrated into all the different stages of an investment's life cycle, as shown in figure 15. The second approach seems to focus EDD mainly in the investment's appraisal stage. However, it was noted that even those institutions that had not established a separate environmental review procedure have included environmental and social criteria into their screening process.

- Each of the contacted institutions had different requirements for project sponsors during the investment appraisal process. According to the information provided during interviews or examination of relevant documentation, for the specific case of RET investments the requirements would be likely to depend on factors such as the degree of formalisation of the environmental review procedures, the institution's experience with RET project financing, the scale and/or type of the RET project(s) in consideration, and in some cases, the financial mechanism (e.g. loan, equity investment, co-financing, etc.) or fund considered for the project. For instance, at the IFC the specific environmental assessment procedures required of the project sponsor during the environmental review procedure are mainly dictated by the category in which the project is classified during the screening process. Therefore, a RET project classified in the C category would have less requirements than project classified in the A category. The same is true for the European Bank of Reconstruction and Development-EBRD (featured in Appendix 5), the IIC and the DEG, all of which have defined project categories. On the other hand, the review procedure and project requirements at Finnfund depend mainly on whether the project involves the presence of co-financiers or whether it is a lone undertaking, with the latter procedures likely to be stricter than otherwise. At Triodos the requirements were different depending on the technology and on the fund through which the investment would be made, while at SAM the requirements for biomass investments are likely to be stricter than for PV and wind investments because the institution considers that the environmental impacts of biomass projects are more ambiguous.

Given the limited number and type of institutions examined for this thesis (most of the institutions featured in the thesis are development agencies), it is not possible to determine whether the environmental review procedures are likely to differ depending on the type of institution examined. However, it was possible to observe that the larger institutions were more likely to have separate, more formal environmental review procedures in place than smaller institutions.

4.3.2 Aspects considered in environmental review procedures

It was possible to review some of the actual EDD aids employed by IFC, EBRD, DEG, KfW, Finnfund, SAM and E&Co. The IFC guidelines, the BMZ environmental handbook employed by KfW, and sample formats used by the EBRD for their environmental reports are publicly available and may be accessed on the Internet, at the links specified earlier in this document. The documentation provided by the remaining institutions is confidential and will not be disclosed in this thesis.

The documents examined are different in format. Some of them are checklists, others are question lists, others are document templates, and still others are guidelines. In order to provide information about the aspects covered in these documents and at the same time respect the confidentiality of the documents, the following table provides examples of the types of issues considered within each aspect category, without disclosing from which documentation they were obtained.

Table 6: Aspects considered in environmental due diligence aids

Environmental aspects	Other aspects
• **Laws, regulation, and guidelines** Past and present compliance with legislation: lawsuits, penalties, emissions limits, permitting requirements, reporting requirements, record-keeping requirements Legislated requirements for EIA Compliance with international best practice guidelines Compliance with public consultation requirements Effect on project/company of anticipated environmental legislation, regulation, etc. • **Impacts** Effluent emissions to air, water and soil: sources, quantities, concentration sensitive recipients, wastewater treatment Waste: composition, quantity, storage, management, recycling, disposal Impacts on natural resources and ecology: critical habitats, protected areas, wetlands, endangered animals or species Positive impacts: Improvement or protection of environment, CO_2 displacement Noise and smell emissions: limits, distance from nearest receptor, complaints from neighbours • **Risks** Hazardous materials: use, management, storage Underground storage tanks on site Risk potential for major hazards or accidents such as fires, explosions, poisonings, etc. Status of environmental responsibilities/liabilities: knowledge about such issues, past liabilities Potential site contamination from past or present activities	• **Company and project aspects** Company information: Historical overview, directors, key management personnel, legal standing, corporate management, environmental management systems in place Project information: Description: technology, market, implementation schedule, Site information: size, prior use, present use, ownership or leasing agreement • **Social aspects** Worker health and safety issues: compliance with national regulations, prevention and mitigation measures, working environment, emergency plans, frequency of accidents by type and by department, recent safety inspections, environmental health surveys, noise level surveys, workers compensation claims Compliance with labour regulations Employee rights: Trade unions, representation on decision making bodies, benefits: medical plans, overtime compensation, wages: compliance with national minimum wages, regularity of payment Resettlements Impacts on indigenous people Impacts on existing infrastructure, land dispute rights • **Ethical aspects** Discrimination: wage discrimination due to gender, race, colour, political affiliation, religion, national or social origin Child and forced labour: children under 15, national and plant guidelines regarding young workers' terms, work carried under threat, coercion, or as penalty Bribery • **Cultural aspects** Impacts on cultural property with historical, archaeological, religious, or other unique value

There was no possibility to examine the environmental review documentation of an actual investment proposal at any of the institutions featured in the thesis, since in general the environmental reports filed during the review are confidential, as are any covenants, contracts or other legal documentation pertaining to an investment agreement between a financial institution and a project sponsor. Therefore it is still unclear how the financial institutions use the results of the environmental review procedure. For instance, are projects with significant environmental risk rejected, or are higher tariffs imposed, or are there additional requirements for insurance coverage? Although it is not possible to provide a comprehensive answer to these questions, some of the institutions, notably the EBRD, mentioned that projects could be rejected on environmental grounds, if the operation had major environmental problems or if the environmental issues associated with a project were not handled appropriately.[113]

4.3.3 Ensuring environmental soundness of RET projects through EDD

The first two analysis points focused on the environmental review procedures themselves. The third point concentrates on the attitudes of the persons within the financial institutions responsible for carrying out these procedures. Given that the purpose of the research is to develop EDD guidelines for RETs, it was important to understand their perceptions concerning the general usefulness of EDD reviews, and about whether they considered that this procedure could help to ensure the environmental soundness of RET projects. These issues are analysed in turn.

Several interviewees mentioned that a well-conducted EDD actually has a dual nature: (1) It helps to assess the environmental risks and opportunities associated with a project, which is important from the business point of view, and (2) It helps to incorporate environmental, social and ethical policies during the investment decision process in a more systematic way, which is important from the point of view of the environmental and social responsibility of a financial institution.[114] The extent to which an institution realises both of the potential benefits of EDD depends of course on its commitment to environmental and social responsibility. This is a significant point to consider given the fact that there are other instruments for risk management that can achieve the first benefit, but that by themselves do not accomplish the second, which is just as important from an environmental and social perspective.

Box 2: Example of other risk management strategies for financial institutions

Environmental insurance versus environmental due diligence[115]

An article running in the November 1999 issue of the online magazine "Liability Issues" predicted greater demand for environmental insurance from financial institutions. The article based this prediction on a report by Moody's Investor Services (a respected Australian-based credit rating firm), in which environmental insurance was cited as an acceptable substitute for environmental due diligence. The report titled "CMBS: Moody's Approach to Secured Creditor Environmental Insurance" made the following arguments in favour of environmental insurance: (1) Environmental insurance covers environmental conditions that may occur as a result of changes in environmental laws or regulations; (2) Insurance covers future occurrences, changes in use of the property and errors that may occur in the due diligence process; (3) An institution may have more recourse opportunities against an insurance carrier than it does against an environmental consulting firm that performed due diligence activities; (4) Insurance may save time and money in comparison to the due diligence process; and last but not least: (5) An institution can transfer the bulk of its environmental risk to an insurance carrier, whereas in the due diligence process environmental risk still is retained by the institution.

113 EBRD. (1996). *Environmental procedures*. [Online]. pp. 13

114 Schut, Hans (August 23, 2002) Telephone interview

115 Britt, Scott A. (1999). Insurance vs. due diligence. *Liability issues*. [Online]. Available: http://www.pollutionengineering.com/beyondcompliance/liability/lia1999/lia1199.htm [August 5, 2002]

The article highlighted on the preceding box mentions the potential for errors occurring during the due diligence process, which brings us to one point that was stressed by several interviewees: the fact that the added value of the EDD tool is very dependent on the quality of the review process: a poorly conducted review will most likely miss potential problems that could have serious financial, legal and environmental consequences in the future, while providing the institution with a false sense of security that would be counterproductive.[116]

A third point made about the usefulness of EDD arose from the following question: "From the point of view of protecting the environment, isn't it enough to require environmental assessments of a project?" One of the interviewees answered the following:

"In my opinion, simply requiring an environmental assessment of a project is not enough from the financial institution's perspective. While an environmental assessment, whatever form it may take, is a useful tool for highlighting the environmental impacts of a project, it should be a viewed as an <u>element</u> of EDD, rather than as the extent of the environmental review itself. The importance of EDD is that it compels an institution to go over the results of the environmental assessment, analyse them, and draw its own conclusions, not only about the significance of the impacts, but also about the mitigation measures and monitoring requirements that need to be put in place to ensure that the environmental issues of a project are managed in an acceptable way."[117]

Other interviewees agreed with the importance of monitoring and following up the results of environmental assessments. As one of them put it:

"Without monitoring and following up the results, EDD would be just another procedure. It is just as important to make sure that the findings of the review procedure are developing in the way that it was predicted, as making the predictions in the first place." [118]

With regards to the usefulness of developing specific EDD guidelines for RET projects, basically two attitudes were encountered. Some interviewees considered the development of environmental due diligence procedures for RET projects an interesting and potentially useful undertaking in view of the current paucity of EDD aids for this sector.[119] Others considered that general environmental review procedures followed for any type of project would ensure adequate assessment of the environmental issues of RET projects as well, so that this sort of project would mostly benefit those institutions that had not established their environmental review procedures.[120]

It was also mentioned that while the development of standardized guidelines for RET projects was important, this would only address part of the issue concerning why RET projects encounter financial barriers. For instance, it was stated that one of the most frequent reasons why RET projects in developing countries were rejected by international financial institutions was due to technical design issues that affect the project's financial viability. The case of biomass energy technologies was cited as an example: the emission limit values set in IFC guidelines for combustion technologies are based on modern technologies such as fluidised beds, which frequently are too costly for SME project sponsors in developing countries.[121] Other problems mentioned were incorrect technological assumptions, e.g. about the useful life of a technology, based on the operation of a similar project in a developed

[116] Korhonen, Helena (July 28, 2002) Telephone interview

[117] Miller, Angela (August 7, 2002) Telephone interview

[118] Lundgren, Annika (August 20, 2002) Telephone interview

[119] Korhonen, Helena (July 28, 2002) Telephone interview

[120] Weiler, Wolfgang (August 28, 2002). Telephone interview

[121] Miller, Angela (August 7, 2002) Telephone interview

country, which when corrected to allow for the reality of the host country's operational conditions resulted in additional costs that rendered the project financially unviable, for instance if the equipment had to be replaced more frequently, to continue with the same example.[122]

4.3.4 Design considerations from the analysis

The analysis provided several useful considerations for the design of the guidelines. These are listed below:

- Along with purely environmental issues, the guidelines should ideally incorporate social issues as well. This would ensure that the concept of 'environment' embodied in the guidelines corresponds to that of the financial institutions.

- RET projects are generally considered environmentally sound, and therefore in most cases financial institutions would not require strict EDD procedures for these types of projects. Possible exceptions could occur for RET projects presenting any, or all, of the following characteristics: Large scale developments, 'greenfield' or 'brownfield' operations[123], as well as other environmentally or socially sensitive locations, and projects involving co-financing. Besides these characteristics, biomass and geothermal energy projects are more likely to require stricter procedures than wind or solar, for example. Thus, the guidelines could try to make a distinction between projects for which the EDD would likely be less strict, and focus on those for which the procedure is likely to be stricter.

- The guidelines should lay out a procedure for carrying out an environmental review of an RET project, ideally incorporating all four stages shown in figure 15, but at least stages II and IV, the appraisal and monitoring phases.

- The procedure could then be supplemented with EDD aids. Acceptable formats for these aids could be checklists, or questionnaires. The environmental issues presented in Tables 2 and 3 would then be translated into a question or checklist point. Another option is the development of an environmental risk document, in which the issues presented in the tables would be categorised as high, medium, or low risk issues based on the likelihood of their being regulated or legislated, on the results of LCA studies of these types of projects, on public perception issues, among other possible criteria.

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[122] Lundgren, Annika (August 20, 2002) Telephone interview

[123] "A 'greenfield' project is one that is built on a green field, in other words where no project has been built before. This expression actually comes from the term 'brown field', which means a project built on a site that was previously used for some other purpose. Being a brownfield project means additional considerations will need to be taken into account for investors, specifically does the site have environmental issues (e.g. contaminated groundwater) linked with the previous use of the site." Usher, Eric (Eric.Usher@UNEP.fr) (August 26, 2002) *RE: What is a greenfield project?* E-mail to Gloria Argueta (Gloria.Argueta@student.iiiee.lu.se)

5. Drivers and barriers to EDD use for RET investments

As mentioned throughout this document, the overall purpose of the research work is to develop guidelines for each RET that may be used by financial institutions for the process of environmental due diligence. Chapter 4 focused on selected financial institutions, describing and analysing current environmental review procedures in order to provide useful information for the design of the guidelines. This chapter tries to round out this information by examining internal and external factors that could either promote or hinder the use of environmental due diligence for RET investments.

The information sources for the first two sections of this chapter are the interviews held with FI officials, and consequently it is basically their perspective that will be discussed. The following figure illustrates the drivers and barriers that were identified during the interviews.

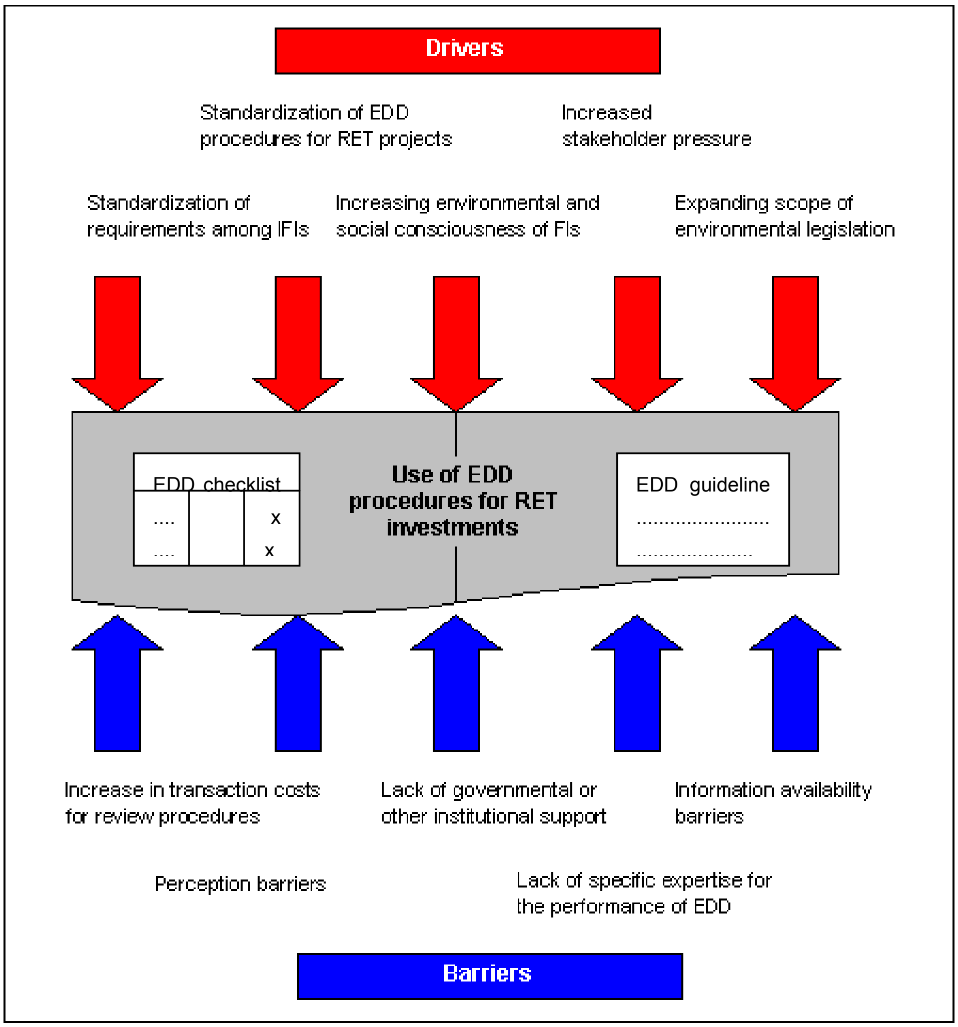

Figure 16: Drivers and barriers to EDD use for RET investments.

The following section will proceed with the examination of the drivers to the use of EDD for RET investments.

5.1 Drivers to EDD use for RET investments

Some of the factors that may promote the use of environmental due diligence for RET investments are the following:

- **Expanding scope of environmental legislation**

The growing popularity of environmental due diligence for FI investment review procedures can be largely attributed to the expanding scope of environmental legislation. It is also one of the most important factors that could lead to a general use of EDD for all types of projects, RETs included.

The environmental legislation applicable to a proposed operation was characterised as the starting point for identifying existing and potential environmental problems, and for providing insights into the environmental future of an investment.[124] As mentioned in Chapter 3 and Chapter 4, environmental risks arising from permitting, penalties from incompliance, and environmental liabilities, often have financial consequences that could ultimately affect the bankability of a proposed investment. In this respect, it was mentioned that an EDD review benefits the project sponsor or owner as much as the financial institution, and may even enhance the financial performance of the project, e.g. by outlining opportunities for cost savings through energy efficiency or cleaner production or by highlighting potential compliance or permitting problems before they occur, thereby resulting in cost savings and other financial benefits.[125]

- **Increasing environmental and social consciousness of financial institutions**

Some of the interviewees mentioned that a potential driver for the incorporation of environmental and social considerations into investment review procedures is the increasing commitment of Financial institutions to sustainable development, which mandates that their investments should be viable from economic, environmental, and social perspectives in equal measures. Thus the advantage of performing an environmental due diligence review of an investment is that this process helps to ensure that a financial institution's environmental and social policy mandates are respected during the appraisal procedure, and also that the results of environmental and social investigations of the investment are considered during the decision-making process.[126]

- **Standardization of requirements among international financial institutions (IFIs)**

Another possible driver that was discussed is a current initiative to standardize the requirements that project sponsors have to comply with during an investment's application and appraisal process, among all international financial institutions (IFIs). The World Bank, through the IFC, coordinates this initiative, and for this purpose a working group of representatives from approximately 50 IFIs hold semi-annual meetings to discuss issues such as sustainable development and the financial sector's role.[127]

Two possible outcomes of such an initiative were mentioned: (i) It could help to improve the process of investment application from the perspective of project sponsors, who could then avoid having to

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[124] Korhonen, Helena (July 29, 2002). Telephone interview.

[125] Miller, Angela (August 7, 2002). Telephone interview

[126] EBRD. (1996). *Environmental procedures*. [Online]

[127] Weiler, Wolfgang (August 28, 2002). Telephone interview

comply with different, sometimes even conflicting, requirements from different investors, and the ensuing confusion, complication, and added expense; and (ii) By standardizing investment requirements it is also possible that the review procedures followed by the participating IFIs could also become standardized. Since the IFC mandates the environmental review of all proposed investments, the standardization of requirements could provide incentives for participating institutions that have not put in place the procedure for this kind of review to do so.[128]

- **Increased stakeholder pressure**

Many interviewees mentioned that financial institutions are facing growing stakeholder pressure (e.g. general public, customers, government, and media) to develop sound environmental policies and practices.[129] It has become increasingly problematic to discount the public perception of the potential environmental issues associated with a financial institution's activities; reputation impacts arising from public association to environmentally controversial operations or companies may result in negative publicity, affect the organization's business opportunities, or even lead to targeting by militant environmental organizations.

Box 3: Example of increased stakeholder pressure for financial institutions

Friends of the Earth: targeting IFIs[130]

Friend of the Earth (FoE) is a U.S. based environmental organization that advocates the preservation of health and diversity of the planet for future generations. It is one of the largest international environmental networks in the world, with affiliates in 63 countries. The organization unequivocally states its commitment to "empower citizens to have an influential voice in decisions affecting their environment".[131]

One of FoE's campaigns targets IFIs, particularly the World Bank Group, the International Monetary Fund, and export credit agencies, claiming that these institutions too often finance environmentally harmful projects, or projects without real developmental benefits. The current campaigns are focused on corporate finance, and on fossil fuel and mining investments. FoE has prepared and issued a number of publications censuring the policies and practices of these IFIs. For instance, one of its publications criticises the re-structuring of the World Bank on the grounds that it has "weakened the role and purpose of its Environmental Department…. limiting [its] ability to promote environmentally sustainable development in the Bank Group's loans and operations. "[132] The organization also organizes demonstrations against what it perceives as environmentally controversial finance activities: as recently as June 17, 2002, it called for a public demonstration outside the World Bank's Washington offices to protest against the IFC's financing of a hydroelectric power project in Uganda. FoE may also support civilian litigations arguing environmental violations, such as a recent lawsuit (August 27, 2002) filed against two US governmental agencies for allegedly financing fossil fuel and other investments without complying with the National Environmental Policy Act (NEPA).

As a result of these developments, some financial institutions have enacted steps to protect themselves. These steps can include the establishment of institutional environmental policies, environmental training for bank officers and in-house counsel, adoption of environmental management systems, and

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[128] Korhonen, Helena (July 29, 2002). Telephone interview.

[129] Schut, Hans (August 23, 2002). Telephone interview.

[130] The main source for the following paragraphs is: Friends of the Earth (FoE). [Online]. Available: http://www.foe.org/ [September 3, 2002]

[131] (FoE). *About FoE*. [Online]. Available: http://www.foe.org/about.html [September 3, 2002]

[132] FoE. (1998). *Greening the Bretton Woods Institutions: Sustainable development recommendations for the World Bank and International Monetary Fund*. [Online]. Available: http://www.foe.org/ p.6 [September 3, 2002]

environmental review procedures of their loans and projects. Other possible steps are joining initiatives such as the UNEP's Financial Institutions Initiative, which promotes sustainable development efforts among the world's banks (approximate membership: 165 Financial institutions); or endorsing environmental management principles established by other organizations, such as the Coalition for Environmentally Responsible Economies (CERES). [133] All of these steps provide incentives for a financial institution to enact EDD reviews of all investment proposals, including RETs.

- **Standardization of EDD procedures for RET projects**

All of the interviewees agreed that standardized guidelines could be a driver for the use of EDD procedures for RET investments, but there were several interesting reflections about the form that these guidelines should take.

For instance, many of the interviewees mentioned simplicity of use as one of the factors that would most likely influence the acceptance of the guidelines by financial institutions. There were different assessments of what 'simplicity' means. Some of the interviewees equated 'simple' with 'streamlined'[134], while others explained that in the case that an institution has already established environmental review procedures, simple was basically how easily they could be incorporated to the institution's procedures: the guidelines in this case would have to approximately follow the implemented EDD procedures, and be couched in a language and format familiar to the users. If the guidelines were completely different to what was currently employed they would probably not be accepted.[135]

It was also mentioned that what would be considered simple in a country such as Germany would probably not be considered so in Ghana, for example, and consequently that could be one problem with attempting to develop a general guideline for all institutions.[136] Another reflection concerning problems with developing standardized guidelines referred to the fact that even if the plan is to propose a set of guidelines for each RET, the procedure could end up being still not flexible enough. The environmental impacts that may be associated to a particular RET project are very dependent on the scale of the project as well as site specific issues (e.g. proximity to environmentally sensitive areas, greenfield or brownfield locations, etc.), and therefore environmental issues relevant for one project would not be important for other. In this respect the suggestion was to have different levels of EDD (e.g. modular or graduated levels), so that the analyst could choose the appropriate level based on the task at hand, rather than following a process that could be very tedious and time-consuming for projects that were simpler, had few or negligible environmental impacts, or were environmentally beneficial.[137]

5.2 Barriers to EDD use for RET investments

Some of the factors that may hinder the use of environmental due diligence for RET investments are discussed below.

- **Lack of specific expertise for the performance of environmental due diligence**

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[133] Gracer, Jeffrey B.(2000). *Green risks on the rise.* Latin Finance. [Online].

[134] Lundgren, Annika (August 20, 2002) Telephone interview

[135] Weiler, Wolfgang (August 28, 2002) Telephone interview

[136] Lundgren, Annika (August 20, 2002) Telephone interview

[137] Schut, Hans (August 23, 2002) Telephone interview

Carrying out an EDD review of an investment requires certain skills from the financial institution's staff, particularly for smaller organizations where in-house environmental specialists are frequently not available.

Since financial institutions began to implement EDD reviews in the mid 1980's, it has spread to other countries, particularly Europe and other developed nations. However, it is still not a common practice in many developing countries. For instance, according to officials from the Inter American Development Bank's (IDB) Honduran office[138], and the Central American Bank of Economic Integration (CABEI) [139], due diligence reviews of investments would only be carried out in very special cases (for instance, large-scale hydroelectric power projects, or infrastructure developments such as road building). While the representatives from both Banks mentioned the use of World Bank guidelines, such as the PPAH, for appraising investments in certain sectors, it was stated that currently these types of reviews were not generally performed for RET investments in the Central American region. A conversation with an official from the African Development Bank (AfDB) yielded similar conclusions.[140]

It was mentioned that in order for EDD to be accepted as a general practice in financial institutions of developing countries, it had to be coupled with proper training and a process that could be embraced by bank managers. Otherwise, institutions faced with a procedure for which they have no preparation and is unfamiliar to them would be more likely to disregard it. Some development agencies, such as FMO, a Dutch-based bilateral development bank, and E&Co, have started to sponsor training programs targeted at commercial and regional commercial banks in developing countries, in which selected bank managers are trained in such areas as the establishment of environmental and social policies, environmental and social investment reviews, and environmental due diligence. [141]

- **Perception barriers**

Another possible barrier that was discussed arises from the fact that in many cases RET projects are small and medium sized enterprises, often sponsored or owned by non-corporate developers. This is particularly valid for RET projects proposed in developing countries. Therefore, it may be difficult for them to comply with extensive project preparation or costly environmental investigations that may be required as a result of environmental reviews and their associated procedures.[142]

These types of compliance problems have been discussed in specialist literature as a potential financial related barrier to the widespread deployment of RETs, and environmental advocates have often urged the simplification of investment review procedures for RET projects as a way to encourage further implementation.[143] Consequently, there is a possibility that promoting the use of EDD guidelines to review RET investments could be viewed by some as contrary to the interest of RET implementation, and that this could lead to financial institutions electing not to use the tools to avoid potential opposition.

- **Information availability barriers**

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[138] Molina, Mateo (June 19, 2002) Personal interview

[139] Barahona, Gracia and Morales, Jorge (June 21, 2002) Personal interview

[140] Vyas, Yogesh (July 24, 2002) Telephone interview

[141] Lundgren, Annika (August 20, 2002) Telephone interview

[142] Schut, Hans (August 23, 2002) Telephone interview

[143] Wohlgemuth, Norbert. (2001). *Directing investment to cleaner energy technologies.* In Jan Jaap Bouma et al. (2001). *Sustainable banking.* pp.406-408

In the past, the environmental issues of RETs were often regarded as ambiguous or not sufficiently researched. Therefore, information availability was a constraint for financial institutions to conduct environmental appraisals of these technologies. Today, the environmental issues associated with mature technologies such as hydropower, onshore wind, biomass, geothermal and solar, have been documented in numerous studies, and this type of constraint should no longer apply. Exceptions occur for newer technologies at experimental stages (e.g. marine technology), technologies that have not yet reached commercial maturity (offshore wind power), or that have not been as widely implemented in a country or region and which therefore are not familiar to the investment analysts in charge of the review.[144]

- **Lack of governmental and other institutional support**

Just as the increasing enactment of environmental legislation has been a driver for the use of EDD reviews, the lack thereof can be a barrier to their use. As was explained in Chapter 4, an EDD review is grounded on a regulatory framework. If this framework does not exist, it is more difficult for some types of financial institutions, such as commercial banks, to consider environmental and social reviews of their investments as necessary to their business activity.[145]

Throughout this document there have been references to studies indicating an increasing environmental proactivity on the part of financial institutions. However, the reality check is that financial and technical due diligence are still more common practices for investment reviews of project finance transactions, particularly in the case of private institutions. Surveys on the financial sector have indicated that environmental due diligence is a standard practice only for real estate secured transactions, with private financial institutions paying much less emphasis on EDD of lines of credit, project finance transactions, or equipment financing. While these surveys have pointed out the potential for this practice to become more generalised in the future, there is still a long way to go before EDD can be regarded as business as usual. [146] Therefore, governments and other institutions such as multilateral development agencies, still have a fundamental role in providing incentives for private sector companies to incorporate environmental considerations in their investment reviews, particularly in those regions of the world were environmental values are considered less important.

- **Increase in transaction costs for review procedures**

Another barrier that was mentioned is the fact that an EDD review of an RET investment might make the transaction cost prohibitively high.

There were two different, seemingly contrary, attitudes towards this potential barrier. On one hand, some of the interviewees stated that the cost of an EDD review procedure is more than offset in the long run by avoided costs of environmental penalties and liabilities.[147] It was also mentioned that environmental considerations were as much a part of the institution's business as financial and technical issues, and that therefore EDD reviews could not be considered as 'adding' to the transaction cost of the investment review.[148] On the other hand, some interviewees mentioned that higher transaction costs could lead to some sort of economy of scale, in which only large scale projects with potential high return on investments would be analysed in this way, while smaller projects, or less financially attractive ones would tend to be sieved out. It was also mentioned that the smaller the

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[144] Wüstenhagen, Rolf (July 18, 2002) *Re: Questionnaire for investment review procedures at SAM.*

[145] Lundgren, Annika (August 20, 2002). Telephone interview

[146] Ganzi, John T., Tanner, Julie (1997) *Global survey on the environmental policies and practices of the financial services industry: The private sector.* [Online]. Available: http://www.nwf.org/finance/survey.html [September 4, 2002]

[147] Miller, Angela (August 7, 2002) Telephone interview

[148] Weiler, Wolfgang (August 28, 2002). Telephone interview

institution, the more significant is transaction cost likely to be.[149] Another related consideration was that ironically, smaller institutions are often the ones that must rely on external consultants for the EDD reviews, which are time intensive and costly.[150]

In conclusion, the increase in transaction costs due to EDD reviews has the potential for being offset in the long run. However, it is still likely to be a barrier for the acceptance of this process by smaller institutions, which are more influenced by short and medium term financial results and less able to bear increased costs in the short term.

5.3 Design considerations from the analysis

Concerning the design of the guidelines, there were mainly three new considerations arising from the discussion of drivers and barriers to EDD:

- Simplicity of use and efficiency were cited as important factors for acceptability. Therefore the guidelines should aim at pinpointing the most relevant issues related to a particular technology, and incorporate some sort of user-friendly outline (e.g. a diagram or flowchart) of the process to enhance facility of use.

- As far as possible, the guidelines should be constructed in a modular design, so that the user has greater options concerning the level of EDD appropriate to a particular project.

- The guidelines are intended for general use, and consequently it is not possible to determine the exact legal regime that may be related to a project. However, the establishment of compliance with environmental legislation and standards is a very important part of any EDD process. A possible way to deal with this issue would be to have one general point, or question, about project compliance with relevant international, national, local regulations and legislation, as well as international 'best practice' guidelines, and then include links to useful Internet sites with compilations of environmental laws, the IFC guidelines, etc. in the EDD aids.

[149] Lundgren, Annika (August 20, 2002). Telephone interview

[150] Korhonen, Helena (July 29, 2002). Telephone interview

6. Preliminary EDD guidelines for RET investments

The objective of these guidelines is to provide financial institutions with a procedure for carrying out environmental due diligence investigations of renewable energy technology investments. The procedure consists of three stages, which are schematised in the following figure.

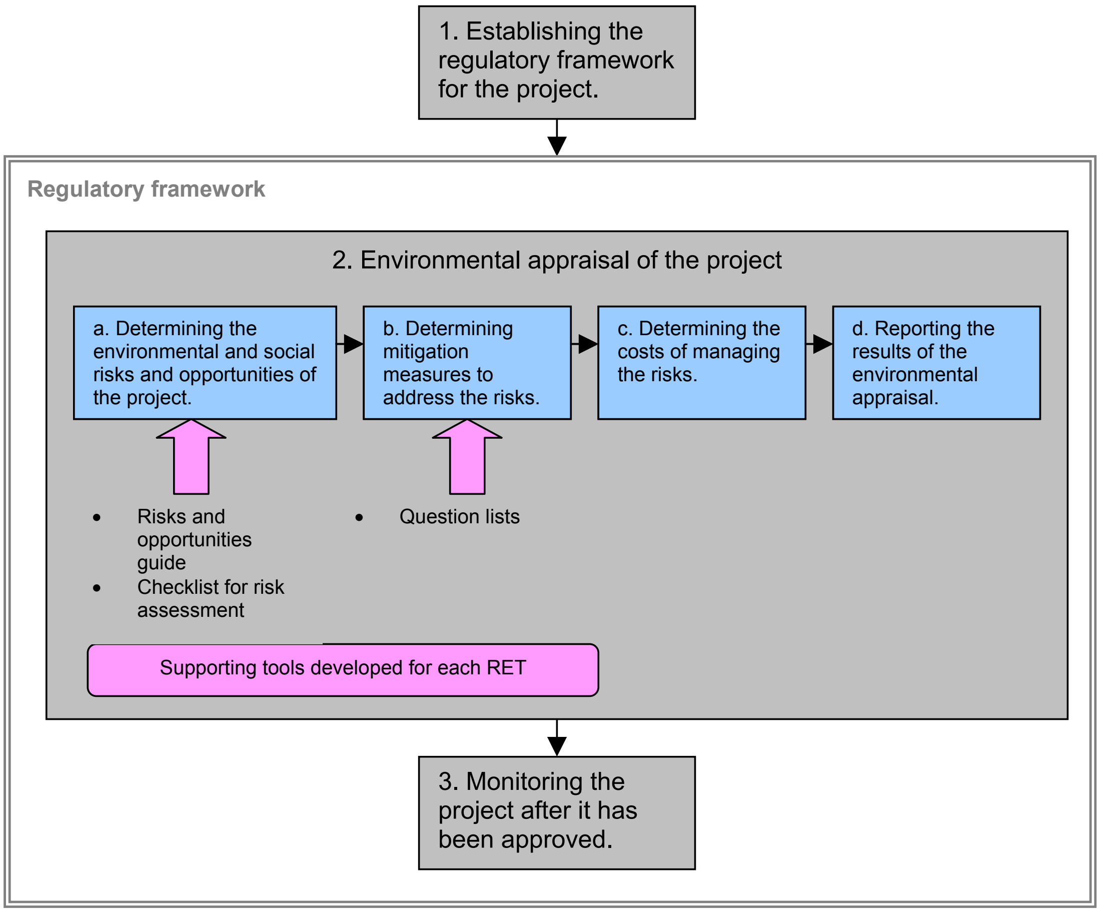


Figure 17: Procedure for environmental due diligence of RET investments

The starting point of the procedure is the determination of the relevant regulatory framework of the project, including national regulations, international standards and good practice guidelines. This should be done on a case-by-case basis, as carefully and as comprehensively as possible. There are two different timeframes that should be considered for this process: first, that of existing laws and regulations that currently affect the project, and second, that of anticipated laws and regulations (e.g. in process of development, discussion, or approval) that may change the conditions under which the project operates. The environmental laws provide the background for determining the main issues that should be considered during the environmental appraisal process, while environmental regulations, standards and guidelines provide practical information concerning emission limits, permitting requirements, pollution abatement and control techniques and equipment, best management and operational practices, etc, against which the investment proposal should be benchmarked.

The second stage is the core of the whole process. It comprises four main steps. The first step is to determine the main environmental and social risks and opportunities associated to a project. The main objective of this step is to assess the risks in order to determine their sensitivity. The second step is to determine what mitigation measures are necessary to address the risks. The third step is to determine the costs of managing the risks. This means both the costs of the mitigation measures, as well as the potential costs for non-compliance (e.g. increased charges, fines and other penalties, the closure of an operation by environmental authorities, project delays due to permitting requirements, etc). The fourth and final step is to report the results of the environmental appraisal process, so that they can be used for future discussions with the project sponsor, for negotiations, to determine the actions needed in the future, and for the investment decision-making.

In order to facilitate the first two steps of this stage, a number of EDD aids developed specifically for each of the RETs addressed in the thesis will be introduced. These aids try to reflect the information obtained during the research project concerning both the environmental issues of the RET systems, as well as the design information obtained in the previous two chapters. It is intended that these aids be used as a complement, not a replacement, of any due diligence tools currently used for environmental review procedures. In addition, it is important to note that since these tools are intended for general use, they may not reflect all possible environmental or social issues related to a particular investment. The investment analyst should incorporate additional issues as needed.

The third stage is the monitoring and environmental evaluation of the project. This is an important aspect of the EDD procedure, serving two main purposes. The first is to ensure that the project sponsor complies with the applicable environmental standards and various environmental components of operations included in legal agreements. The second is to keep track of the ongoing environmental impacts associated with operations and the effectiveness of mitigation measures as a feedback mechanism.

The following sections establish the procedures for EDD of each RET focused in the thesis and explain the tools that have been developed specifically for this purpose.

6.1 Preliminary EDD guidelines for energy crop systems

The preliminary guidelines for energy crop systems that are described in the following sections follow the three main stages shown in Figure 17.

6.1.1 Regulatory framework of the project

The starting point of the environmental review procedure is establishing the regulatory framework applicable to the specific project that will be reviewed. The regulatory framework includes:

- Environmental laws and regulations in the host country, e.g. national and local requirements concerning pollution control, land use planning, environmental impact assessments, health and safety, public consultation, Indigenous rights, banned substances, etc.
- Anticipated environmental laws and regulations
- Applicable international agreements
- International standards
- International best practice guidelines

For energy crop systems, the following international standards and guidelines may provide useful information for benchmarking a proposed project:

- IFC. (1998). *Environmental, health and safety guidelines for plantations*. [Online]. Available: http://www.ifc.org/enviro/enviro/pollution/guidelines.htm

- IFC. (1998). *Environmental, health and safety guidelines for pesticide handling and application*. [Online]. Available: http://www.ifc.org/enviro/enviro/pollution/guidelines.htm

- EBRD. (n.d.). *Sub-sectoral environmental guidelines for agricultural production: Crops*. [Online]. Available: http://www.ebrd.com/enviro/index.htm

- British Biogen (1998). *Wood fuel: Good practice guidelines for the development of a sustainable energy production industry*. [Online]. Available: http://www.britishbiogen.co.uk/gpg/wfgpg/woodfuelgpg.pdf

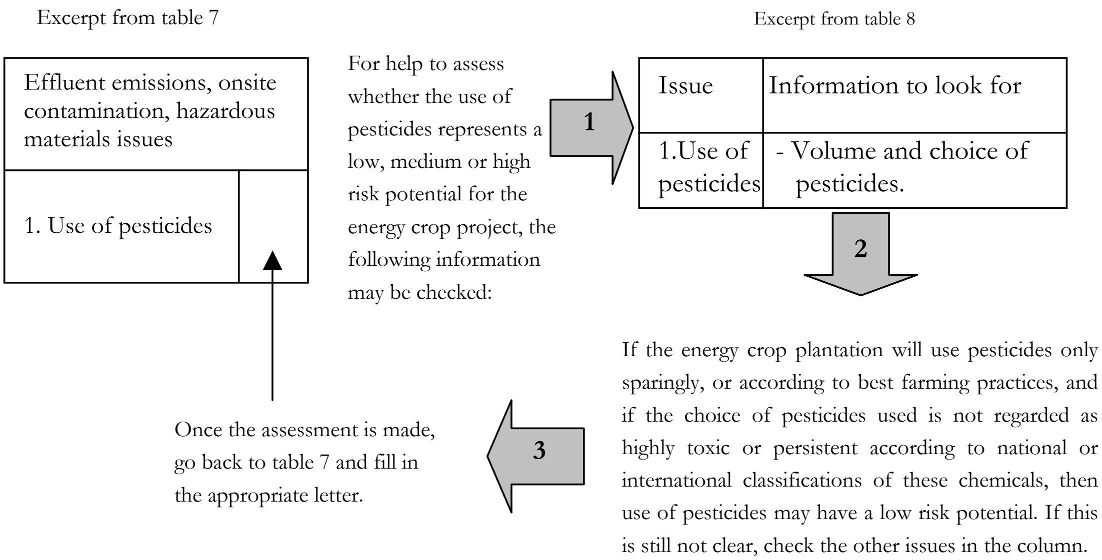
6.1.2 Environmental appraisal of the project

a. Determining environmental and social risks and opportunities: The objective of the first step is to provide an initial assessment of the sensitivity of potential environmental and social risks and opportunities associated to the most environmentally significant activities of an energy crop system. For this purpose two tables have been developed.

The first table (Table 7) shows potential environmental opportunities of an energy crop project, and provides an overview of the environmental issues of an energy crop system that may lead to potential environmental liabilities (arising from damage to persons and goods, onsite contamination, or damage to nature or biological diversity); requirements for compliance with effluent emission limits to air, water and soil; and/or reputation risks from negative public perception of an issue. These issues are the project's environmental and social risks. This part of the table is to be filled in by the investment analyst using project specific information with the following key:

Key	Meaning	Characteristics
L	Low/no risk potential	The issue is either not relevant to the project, or it is adequately managed, well documented, and unlikely to pose serious difficulties.
M	Moderate risk potential	The issue is relevant to the project; there is documentation for the issue; the management of the issue requires improvements; the issue is unlikely to pose serious difficulties if adequately managed.
H	High risk potential	The issue is relevant to the project; there is no or little documentation of the issue; there are currently inadequate or no provisions in place for its management; the issue is likely to be critical if not adequately managed.

The second table (Table 8) provides a checklist guide of information to look for, which may help the investment analyst decide which level of risk is appropriate for the issue. An example illustrates the use of the tables:



Other important information for assessing the risk potential of an issue is the following:

- Impending environmental legislation that may affect the project
- The environmental liability regime of the host country
- Project sponsor characteristics, particularly previous compliance problems and history of accidents.

In general, if not enough information is available about a particular issue, it is better to regard it as moderate to high risk until information is received proving the contrary.

The assessment of the risk potential of an issue will depend on the results of the review of relevant information as well as on the investment analyst's experience and common sense. The purpose of filling in the table is to give the investment analyst an initial estimate of the issues that should be further analysed in the following steps of the environmental due diligence process. For instance the analyst could determine whether the project requires and EIA, an environmental audit, or other type of environmental investigation, or whether the project will require site visits, as well as identify if there is any missing information that may be important for conducting the following stages of the environmental due diligence process.

It must be noted that some of the issues included in Table 7 may not apply to all projects. Therefore, the analyst may decide not to look into some issues that clearly do not apply to the regulatory framework, operational conditions, etc., of the specific project being reviewed. Just to give an example, issue 3, 'Brownfield location', clearly does not apply to projects in greenfield locations, or locations not previously used for industrial or agricultural purposes.

Table 7: Environmental and social risks and opportunities guide for an energy crop system

Activity	Environmental and social risks				Environmental opportunities
	Effluent emission, onsite contamination, hazardous materials issues	Biodiversity protection issues	Worker health and safety issues	Environmental issues sensitive to public opinion	
Crop cultivation and harvesting	1. Use of pesticides	7. Introduction of non-native species	9. Pesticide application	12. Significant land use	Soil stabilisation in degraded or excess agricultural lands
	2. Use of chemical fertilisers	8. Use of GMOs	10. Accidents (poisonings, injuries sustained due to farming operations, etc.)	13. Soil erosion or compaction	Biodiversity improvement in degraded or excess agricultural lands
	3. Brownfield location			14. Contamination of soil, groundwater, and/or surface water	Potential for improving local water retention and microclimatic conditions in degraded lands
				15. Water depletion	
				16. Loss of biodiversity	
				17. Visual impact	
Generation activity	4. Emissions of NOx, SO_2, CO, VOCs and particulates	—	11. Accidents (fires, explosions, etc)	18. Noise	Avoided CO_2 emissions from deployment
	5. Emissions of CO_2 and other greenhouse gases				
	6. Solid waste (ash)				

Table 8: Checklist for environmental and social risk assessment of an energy crop system

Risks	Information to look for
Effluent emissions, on-site contamination, hazardous materials issues	
1. Use of pesticides	• Volume and choice of pesticides used • Integrated pest management schemes in place • Pesticide storage and disposal • Method of application employed (e.g. ground spraying, air spraying, etc.) • Studies on waste water releases, and runoff or leaching potential, into local water ways
2. Use of chemical fertilisers	• Rate, timing and methods of application • Studies on waste water releases, and runoff or leaching potential, into local water ways
3. Brownfield location	• Previous land use: If land was used for intensive arable cultivation, or other potentially contaminating activity, look for soil and groundwater studies to check for potential on-site contamination.
4. Emissions of NOx, SO_2, CO, particulates, VOC	• Conversion technology used, with higher to lower emission potential arising from the following schemes in this order: o Co-firing schemes o Direct combustion systems o Gasification systems • Scale of the generation plant • Maturity of the technology (e.g. is the technology commercially proven and currently used) • Combustion methods, fuel conditions, and modes of operation • Compliance with local, national and/or international air quality standards limits
5. Emissions of CO_2 and other greenhouse gases	• Conversion technology used: if the energy crop is sustainably produced, this point is only applicable to co-firing schemes • Scale of the generation plant
6. Solid waste	• Volume and chemical composition • Disposal methods
Biodiversity protection issues	
7. Introduction of non-native species	• Studies about suitability of chosen crop to site soil and water conditions, sensitivity of local ecosystems to introduced species, etc. • Farming and containment practices to control spread of introduced species in neighbouring fields
8. Use of GMOs	• Farming and containment practices to control spread of GMO species in neighbouring fields
Worker health and safety issues	
9. Pesticide application	• Compliance with local health and safety regulations • Compliance with international health and safety guidelines, such as IFC's Plantation Guidelines, which cover issues such as training, supervision, protective clothing, etc. • Outstanding worker compensation claims

Risks	Information to look for
Worker health and safety issues (continued)	
10. Accidents from crop cultivation and harvesting (poisoning, fires, etc.)	• Compliance with international, local, and national health and safety regulations • Operation and maintenance routines in place • Training of personnel • Emergency plans in place • Outstanding worker compensation claims
11. Accidents from generation activities	• Compliance with international, local, and national health and safety regulations • Training of personnel • Emergency plans in place • Outstanding worker compensation claims
Environmental issues sensitive to public opinion	
12. Significant land use	• Site location (e.g. proximity to highly populated areas, ecologically important areas, areas with high recreational value, greenfield locations, etc.) • Scale of project (the higher the scale, the more land is necessary for crop plantations) • Land use being replaced by the plantation (e.g. agricultural, recreational)
13. Soil erosion or compaction	• Prevailing ground conditions (e.g. mountainous or flat terrain) • Farming techniques applied (e.g. use of machines on sensitive land, or best farming practices)
14. Contamination of soil/groundwater/surface water	• Studies on wastewater releases, and runoff or leaching potential of agrochemicals (pesticides, fertilisers, herbicides, etc.) • Compliance with regulated pollutant emission levels of liquid effluents (e.g. local, national or international liquid effluent standards)
15. Water depletion	• Crop suitability to available water sources for irrigation • Irrigation management plans in place
16. Loss of biodiversity	• Prior land use replaced by plantation: On degraded lands or excess agricultural lands, biodiversity is likely to improve. Plantations should never replace natural forests, such as tropical rainforests. • Farming practices concerning use of pesticides, herbicides, or insecticides for crop cultivation activities
17. Visual impact	• Site location (e.g. proximity to highly populated areas, areas with high recreational value, etc.) • Use of best practice plantation establishment guidelines
18. Noise from generation activities	• Compliance with noise emission levels • Complaints from neighbours

b. Determining possible mitigation measures and systematising the information for reporting: This step has two different goals. First to help determine what mitigation measures may be necessary to address the risks identified for the project, and secondly to help systematise the information collected in the previous stage and put it in a format that makes it easier to communicate the results for reporting.

To do this, the analyst may use the following table, which contains questions regarding the status of compliance of the project with regulations, standards and best practice guidelines. The question lists have been constructed in a modular form, with the first module containing general questions that should be answered with respect to all projects, while subsequent modules should be answered only if considered necessary or relevant.

Table 9: Question lists for an energy crop system

Level	Questions
LEVEL I: All projects	1. Has the project complied with all legislated requirements for operation, receiving all necessary licences and permits? (Land use for crop plantation, plant operational permits, requirements from local and national governmental authorities, etc.)
	2. Has the plantation been established according to best practice guidelines to mitigate visual impact? (E.g. Avoid straight edges, follow natural topography, promote species diversity in plantation)
	3.Are good farming practices used for the plantation of the crops? (Including agrochemical use and application, soil protection measures such as no tillage, winter covers, etc., sustainable management of water used for irrigation, etc.)
	4. Are best practices followed for pesticide storage and disposal? (Labelling of containers containing pesticides, fire prevention systems, secondary containment to prevent leakages, locked and posted area for pesticide storage, etc.)
	5. Are prevention and mitigation measures for worker health and safety considered at the plantation? At the generation plant? (Emergency plans, basic medical facilities on site, sanitary facilities, etc.)
	6. Are workers properly trained and equipped for carrying out their activities at the plantation? At the generation plant?
	7. Are air emissions from the generation plant regulated and are these regulations complied with?
	8. Are liquid effluents from the farming activities and from the generation plant regulated and are these regulations complied with?
	9. Is the composition and quantity of solid waste from the generation plant (ash) known, and is it disposed of in an environmentally acceptable way?
	10. Are there proper operation and maintenance routines at the generation plant?
	11. Have all moderate and high risk issues identified in the previous stage, other than those that may have been covered in questions 1-10, been appraised and have mitigation measures been proposed?
LEVEL II: Optional	12. Has an environmental impact assessment report, an environmental audit, or any similar environmental assessment been prepared with respect to the project? Is one required?
	13. Has a site visit been planned? Is one required?
	14. How can the environmental liability regime of the host country affect the financial institution?
	15. Have there been any protests or complaints about the project? If so, what have they focused on?
	16. What are the potential environmental benefits of the project? Is the general public aware of these environmental benefits?

c. Determining the costs of managing the risks: The third stage of the process is to estimate the costs of managing risks, particularly those that have not been accounted for previously and which may therefore affect the financial viability of the project. This includes both the costs of the mitigation measures per se, as well as the potential costs for non-compliance (e.g. increased charges, fines and other penalties, the closure of an operation by environmental authorities, project delays due to permitting requirements, etc). The determination of the costs should be done on a case-by-case basis, depending on the results of the previous step.

d. Reporting the results: The third step of the environmental appraisal stage is to present the key findings of the environmental due diligence review in a report that can be used during the investment decision process. The final report should include at least the following information:

- Brief description of the project
- General information of the project sponsor
- Status of compliance with host country regulations, international standards, best practice guidelines
- Main environmental impacts, and proposed mitigation measures (including an assessment of the adequacy of these mitigation measures if necessary or appropriate)
- An analysis of how the costs of the necessary mitigation measures affect the project's financial viability.
- Environmental opportunities (potential benefits of the project)
- Any missing information that may be significant to the assessment of the environmental risks and opportunities of the project.
- In the case of moderate and high-risk projects, the key findings should highlight high risk potential issues and their mitigation measures, as well as the results of environmental assessment reports and site visits that may have been carried out during the review process.
- Further actions required by the financial institution or the project sponsor with respect to environmental issues

6.1.3 Monitoring the project

If the project is approved, the final stage of environmental due diligence is the monitoring stage. For this purpose, specific provisions should be included in the legal documentation, for example requiring annual environmental reports, independent environmental audits at specific intervals, site visits, etc.

This is especially important for high-risk projects, for which the agreements between project sponsor and the financial institution should always include an environmental reporting and evaluation clause. In this case the monitoring should be carried out at regular intervals (e.g. annually or semi-annually), preferably including independent site visits or audits in addition to the project sponsor's environmental evaluation reports.

For low and moderate risk projects, environmental reports from the project sponsor at annual or semi-annual basis should suffice.

In all cases, significant changes in the project (e.g. projected expansions, changes in technology), changes in the type of financial operation (e.g. from loan to equity), and/or foreclosures should always be preceded by a re-assessment of environmental risk, in order to determine if the modified operation carries environmental and social risks and opportunities that were not considered in the initial review. The environmental monitoring of the project should continue until the time at which the loan has been repaid, the financial institution divests its equity share in a company, or the operation is cancelled.

6.2 Preliminary EDD guidelines for wind energy systems

The preliminary guidelines for wind energy systems that are described in the following sections follow the three main stages shown in Figure 17.

6.2.1 Regulatory framework of the project

The starting point of the environmental review procedure is establishing the regulatory framework applicable to the specific project that will be reviewed. The regulatory framework includes:

- Environmental laws and regulations in the host country, e.g. national and local requirements concerning pollution control, land use planning, environmental impact assessments, health and safety, public consultation, Indigenous rights, banned substances, etc.
- Anticipated environmental laws and regulations
- Applicable international agreements
- International standards
- International best practice guidelines

For wind energy systems, the following international standards and guidelines may provide useful information for benchmarking a proposed project:

- IFC. (1998). *Environmental, health and safety guidelines for wind energy conversion systems*. [Online]. Available: http://www.ifc.org/enviro/enviro/pollution/guidelines.htm

For large-scale projects that involve construction of access roads to the development and electricity transmission or distribution facilities, the following guidelines are useful complements:

- IFC. (1998). *Environmental, health and safety guidelines for roads and highways*. [Online]. Available: http://www.ifc.org/enviro/enviro/pollution/guidelines.htm
- IFC. (1998). *Environmental, health and safety guidelines for electric power transmission and distribution*. [Online]. Available: http://www.ifc.org/enviro/enviro/pollution/guidelines.htm

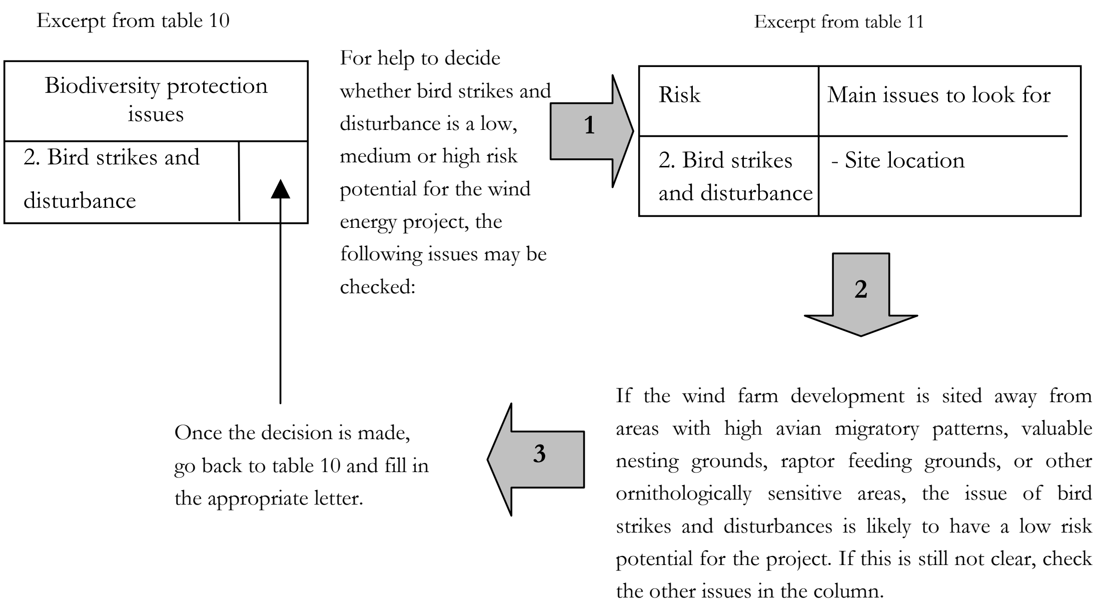
6.2.2 Environmental appraisal of the project

a. Determining environmental and social risks and opportunities: The objective of the first step is to provide an initial assessment of the sensitivity of potential environmental and social risks and opportunities associated to the most environmentally significant activities of a wind energy system. For this purpose two tables have been developed.

The first table (Table 10) shows potential environmental opportunities of a wind energy system, and provides an overview of the environmental issues of an energy crop system that may lead to potential environmental liabilities (arising from damage to persons and goods, onsite contamination, or damage to nature or biological diversity); requirements for compliance with effluent emission limits to air, water and soil; and/or reputation risks from negative public perception of an issue. These issues are the project's environmental and social risks. This part of the table is to be filled in by the investment analyst using project specific information with the following key:

Key	Meaning	Characteristics
L	Low/no risk potential	The issue is either not relevant to the project, or it is adequately managed, well documented, and unlikely to pose serious difficulties.
M	Moderate risk potential	The issue is relevant to the project; there is documentation for the issue; the management of the issue requires improvements; the issue is unlikely to pose serious difficulties if adequately managed.
H	High risk potential	The issue is relevant to the project; there is no or little documentation of the issue; there are currently inadequate or no provisions in place for its management; the issue is likely to be critical if not adequately managed.

The second table (Table 10) provides a checklist guide of information to look for, which may help the investment analyst decide which level of risk is appropriate for the issue. An example illustrates the use of the tables:



Other important information for assessing the risk potential of an issue is the following: impending environmental legislation that may affect the project; the environmental liability regime of the host country; and project sponsor characteristics, particularly previous compliance problems and history of accidents.

In general, if not enough information is available about a particular issue, it is better to regard it as moderate to high risk until information is received proving the contrary.

The assessment of the risk potential of an issue will depend on the results of the review of relevant information as well as on the investment analyst's experience and common sense. The purpose of filling in the table is to give the investment analyst an initial estimate of the issues that should be further analysed in the following steps of the environmental due diligence process. For instance the analyst could determine whether the project requires and EIA, an environmental audit, or other type of environmental investigation, or whether the project will require site visits, as well as identify if there is any missing information that may be important for conducting the following stages of the environmental due diligence process.

Table 10: Environmental and social risks and opportunities guide for a wind energy system

Activity	Environmental and social risks				Environmental opportunities
	Effluent emission, onsite contamination, hazardous materials issues	**Biodiversity protection issues**	**Worker health and safety issues**	**Environmental issues sensitive to public opinion**	
Plant construction	–	1. Habitat damage	4. Accidents	–	–
Generation activity	–	2. Bird strikes and disturbance	5. Accidents	6. Land use	Avoided CO_2 and other air pollutant emissions from deployment.
		3. Habitat damage		7. Noise emissions	
				8. Visual impact	
				9. Electromagnetic interference	
				10. Accidents involving the public	

Table 11: Checklist for environmental and social risk assessment of a wind energy system

Aspect	Information to look for
Effluent emissions, on-site contamination, hazardous materials issues	
–	–
Biodiversity protection issues	
1. Habitat damage from plant construction activities	• Site location: e.g. proximity to sensitive ecosystems such as wetlands or peat bogs, or areas with archaeological or recreational value (e.g. Natura 2000 areas). • Compliance with best construction practices: rights-of-way alignment, noise mitigation, erosion control, replanting of disrupted vegetation, siting of construction materials, etc.
2. Bird strikes and disturbance	• Site location: areas with high avian migratory patterns, nesting areas, raptor feeding areas, or other ornithologically important areas.
3. Habitat damage from generation activities	• Site location: e.g. increased access to sensitive ecosystems such as wetlands or peat bogs, or areas with archaeological or recreational value (e.g. Natura 2000 areas).
Worker health and safety issues	
4. Accidents from plant construction activities	• Compliance with international, local, and national health and safety regulations • Training of personnel • Emergency plans in place • Outstanding worker compensation claims
5. Accidents from generation activities	• Compliance with international, local, and national health and safety regulations • Training of personnel • Emergency plans in place • Outstanding worker compensation claims
Environmental issues sensitive to public opinion	
6. Land use	• Site location: proximity to populated areas, land use replaced by the development (e.g. agricultural, recreational, etc.), possibility of using the land between turbines for other purposes.
7. Noise emissions	• Compliance with statutory (e.g. local or national regulations) or recommended (e.g. manufacturer, international guidelines) noise emission levels • Site location: proximity to populated areas, topographical characteristics that could affect noise emission • Compliance with best practices for wind farm design and development: keeping recommended distances to nearest noise sensitive properties, using wind turbines manufactured and assembled to high quality standards, etc. • Neighbour complaints
8. Visual impact	• Site location: e.g. proximity to populated areas, or areas with high scenic or recreational value (e.g. Natura 2000 areas). • Local community participation in siting decisions • Visual mitigation measures employed for wind farm development: vegetation screens, turbine colour, tower structure, layout of turbines, etc. • Protests about development

Aspect	Information to look for
Environmental issues sensitive to public opinion (continued)	
9. Electromagnetic interference (EMI)	• Material employed for wind turbine blades: this problem is more likely for turbines with metallic blades, which are highly reflective. Fibreglass blades are partially transparent to electromagnetic waves, and therefore do not generally cause EMI problems. • Compliance with guidelines and other requirements to avoid electromagnetic interference with aviation equipment. • Complaints from neighbours about interference with TV or other electromagnetic signals.
10. Accidents involving the public	• Operation and maintenance routines in place.

b. Determining possible mitigation measures and systematising the information for reporting: This step has two different goals. First to help determine what mitigation measures may be necessary to address the risks identified for the project, and secondly to help systematise the information collected in the previous stage and put it in a format that makes it easier to communicate the results for reporting.

To do this, the analyst may use the following table, which contains questions regarding the status of compliance of the project with regulations, standards and best practice guidelines. The question lists have been constructed in a modular form, with the first module containing general questions that should be answered with respect to all projects, while subsequent modules should be answered only if considered necessary or relevant.

Table 12: Question lists for a wind energy system

Level	Question
LEVEL I: All projects	1. Has the project complied with all legislated requirements for operation, receiving all necessary licences and permits? (Land use for wind farm development; operational permits; permits for road construction and for electricity transmission and distribution, when applicable; requirements from local and national governmental authorities, etc.)
	2. Has the project site been chosen giving due consideration to all potential environmental impacts of the development, including impacts on natural habitats and wild life disturbance (particularly to birds), and impacts on populated areas concerning noise or visual intrusion? Is there documentation about the site choosing process?
	3. Are there proper operation and maintenance routines at the wind farm development?
	4. Does the project comply with requirements from aviation authorities to avoid electromagnetic interference?
	5. Does the project comply with the following noise impact mitigation measures: -Statutory or recommended noise emission levels? -Recommended minimum distance to nearest noise sensitive property? -Employment of turbines designed for noise minimisation?
	6. Has the project given due consideration to the following visual mitigation measures: -Employment of neutral, non-reflective colours, tower structure, turbine layout, vegetation screens?

	7. Have there been studies about the ornithological value of the wind farm site? E.g. avian corridors, nesting areas, local and migratory bird species, etc?

Level	Question
LEVEL I: All projects (Continued)	8. Have all moderate and high risk issues identified in the previous stage, other than those that may have been covered in questions 1-7, been appraised and have mitigation measures been proposed?
LEVEL II: Optional	9. Has an environmental impact assessment report, an environmental audit, or any similar environmental assessment been prepared with respect to the project? Is one required?
	10. Has a site visit been planned? Is one required?
	11. How can the environmental liability regime of the host country affect the financial institution?
	12. Have there been any protests or complaints about the project? If so, what have they focused on?
	13. What are the potential environmental benefits of the project? Is the general public aware of these benefits?
	14. Has the local community been encouraged to participate with the wind farm development?

c. Determining the costs of managing the risks: The third stage of the process is to estimate the costs of managing risks, particularly those that have not been accounted for previously and which may therefore affect the financial viability of the project. This includes both the costs of the mitigation measures per se, as well as the potential costs for non-compliance (e.g. increased charges, fines and other penalties, the closure of an operation by environmental authorities, project delays due to permitting requirements, etc). The determination of the costs should be done on a case-by-case basis, depending on the results of the previous step.

d. Reporting the results: The third step of the environmental appraisal stage is to present the key findings of the environmental due diligence review in a report that can be used during the investment decision process. The final report should include at least the following information:

- Brief description of the project
- General information of the project sponsor
- Status of compliance with host country regulations, international standards, best practice guidelines
- Main environmental impacts, and proposed mitigation measures (including an assessment of the adequacy of these mitigation measures if necessary or appropriate)
- An analysis of how the costs of the necessary mitigation measures affect the project's financial viability.
- Environmental opportunities (potential benefits of the project)
- Any missing information that may be significant to the assessment of the environmental risks and opportunities of the project.

- In the case of moderate and high-risk projects, the key findings should highlight high risk potential issues and their mitigation measures, as well as the results of environmental assessment reports and site visits that may have been carried out during the review process.

- Further actions required by the financial institution or the project sponsor with respect to environmental issues

6.2.3 Monitoring the project

If the project is approved, the final stage of environmental due diligence is the monitoring stage. For this purpose, specific provisions should be included in the legal documentation, for example requiring annual environmental reports, independent environmental audits at specific intervals, site visits, etc.

This is especially important for high-risk projects, for which the agreements between project sponsor and financial institution should always include an environmental reporting and evaluation clause. In this case the monitoring should be carried out at regular intervals (e.g. annually or semi-annually), preferably including independent site visits or audits in addition to the project sponsor's environmental evaluation reports.

For low and moderate risk projects, environmental reports from the project sponsor at annual or semi-annual basis should suffice.

In all cases, significant changes in the project (e.g. projected expansions, changes in technology), changes in the type of financial operation (e.g. from loan to equity), and/or foreclosures should always be preceded by a re-assessment of environmental risk, in order to determine if the modified operation carries environmental and social risks and opportunities that were not considered in the initial review. The environmental monitoring of the project should continue until the time at which the loan has been repaid, the financial institution divests its equity share in a company, or the operation is cancelled.

7. Conclusions and Recommendations

The conclusions and recommendations presented in the following sections are the result of the research and analysis performed for this project.

7.1 Conclusions

One of the premises upon which this research project was started is that the process of environmental due diligence for renewable energy investments is currently a poorly defined area, and that consequently most financial institutions are in the necessity of using informal, or ad-hoc, environmental review procedures when examining potential investments of this type.

As the research unfolded it was possible to test the accuracy of this premise, yielding mainly two conclusions. In the first place, the practice of environmental due diligence is indeed less established than its financial, legal and technical counterparts, but this is a general truth for many financial operations. For the activity of project financing in particular, the establishment of environmental review procedures has become more common only since the late 1990's, and then mostly in developed countries. Even in developed nations, these efforts have been regarded in specialist literature as likely to be somewhat unsystematic. Therefore, there is still a need for promoting the integration of environmental considerations into the general process of investment decision-making. If an institution establishes a general practice of environmental due diligence into its operational framework, it is more likely that it will accept and implement EDD guidelines for RET projects, than if they are considered as a requirement only for this type of projects.

Secondly, the paucity of standardized EDD aids for RET investments may be related to the fact that their review is still for the most part not a common activity of financial institutions. A frequent theme of specialist literature refers to the mismatch between the financial sector and the renewable energy industry, and the ensuing barriers to RET project financing. The financial institutions featured in this thesis arguably provide a confirmation of this assessment: most of the interviewees mentioned that RET project financing was either a minor or new part of their institution's activities. Two of them, EBRD and Finnfund, are currently not financing projects in this sector. This is a thought provoking indication, even if the sample of financial institutions in the thesis is too small to provide a representative picture of the status of RET project finance around the world. Therefore, there is a possibility that as the review of these projects becomes more frequent, there will be not only an increasing demand for these aids driving their development, but also more experience regarding what environmental and social issues an EDD process for these projects should focus on.

A related point is that further research is required if RET projects are to overcome financial barriers to their implementation. Based on the study performed for this thesis, two potentially useful research avenues are determining the most common reasons why RET investment applications are rejected by financial institutions on regional and local basis, and determining the perceptions of non-developmental financial institutions as to the risks posed by renewable energy projects, for instance exploring whether the risk perception is based on erroneous or outdated assumptions concerning the status of RETs. Exploring the "why" of current situations is important in the measure that it gives indications as to the "what" can be done for their improvement.

Regarding the current practice of environmental due diligence in the financial institutions featured in the thesis, it became clear that the potential for added environmental and social value of this procedure is dependent both on the quality of the review, and on the actions taken by financial institutions on the basis of the information collected during the environmental review procedure. While some institutions stated the principle that potential investments could be rejected on environmental grounds, there are other possible uses for the information collected during an environmental review procedure, including the possibility of offering preferential loan conditions for environmentally beneficial projects, or of incorporating environmental conditions in loan covenants, which gives a legal standing to any environmental agreements made between the financial institution and the project sponsor, providing greater incentives for these conditions to be kept and also more recourses in case they are not.

The potential for added value of an EDD procedure will also depend to some extent on the degree to which it is a reflection of a financial institution's environmental and social policies. The practice of EDD originated as an approach to manage environmental risks and liabilities arising from an investment decision, and of putting these issues into commercial context (e.g. the costs of these liabilities, and the way in which this costs might affect pricing or deal negotiation). Therefore, an EDD will generally always be a reflection of an institution's prudence, but not necessarily a reflection of its environmental and social commitment. The necessity of managing environmental risks and liabilities has been, and will almost certainly remain, an important driver for EDD, especially when coupled with the rising importance of avoiding reputation risks. However, it is when environmental and social beliefs enter the equation, in my opinion, when the potential for added value of this procedure becomes more apparent, e.g. by providing the right institutional context for incorporating other dimensions of sustainability, such as ethical and social considerations that are unlikely to be contemplated in legislations, and for ensuring that high standards are followed no matter the status of environmental legislation, or its enforcement, in the country or region where a project is to be implemented.

Another conclusion of the research concerning current environmental review practices is the importance of monitoring and following up the results of the review. For instance without monitoring it is more difficult to ensure compliance with environmental clauses in loan covenants, or with environmental legislation, regulations and guidelines, adding to the risk of liability or costs related to incompliance. In addition, monitoring an investment provides a financial institution with the possibility of working out corrective action plans, e.g. in case any assumptions made during the environmental review phase turn out to be erroneous, or in case of the emergence of problems not considered during the pre-investment EDD.

With respect to the objective of developing general EDD guidelines for RET projects, there are several difficulties to overcome. One is related to the fact that the outlook of a loan provider is often different to that of an equity provider, and the focus of the due diligence that is carried out is different too. For instance, an equity provider will concentrate on the company, rather than on its projects. A loan provider would be more likely interested in the project itself, and on the company only in the measure that its character affects the financial institution's exposure to risk. Consequently, it is difficult to develop a general guideline that will accommodate both needs.

A related problem is the fact that not all financial institutions have the same perceptions regarding EDD procedures. As was mentioned before, EDD is still not a 'business as usual' practice, and there seems to be different interpretations as to what the process entails, where in the investment phase it should be incorporated, and what are its objectives. According to some of the interviewees the acceptability of the guidelines will at least partly depend on how well they correspond to the already established procedures at their institutions, which is clearly difficult to accomplish with a general procedure.

Finally, there are difficulties related to the nature of renewable energy technologies. As has been mentioned before, the environmental impacts that may be associated to a particular RET project are very dependent on the scale of the project as well as site specific characteristics (e.g. proximity to environmentally sensitive areas, greenfield or brownfield locations, etc.), and therefore environmental issues relevant for one project would not be important or applicable for others. A related consideration may be illustrated by considering the case of an energy crop system. As was seen in Chapter 3, there are various conversion technologies that may be employed, a fact that may give rise to the necessity of considering different environmental issues depending on the technology. For instance, gasification systems may have wastewater issues (related to the scrubbing of the gases prior to their use as fuels during the generation process) that would not be relevant for direct combustion systems. How to account for this in a general guideline is a difficult issue, especially if one of the goals is to provide a way of facilitating the process of reviewing RET investments. If the guideline is too detailed, it may discourage its implementation, but if it is too general, it may fail to point out critical environmental issues related to a RET project. Therefore, one of the most important issues in designing, developing and testing the guidelines will be to find a good medium point between these two possible extremes.

Although there were two different attitudes concerning the development of EDD guidelines for RET investments, as was explained in Chapter 4, there was still a general feeling that the project had potentially useful applications. However, both the usefulness and applicability of the guidelines will depend on the way in which the difficulties mentioned in the previous paragraphs are dealt with, and the way in which financial institutions, and other interested stakeholders, are involved in the process of their development.

7.2 Recommendations

The discussion of drivers and barriers to EDD provided a more holistic picture of the interactions between the different actors involved in an RET project implementation, and food for thought regarding the actions that could still be required to make environmental assessments of projects more the norm than the exception in developing and developed countries alike. Among the most important reflections are the following:

- The business advantages of EDD procedures should be clearly pointed out. According to the research, there is a general consensus that thorough environmental due diligence provides business benefits in the form of avoided liabilities, compliance problems, and other risks and their associated costs. It was also pointed out that project sponsors are as likely to share the benefits of EDD as the financial institutions themselves. These advantages should be clearly communicated not only to financial institutions, but to project developers as well, to provide more incentives and overcome potential perception barriers for EDD adoption and implementation.

- The introduction of an EDD guideline for RET investments should be coupled with adequate training of bank personnel, particularly in developing countries where EDD is not a common practice.

- The development and implementation of the guidelines should be a participatory effort involving financial institutions, existing RET project operators, and governmental institutions, particularly those related with environmental legislations and regulations. As mentioned previously, many financial institutions are still not familiar with RET investments, and therefore including other participants in the process may lead to a more comprehensive view of the issues that need to be focused in an EDD processes.

- A potentially useful way of continuing the development of the guidelines is to test their applicability in a practical situation. This test could provide crucial information concerning the elements that need to be further refined or changed. The practical test could also provide more information concerning how to streamline the procedure, and how best to incorporate more of the design considerations obtained from the analysis of current environmental review procedures.

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Abbreviations

BMZ	German abbreviation for German Ministry for Economic Cooperation and Development
CERCLA	Comprehensive Environmental Response, Compensation and Liability
CHP	Combined heat and power
DEG	German abbreviation for German Investment and Development Company
EA	Environmental assessment
EAP	Environmental action plan
EBRD	European Bank for Reconstruction and Development
EC	European Community
EDD	Environmental due diligence
EIA	Environmental impact assessment
EPA	Environmental Protection Agency
ERM	Environmental risk management
ERS	Environmental review summary
ESCM	Environmental and social clearance memorandum
ESDD	Environmental and Social Development Department
ESIM	Environmental and social information memorandum
EU	European Union
Finnfund	Finnish Fund for Industrial Cooperation
GMO	Genetically Modified Organism
HAWT	Horizontal axis wind turbine
IFC	International Financial Corporation
IFI	International Financial Institution
IIC	Interamerican Investment Cooperation
IO	Investment officer
IPPC	Integrated Pollution Prevention and Control
KfW	German abbreviation for German Agency for Reconstruction
NGO	Non-governmental organization
OP	Operational Policy
PPAH	Pollution Prevention and Abatement Handbook
PV	Photovoltaic
RET	Renewable energy technology
SAM	Sustainable Asset Management
SME	Small and medium sized enterprises
UNDP	United Nations Development Programme
UNEP	United Nations Energy Programme
VAWT	Vertical axis wind turbine
VOC	Volatile organic compound

Appendix 1: Financial institutions featured in the thesis

Financial Institution	Description	Contact person	E-mail and date of interview
E&Co/Energyhouse	E&Co is a US based financial intermediary established in 1994, which provides debt and equity instruments to emerging enterprises for RETs. It has also capitalised revolving loan funds to facilitate sales and leases of solar home systems and has supported various energy efficiency projects.	Annika Lundgren	annika@energyhouse.com Telephone interview August 20, 2002
European Bank for Reconstruction and Development (EBRD)	The EBRD was established in 1991 with the objective of fostering the transition towards market-oriented economies in Central and Eastern Europe and the former Soviet Union, particularly through the promotion of private entrepreneurial activities. Currently neither the EBRD nor its financial intermediaries are focusing on RET investments.	Alke Schmidt	SchmitdA@ebrd.com Only e-mail contact July 24, 2002
Finnish Fund for Industrial Cooperation (Finnfund)	Finnfund was established in 1980 with the objective of promoting strategic investments in developing and transition countries. Projects eligible for finance must be established or start-up companies involving a Finnish interest. Its financial services include equity investments, loans, financial consulting, and fund management. Finnfund has not yet financed RET projects.	Helena Korhonen	helena.korhonen@finnfund.fi Telephone interview July 29, 2002
German Agency for Reconstruction (KfW)	The KfW was established in 1948 with the objective of financing reconstruction projects in Germany following World War II. Currently, it is Germany's leading promotional bank and plays an active role in the business areas of investment finance, export and project finance, financial cooperation with developing countries and also advisory and other services.	Rolf Seifried	Rolf.Seifried@kfw.de Only e-mail contact July 25, 2002
German Investment and Development Company (DEG)	The DEG is a subsidiary of the KfW specialised in long-term project and corporate financing in the private sector in developing countries. DEG invests in profitable, ecologically and socially sustainable projects in agriculture and in manufacturing, in services and in the infrastructure sector.	Wolfgang Weiler	WL@deginvest.de Telephone interview August 28, 2002

Financial Institution	Description	Contact person	E-mail and date of interview
Interamerican Investment Corporation (IIC)	The IIC is a multilateral investment institution that is part of the Interamerican Development Bank (IDB) Group. It was established in 1989 with the objective of promoting SMEs in Latin America and the Caribbean. The IIC provides long-term financing in the form of direct loans and direct equity or quasi-equity investments among other possibilities. It finances expansion projects in all economic sectors (except for arms manufacturing and trade, gambling, and real estate speculation), as well as new (greenfield) projects on a limited and selective basis.	Angela Miller	ANGELAM@iadb.org Telephone interview August 7, 2002
International Finance Corporation (IFC)	The IFC was established in 1956 as the private sector arm of the World Bank Group. Currently, it is the largest multilateral source of loan and equity financing for private sector projects in the developing world. It promotes sustainable private sector development primarily by financing private sector projects located in the developing world; helping private companies in the developing world mobilize financing in international financial markets, and providing advice and technical assistance to businesses and governments	Richard Spencer	Rspencer@worldbank.org Only e-mail contact July 17, 2002
Sustainable Asset Management (SAM)	SAM is a Swiss-based independent asset management company established in 1995. It specialises in the field of sustainability driven investments. SAM sponsors two private equity funds, the 'Sustainability Fund' and the 'Energy fund', which make venture investments in technology companies that contribute to more sustainable use of resources. SAM's Private Equity specialises in three thematic areas: Emerging Energy, Resource Productivity, and Healthy Nutrition. The Emerging Energy theme includes renewable energy as an area of interest.	Rolf Wüstenhagen	rolf.wuestenhagen@sam-group.com E-mail questionnaire July 18, 2002
Triodos International Fund (Triodos)	Triodos International Fund is part of the Triodos Bank, a Dutch-based public bank established in 1980. The Bank has distinguished itself since its origins by specialising in financing innovative environmental and social enterprises and initiatives. It focuses in a number of different sectors, ranging from complimentary health services to organic food and farming and social businesses. The renewable energy sector is also one of the Bank's focal areas, and the bank has established or participates in a number of funds for the promotion of this type of projects.	Hans Schut	hans.schut@triodos.nl Telephone interview August 23, 2002

Appendix 2: Questionnaire for interviews

QUESTIONNAIRE

General information

1. Name:

2. Place of work:

3. Position:

4. How long have you been working in the field of renewable energy technology (RET) investments?

Experience with RET investments

5. Which of the following RETs have you worked with?

___________ Biomass ______________ Small scale hydroelectric

____________Geothermal _______________ Wind

____________ Solar Photovoltaic _____________ Solar Thermal

6. Please estimate the percentage of projects reviewed by your institution that fall under each of the following financial requirement brackets: (Example: if your institution provides up to US $ 1 million for projects as a maximum, then you would fill 100% in that bracket).

RET project's financial requirement

___________ Up to US $ 1million

___________ From US $ 1 to 10 million

___________ More than US $ 10 million

7. Please provide a short description of a typical investment review procedure for an RET project.

8. Do you follow any standardized guidelines, checklists or questionnaires for the review process?

9.Does your institution take into consideration potential environmental, health or safety issues associated with RET projects? If so, please provide examples.

10. Does your institution require environmental impact assessments for RET projects? If no, please elaborate on reason.

11. What kind of projects are you looking into, are they demonstrations or more mature technology?

12. Does the review process followed for a particular RET project likely to differ from the general description provided in Question 7, depending on:

a. The type of RET?

b. The country or region where the project is to be implemented?

c. Other reason(s)? Please specify

Environmental due diligence (EDD)

13. Are you familiar with EDD review procedures?

14. Does your institution perform EDD for RET projects?

15. Can you send me the guidelines you follow?

16. How useful do you think EDD is as a tool for ensuring the environmental soundness of RET investments?

17. Do you think EDD for RET investments should be a general practice for financial institutions?

18.What advantages do you see?

19. Disadvantages?

20. What barriers, constraints or problems could you see to performing EDD reviews for RET projects?

21. What factors do you think could help to promote the use of EDD reviews for RET projects? Do you think a standardized guideline could be a promoting factor?

22. Who else can you suggest I speak with?

Appendix 3: Environmental issues of energy crop technologies

In spite of the lower energy densities of biomass fuel in comparison to fossil fuels, from an environmental standpoint the chemical composition of biomass has considerable advantages over the latter. For instance, the ash content of biomass is typically much lower than that of coal and it is generally free of the toxic metals and other contaminants that make the coal ash difficult to dispose in environmentally acceptable ways. Also, the sulphur content of biomass feedstock is typically less than 2% by weight of the sulphur content of coal, which means that the emissions of sulphur dioxide of a biomass powered plant are negligible compared to the emissions of a coal powered plant. [151]

In order for these and other environmental benefits to be realised, a major challenge is to shape the development of biomass energy systems in a way that capitalizes their inherent advantages. In the case of energy crop systems, important issues to consider concern how to warrant the sustainable production of the biomass crop and the preservation of biological diversity. Global experience with plantations has shown that as energy crops are intensively managed, unsustainable practices may exacerbate problems such as soil degradation and chemical contamination due to agrochemical use. Poorly chosen crops may lead to problems such as local water depletion and loss of biological diversity. These problems are very much site and crop dependent, but illustrate the importance of careful planning and sustainable management of the energy crop system for environmental benefits to be realised. Technological considerations are also important. For instance, the gasification systems not only have the potential for greater efficiency but also for lower atmospheric emissions than direct combustion systems. Even when assessing environmental impacts from the same type of conversion system, factors such as emission controls on site, equipment manufacturer and age, and even plant management practices, will influence the outcome.

The main environmental issues related to energy crop systems will be discussed in the following paragraphs. In this document, the manufacture stage of a biomass energy technology will refer solely to the processes that lead to the manufacture of the physical components of the combustion or gasification plant. The implementation stage will include the construction of the plant and the cultivation of the energy crop, since at least for perennial grasses and woody crops, the cultivation activities take place during the implementation of the energy crop system, prior to the generation activities, and generally the crops may be harvested for long periods of time (six years for grasses and 20 to 30 years for woody crops) before replanting is necessary. In the case of annual grasses, cultivation takes place every year, but currently the vast majority of energy crop systems rely on woody plantations, since the use of herbaceous energy crops is still for the most part at experimental stages.[152] The operation stage will include the impacts from the harvesting and transport of the biomass to the plant as well as those related to the generation process of the plant. While harvesting of woody crops does not take place every year, it occurs at more frequent intervals than cultivation activities. Perennial and annual grasses may be harvested annually. The end of life stage relates principally to the decommissioning activities of the plant itself and the activities necessary to render the plantation land suitable for other purposes.

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[151] Hall, David O. et al. (1993). *Biomass for energy: supply prospects*. In Thomas B. Johansson et al. (1993). *Renewable energy*. p. 597

[152] IEA. (1998). *Benign energy? Appendix H: Energy crops*. [Online]. p. H-4

A. MANUFACTURE STAGE

It was not possible to find a discussion of impacts related to the manufacture stage of biomass plants.

As mentioned previously, the technological components of a biomass plant are basically the same used for coal based power stations. Therefore the environmental impacts of the manufacture of a biomass plant may be approximated using corresponding data from the manufacture of coal-based power stations, which can be found in specialist literature. However for this review, it was more important to determine how significant would these impacts be in relation to other life-cycle stages. To do this, the results of the ExternE study (1998) for different fossil fuel life cycles were reviewed.[153] The result of this review was that in general, the manufacture of the components of a fossil fuel based technology is not considered in the assessment of environmental impacts from the technology because the impacts that arise from other life cycle stages, particularly the operation stage, are generally much larger. Therefore the impacts from the manufacture stage become relatively less important.

Although the life cycle of biomass technologies can not be directly compared to that of coal based technologies, there are undeniable similarities: both are based on the combustion of solid fuels that require processing, handling, and transportation from the point of collection to the point of production, and the combustion process itself has associated emissions. Therefore, based on the life cycle similarities and the results of the ExternE study, it is concluded that in general the manufacture stage of a biomass power plant is not likely to produce significant environmental impacts in comparison to other life-cycle stages.

B. IMPLEMENTATION STAGE

- **Crop cultivation impacts**

Atmospheric emissions

During establishment and cultivation, farm equipment is used for ploughing, spreading of fertilisers and herbicides, and planting. The farm equipment runs on diesel, and therefore emissions of CO_2, SO_2, NOx, particulates, CO, and VOCs are produced. The ExternE study (1998) calculated emissions of these and other pollutants per dry tonne of crop for the cultivation stage of several case study energy crop systems in Greece, the UK, and Portugal. The most significant emissions in terms of g/KWh were those of CO_2, which ranged from an estimated 15.8 g/KWh in Greece to 9.2 g/KWh in the UK. The other pollutants were emitted at much lower concentrations in this stage. In general, the ExternE studies concluded that the atmospheric emissions of from the cultivation stage were the most important contributors to through life emissions of the energy crop system, particularly for CO_2.[154]

[153] The ExternE study is a EU funded research project that was undertaken to establish and develop a methodology for the quantification of externalities of different power generation technologies. The National Implementation component of this study has the objective of establishing a comprehensive and comparable set of data on externalities of power generation for all EU member states and Norway. The fossil fuel life cycles analyzed for this study were coal, oil, orimulsion, natural gas, and peat. For more information see: ExternE [Online]. Available: http://externe.jrc.es/All-EU+Summary.htm [July 29,2002]

[154] The ExternE study assumed that CO_2 emissions from the generation stage are cancelled out because of the previous fixation of CO2 by the growing plants. The study noted that this assumption may not always be justified, as it depends on the way that the biomass has been obtained. For more information, see: ExternE (1998). *Biomass fuel cycle.* [Online]. Available: http://externe.jrc.es/All-EU+Biomass.htm [August 6, 2002]

The potential impacts and significance of the atmospheric emissions of energy crop systems will be discussed in the operational stage.

Agrochemical use

- ✓ Herbicides: These may be used to prepare ground prior to planting woody crops and again in the first and second years after planting, because uncontrolled weeds can seriously reduce the successful establishment of the crop. However, applications in further years should not be required because the crop should be established and canopy closure should occur. The use of herbicides in the initial stages leads to a loss in floral diversity but, as the crop becomes established, floral diversity should return. Herbicides could also enter surface waters through atmospheric drift, surface runoff, erosion and/or direct spills. These impacts will depend on the diluting power of the receiving water body. Good farming practice can minimise these impacts. [155]

- ✓ Fertilisers: The rates of application of fertiliser are likely to vary significantly with climate, soil conditions and the type of crop. The main impacts of fertiliser use include nitrification of groundwater, saturation of soils with phosphate (leading to eutrophication), and difficulties meeting drinking water standards. In addition, the application of phosphates may increase heavy metal flux to the soil.[156] Overall, the impact of energy crops in this respect is likely to depend on the type of land use that the energy crop replaces. If the land was previously used for arable crops (as might be the case in EU countries, if energy crops are grown on 'set-aside' farmland), then fertiliser use and consequent nitrate leaching is likely to be reduced, as long as the fertiliser is applied in accordance to the nutrient demands of the energy crops. However, if energy crops are grown on land which was previously unfertilised, the introduction of fertilisers would bring about the potential for nitrate leaching. In degraded lands the impact of fertiliser use is uncertain, although the experience from Ethiopia and Brazil concerning the establishment of energy crop plantations with sustainable management practices on deforested and otherwise degraded land has been positive.[157] In general, the impact from the use of fertiliser may be mitigated through good farming practices. In addition, replacing chemical fertilisers with biological ones is another option to avoid the impacts of fertiliser use.[158]

- ✓ Pesticides: The use of pesticides, insecticides, and fungicides is very site specific and so are their impacts. In general, the agricultural use of pesticides can affect the health of people as well as the quality of groundwater and surface water, and consequently the health of animal and plant populations. Specific effects will depend on the type of the chemical, the quantities used, and the method of application (e.g. air spraying versus ground spraying). Current experience with plantations indicates that in many cases their use may be considered impractical due to the low-value nature of the crop and therefore the potential impacts of pesticide use are avoided.[159]

Soil erosion

Erosion is related to the cultivation of many annual crops in different regions, and is a concern particularly for woody energy plantations during their establishment phase due to the additional soil

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[155] IEA. (1998). *Benign energy? Appendix H: Energy crops.* [Online]. p. H-16

[156] UNDP. (2000). *World energy assessment*. p. 161

[157] Hall, David O. et al. (1993). *Biomass for energy: supply prospects*. In Thomas B. Johansson et al. (1993). *Renewable energy*. pp. 618-620

[158] UNDP. (2000). *World energy assessment*. p. 161

[159] UNDP. (2000). *World energy assessment*. p. 161

stabilisation measures that are required.[160] The rate of soil erosion from managed lands depends on climate (particularly rainfall), topography, soil characteristics and the crop. There are few measurements of soil erosion on woody plantations. It is thought that erosion will be highest in the first and second years after the crop is planted, after which it will reduce substantially. Over the lifetime of the energy plantation, erosion rates are much lower than for arable land used for annual crops, but higher than for established woodland.

Once again, impacts on soil erosion will depend very much on the type of land use displaced by the energy crop. For instance, in degraded land the establishment of energy crop plantations may help to stabilise soils.

The impacts of soil erosion and runoff of soil into streams and rivers can include: increased water turbidity, stream scouring, silting, and increased concentrations of nutrients or pesticides. Most of the soil removed by erosion is expected to settle in stream beds and reservoirs, where it could lead to an increased need for dredging and clogging of drainage ditches as well as having an impact on flood control measures. Soil remaining suspended in the water could increase its turbidity, which, in the case of surface waters used for public water supply, could increase the amount of water treatment needed. The impact on aquatic fauna will depend on the stream size and characteristics but it may be adverse for small clear-water streams, where suspended sediment concentrations can pose a long-term stress on aquatic organisms.[161]

Biodiversity effects

Energy crop plantations generally support a narrower range of biological species than those found in a natural ecosystem such as a forest. However, whether this narrower range of species poses an impact or not depends on the previous land use of the plantation and the nature of the energy crop. For instance, plantations established on degraded or excess agricultural land are likely to support a greater range of species than before. Plantations of perennial woody crops allow an under storey of ground vegetation to develop, so that there is some floral diversity and a habitat for insects and birds. However, if the plantation displaced permanent woodlands or other environmentally sensitive habitats (e.g. riparian areas), then impacts are likely to be negative. Guidelines for plantation developers can help to ensure that they are located in appropriate areas and that they are designed to maximise, as far as possible, habitat diversity. Such good practice guidelines have been developed for the production and use of biomass for energy in several European countries (e.g. Sweden, Austria, UK) and the United States.[162]

Water use

Increased water use due to additional demands from new vegetation may be a problem, especially in arid or semi-arid regions. Thus, the crop chosen for the plantation must be suited to the rainfall and other water supply conditions of the location, as it may have a considerable effect on water-use efficiency. While some plant species may increase local demands for water, and thereby lead to a water shortage problem, the effect of improved land cover is generally good for the water retention and microclimatic conditions. Thus, the hydrological impacts of a plantation must be evaluated at the local level.[163]

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[160] UNDP. (2000). *World energy assessment*. p. 161

[161] IEA. (1998). *Benign energy? Appendix H: Energy crops*. [Online]. p H-17

[162] UNDP. (2000). *World energy assessment*. p. 162

[163] UNDP. (2000). *World energy assessment*. p. 226

Visual impact

Energy crops are likely to be grown in rural or semi rural environments. It has been estimated that a 50 MW combustion plant would require 15,000 to 20,000 ha of energy crop plantation, a significant land requirement that could lead to impacts on visual amenity. These types of impacts are highly location dependent. However, the appropriate design of the plantation may mitigate their visual effect (e.g. avoiding straight edges to the plantation and using the natural topography of the land). In addition, using different species within plantations to provide visual variety is another measure that can be taken. Guidelines for developers on such matters are already available in some countries.[164]

- **Plant construction impacts**

The construction phase (excavation, civil works, mechanical and electrical work, etc.) is a potential source of many environmental burdens. These impacts will be equivalent to a civil engineering project of a similar scale. Possible impacts include atmospheric emissions from all plant and equipment used on site, noise from the construction site equipment and vehicles, increased visual intrusion from construction activities, and emissions from road transport of personnel and material. However, these impacts are likely to be much smaller than those arising from other life cycle stages. They are also of temporary duration.[165] Therefore, plant construction impacts have generally not been taken into account in specialist literature.

C. OPERATION STAGE

- **Harvesting and transport of energy crops**

Atmospheric emissions

As in the case of cultivation activities, generally diesel fuelled farm equipment is used for harvesting the energy crop. Therefore, the atmospheric emission of pollutants is a potential environmental issue associated to this stage, particularly considering that harvesting activities are likely to occur with more frequency during the life cycle of an energy plantation than cultivation related activities like ploughing and planting.[166] In the ExternE study, the results of the emissions from the cultivation and harvesting activities were aggregated. Thus, it is not possible to estimate the impact due to the harvesting activity itself, but the conclusion is the same: the atmospheric emissions due to cultivation and harvesting activities are the most important contributors to through-life emissions of energy crop technologies.[167]

In relation to the transportation of energy crops, as mentioned in section 3.1.1, the low energy density of biomass generally means that this cost may be a significant penalty for distances greater than 100 Km. In practice this means that the crop plantations are sited as near as possible to the generating facility, generally not more than 50 Km for economical reasons. Therefore even if fossil fuelled vehicles are used, the overall emissions from transportation per KWh generated are likely to be very small in comparison to other life-cycle stages.[168]

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[164] IEA. (1998). *Benign energy? Appendix H: Energy crops.* [Online]. pp. H-18 to H-19

[165] Berry, J.E., Holland, M.R., Watkiss, P. R., Boyd, R., Stephenson, W. (1998). *Power generation and the environment-a UK perspective.* [Online]. Available: http://externe.jrc.es/uk.pdf , p.149. [July 29, 2002]

[166] As mentioned previously, this applies principally to non-annual energy crops, such as perennial grasses and short rotation woods.

[167] Berry, J.E. et al (1998). *Power generation and the environment-a UK perspective.* [Online]. p.153.

[168] IEA. (1998). *Benign energy? Appendix H: Energy crops.* [Online]. pp. H-8 to H-9

- **Generation**

Atmospheric emissions

As a fuel, biomass is inherently cleaner than coal, but the actual emissions from energy production systems depend on the conversion technology used. In general, the emissions arising from direct combustion systems will be greater than those from gasification systems deploying gas turbines. This is particularly true for the emissions of CO and VOCs, as well as for the emissions of particulates.

The potential emissions of NOx are a more difficult problem since nitrogen is present in biomass, albeit in smaller quantities than in coal. In this case solutions developed to address the issue of NOx emissions for coal gasification may also be applicable to biomass.

In terms of CO_2, the operational stage of an energy crop system has the potential to contribute essentially zero net emissions of this gas, if the energy crop is produced sustainably. In this context, sustainable production means that the amount of biomass used for energy is equal, on average, to the amount of biomass grown in given period. Under these conditions, the CO_2 released in combustion is equal to the CO_2 extracted from the atmosphere during photosynthesis. A minor net release would result if fossil fuels were used in the biomass production process (e.g. petrochemical fertilizers, harvesting machinery, transport-vehicle fuel, and so forth), however this is usually discounted, and so generation with biomass fuels is often credited with being carbon dioxide neutral.[169]

The impacts that can result from atmospheric emissions of air pollutants include global warming, public health effects and acid deposition among others.

In conclusion, on a life-cycle basis the chief atmospheric emissions of pollutants occur during the implementation stage and the operation stage as seen before. For CO_2, the main emissions arise during the cultivation and harvesting of the energy crop. For all other pollutants (e.g. NOx, CO, VOCs, and particulates), the emissions arise primarily from the generation stage. In general, electricity generation using gasification biomass technology will bring about a reduction in most emissions. In addition, the emissions associated with either conversion technology for a sustainably produced energy crop will be generally lower than those associated with the conversion of coal, although direct combustion systems may approximate (and in some cases surpass) the emissions of best practice fossil fuel fired plants such as combined cycle gas turbines or coal plants with flue desulphurisation and low emission NOx burners.[170] In all cases, the impacts of atmospheric emissions during the generation stage may be mitigated or avoided through the installation of appropriate pollution abatement equipment and use of combustion control techniques.[171]

Solid wastes

The main solid waste from the operational stage is ash. The ash content of biomass is generally much lower than for coal, and it is generally free of toxic metals and other contaminants as mentioned previously.

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[169] Williams, Robert H., et al. (1993). *Advanced gasification-based biomass power generation.* In Thomas B. Johansson et al. (1993). *Renewable energy.* pp. 761-764

[170] IEA. (1998). *Benign energy? Appendix H: Energy crops.* [Online]. pp. H-9 to H-13

[171] British Biogen (1998). *Wood fuel: Good practice guidelines for the development of a sustainable energy production industry.* [Online]. Available: http://www.britishbiogen.co.uk/gpg/wfgpg/woodfuelgpg.pdf [August 6, 2002]

Although this ash may be safely disposed in a landfill, its high phosphate and potash content make it suitable for use as a fertiliser. Thus a better alternative for the disposal of the ash is to use it as a fertiliser for the energy crop plantation.[172]

Avoided greenhouse gas emissions from global deployment

Many studies have demonstrated that the production of electricity using sustainably produced biomass provides significant environmental benefits over conventional fossil-based power generation. One of the most important environmental benefits is that biomass energy systems have the potential to reduce greenhouse gas emissions and acid gases from power generation, provided that increased global deployment of these systems leads to the displacement of conventional technologies.

D. END OF LIFE STAGE

Overall, biomass facilities that utilize a resource that is sustainably generated leave few on-site or off-site land impacts at the end of their life. Although they produce solid waste, as mentioned before this waste is of less toxicity than the wastes from fossil fuel resources, and thus even if it was routinely stored on site, this storage should not leave behind impacts such as soil or groundwater contamination once the plant is decommissioned.[173]

Considering possible alternative uses for the plant facility at the end of its life during the planning stage is considered a good practice, as this may give further incentives for the careful operation and maintenance of the facility, generally resulting in fewer problems during decommissioning activities. As for the energy crop plantation, if the development has been sustainably managed, employing good farming practices and giving due consideration to cultivation and other relevant guidelines, there should not be any problems to convert the land for other uses at the end of life stage of the technology.[174]

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[172] Berry, J.E. et al (1998). *Power generation and the environment-a UK perspective.* [Online]. p.147

[173] Power Scorecard (2002). *Land use issues of electricity production.* Pace Law School Energy Project. [Online]. Available: http://www.powerscorecard.org/issue_detail.cfm?issue_id=7 [August 3, 2002]

[174] British Biogen. *Wood fuel good practice guidelines.* [Online].

Appendix 4: Environmental issues of wind energy technologies

When assessing the environmental issues of wind energy systems, it is perhaps easy to understand that the specific conversion technology in discussion will play a significant role in determining the relevant issues to consider. For instance, as seen in section 3.2.1, the number of blades of the rotor of a wind turbine may have a direct effect in the noise level of the machine, and visual impact may be related to the rotational speed of the rotor.

However, an even more important determinant of the relevant environmental issues to consider is whether the project refers to a stand-alone machine supplying off-grid demands, or to grid-connected wind farms. As mentioned in the introduction, the scale of deployment of an RET is directly related to the scale of its environmental impacts. This is especially pertinent in the case of wind energy systems. Clearly the environmental impacts that might be related to a wind farm, which might consist of a group of up to 100 turbines, spaced between 5 and 10 rotor diameters apart, will be different from those related to a single machine being used by a farmer to supply his electricity needs. Thus, although the environmental issues to consider might be the same, the potential impacts from the system will be significantly different. This is an important point to keep in mind during the following discussion, which is relevant mainly to on-grid wind farms.[175]

A. MANUFACTURE STAGE

- **Atmospheric emissions**

According to the results of the Externalities of Energy (ExternE) study, the most significant atmospheric emissions arising from a wind energy system occur during the processing and manufacture of materials and components for the wind turbine.[176] In this study, atmospheric emissions of CO_2, SO_2, NOx , and particulates, among other air pollutants were calculated for case study wind farms in Denmark, Germany, Greece, Norway, Spain, and the UK. The wind farms ranged in size from a 30.9 MW wind farm with 103 turbines in the UK to a 2.2 MW wind farm with 5 wind turbines in Norway. The results in calculated atmospheric emissions varied from country to country, partly due to variations in turbine manufacture, but mostly due to different assumptions about generation and fuel mixes in the different countries. The impacts that were studied in connection to atmospheric emissions also varied from country to country, and included the following: In Denmark, impacts on human health, and on crops and materials due to acid deposition; in Germany, impacts on public health, agriculture, forests, materials, and the global climatic system; in Greece, public health, crops, forests, ecosystems, materials and global warming; in Norway, public health, forests, materials and global warming; in Spain, global warming; and in the UK, impacts on global warming and on crops, forests and materials due to acid deposition. In each country, the analysed impacts were quantified and monetized to give an estimation of the monetary value of the burdens produced by the turbine construction stage. Although the results obtained were usually pronounced as fairly inaccurate, the general conclusion was that the impacts produced by the turbine manufacturing stage were likely to be very small, as could be expected. Even so, the UK report added the following comment: "Interestingly, in this case the damage estimates for the impacts associated

[175] Unless otherwise noted, the main source for the discussion of the environmental issues at different stages is: IEA. (1998). *Benign energy? Appendix D: Wind* [Online]. Available: http://www.iea.org/pubs/studies/files/benign/pubs/append3d.doc [July 26,2002]

[176] The ExternE study assessed wind energy systems in the countries of Spain, Denmark, Germany, UK and Greece. For more information, see: ExternE [Online]. Available: http://externe.jrc.es/All-EU+Summary.htm [July 29,2002]

with atmospheric emissions arising from the energy use in the manufacture of the wind turbine and its materials are significantly greater in value than the direct local impacts [i.e. noise and visual intrusion impacts]."[177]

B. IMPLEMENTATION STAGE

- **Atmospheric emissions**

As in the case of the manufacture stage, the ExternE study calculated atmospheric emissions of CO_2, SO_2, NOx, and other air pollutants associated with the site preparation and wind farm construction, although the majority of the country studies concentrated on the emissions arising from the processing of the materials needed for the turbine foundation (e.g. concrete and steel for the turbine bases) rather than on the engineering works, such as road preparation, excavations and so forth, required for the plant construction. In the ExternE study, the results of the emissions from the manufacturing and implementation stages were aggregated. Thus, the analysed impacts were the same as the ones mentioned in the previous stage, and the general conclusion is the same too: While the impacts resulting from atmospheric emission of the implementation stage are likely to be small, they are nevertheless significant compared to the impacts arising from other life-cycle stages. Therefore, the ExternE study argues that to discount them produces a significant underestimation of the environmental impacts of wind energy systems.[178]

- **Other**

Other environmental issues discussed in relation to the implementation stage include the potential impact of construction activities on terrestrial ecosystems and accidents due to construction and transportation. In relation to the former issue, generally the land disruption produced by the construction activities is temporary, with rapid recolonisation of the disrupted land once the civil work has concluded. However, exceptions may occur in the case of fragile ecosystems, or when the construction activities lead to a permanent increase of human intrusion in previously isolated areas, for instance in the case of new or better roads to formerly inaccessible sites. Occupational and public accidents may also be related to the implementation stage of a wind energy development. Although both are unlikely, occupational accidents would be less uncommon than public accidents at this stage of wind turbine life cycle. In the ExternE study, of the country cases discussed only Spain reported non-negligible impacts due to occupational accidents, although the reason was probably that the case study wind farm site was located in a comparatively remote area, and therefore required considerable road travel for building crews.[179]

C. OPERATION STAGE

- **Noise**

Sources of noise

During their operational stage, wind turbines generate two major types of noise: aerodynamic noise and mechanic noise. The total noise emitted by the turbine is the sum of both types.

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[177] Berry, J.E., Holland, M.R., Watkiss, P. R., Boyd, R., Stephenson, W. (1998). *Power generation and the environment-a UK perspective*. [Online]. Available: http://externe.jrc.es/uk.pdf , p.165. [July 29, 2002]

[178] ExternE (1998). [Online]. Available: http://externe.jrc.es/All-EU+Wind.htm [July 29, 2002]

[179] CIEMAT. (1997). *ExternE National Implementation Spain-Final report*. [Online]. Available: http://externe.jrc.es/es.pdf [July 30, 2002]. p. 103

Aerodynamic noise is a random mixture of high frequencies produced when the wind hits objects at different speeds. In the case of a wind turbine, aerodynamic noise is generated by passage of air over the moving blades, resulting in a 'swishing sound' that can be heard when standing close to a wind turbine at low wind speeds. If the surfaces of the blades are very smooth, a minor part of the noise will be emitted because of them. Most of the noise is originated by the trailing, or back, edge of the blades. Thus, aerodynamic noise will be influenced by blade design, a realization that has drawn considerable attention to the importance of carefully designing the trailing edges. [180] Finally, since aerodynamic noise is also influenced by the rotational speed of the blades, and increases at higher rotor speeds with the fifth power of the speed of the blade relative to the surrounding air, modern wind turbines with large rotor diameters have very low rotational speeds to ensure acceptable levels of aerodynamic noise.

Mechanical noise can be generated by all the moving parts in the nacelle (see figure 8), but the major source of noise is usually the gearbox. The noise levels depend on the quality of the construction, and may be emitted directly or through the rest of the construction, including the tower. According to the IEA (1998), most noise related complaints about wind turbines seem to relate to mechanically generated noise, especially where the noise has a strong tonal component.

There are two main approaches to reducing mechanical of noise: reducing the noise from the gearbox itself and using acoustic enclosures. For instance, the Danish Wind Industry Association (2000) reports that both approaches are being used in Danish manufacturing practices, although the first approach is the preferred one. Thus, gearboxes in Danish constructed wind turbines are no longer standard industrial gearboxes, but are specifically constructed for low noise operation, with a semi-soft, flexible core, and a hard surface to ensure long wear.[181]

Environmental impacts of noise emissions

The potential impact of a noise source depends upon a number of factors which include the level of emissions relative to background noise, the nature of the noise in terms of tone and broad band content, site characteristics such as topography and meteorological conditions which may affect propagation, the number of people exposed to the noise source, and personal characteristics such as individual tolerance of noise in general and attitudes towards the development. In the case of wind turbines, an additional element to consider would be the age of the machines, as older machines tend to be noisier than more modern designs. In conclusion, the impact of noise is extremely site-specific and depends mainly on the population density in the area around the wind farm. It should also be considered that wind farms are usually sited in areas with low background noise, such as rural environments, and therefore even relatively low noise levels may be significant. Another problem that is mentioned in connection with noise from wind turbines is the fact that few countries have made general noise rules for wind machines, which could help to secure public acceptance of large-scale wind developments in their vicinity by giving people a feeling of more security and protection, and also give incentives for manufacturers to develop low noise machines.[182]

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[180] Danish Wind Industry Association. (2000). *Designing for low aerodynamic noise from wind turbines*. [Online]. Available: http://www.windpower.org/tour/design/quietae.htm [July 30, 2002]

[181] Danish Wind Industry Association. (2000). *Designing for low mechanical noise from wind turbines*. [Online]. Available: http://www.windpower.org/tour/design/quietae.htm [July 30, 2002]

[182] Grubb, M. J., Meyer, N.I. (1993). *Wind energy: Resources, systems and regional strategies*. In Thomas B. Johansson et al (1993). *Renewable energy*. p. 173

Noise impact assessment

Different methods can be used to assess the environmental impacts of noise emissions. Noise propagation can be measured using different equations and models, and the impact can be monetized using methods such as contingent valuation and hedonic pricing. In general, several studies conducted within the EU and the US have concluded that large noise increments are likely to affect only isolated properties sited close to the developments; noise increments at distances of 1.5 Km are generally less than 2dB(A), even for a large wind farm. A rule of thumb is that properties located farther than 350-400 meters from the nearest turbine are unlikely to suffer from significant noise increments. Of course, there are exceptions to this rule, e.g. natural or man-made sound buffers that reduce background noise levels and would therefore increase the noise impact of a wind farm for properties in their vicinity.[183]

In conclusion, the potential noise impacts of a wind farm are very location dependent, but proper siting can significantly avoid noise related nuisances. The IEA has identified the following points to take into account for minimizing the potential of significant noise impacts from wind farms:

- ✓ The turbines should be located at sufficient distance from houses and other noise sensitive properties. This distance can be determined through noise propagation studies, manufacturer information, available legislation and site assessment.

- ✓ The turbines should be manufactured and assembled to a high standard, thereby ensuring that they operate within their design levels.

- ✓ Noise levels should be controlled by the application of statutory or recommended noise limits at the nearest noise sensitive property.

- **Visual intrusion**

Sources of visual intrusion

Another frequently considered impact of wind farms is their effect on visual amenity, mainly caused by the physical presence of the wind turbines. Thus, the visual intrusion is comprised of the height, the shape, form, colour, and number of the turbines themselves. Although it is difficult to generalize about which of these elements is more likely to produce impacts on an observer, this being a highly subjective issue, the experience from existing schemes indicates that height is normally the most important parameter, as it determines the range of visibility in clear conditions, and the magnitude of any visual effect. Turbine towers are typically 40 m tall, with the blades adding another 20 m, and therefore their height is potentially significant.

Environmental impacts of visual intrusion

Similarly to noise, visual intrusion from wind turbines is site-specific and likely to be influenced by a number of factors, including the physical size of the turbines, the number and design of the turbines, the layout of the wind farm, the number of visitors to the site's vicinity, the landscape type and availability of alternative 'unspoilt areas', weather conditions and local topography, and personal attitudes to scenery and natural beauty, perceptions of the existing level of visual amenity, and attitudes to wind energy. The impact of the visual image of the turbines in itself falls on observers in the line of sight of the wind farm. Beyond 20 Km, the turbines will not be visible to the human eye.

[183] Eyre, N.J. (1995). *Externalities of energy, ExternE project. Volume 6. Wind and hydro, Part I, Wind.* European Commission. pp. 1-121

Between 6-12 Km, the towers are indistinct and the rotor movement will be visible only in good conditions. Therefore, the visual amenity effects are generally concentrated within 6 Km of the wind farm. Along with distance, visibility may also be affected by the local landform. For instance, wind farms located on a ridge or on open countryside may be visible from most directions. In all cases, vegetation and buildings will reduce visibility further.

Visual impact assessment

There are two forms of visual impact. One is the 'objective impact' of the turbines, which is their visual image from observers in line of sight of the wind farm. This depends on the landform and visibility, which define the 'zone of visual intrusion', and the number of observers in that zone. The second is the 'perceived impact', which will depend on the personal attitudes of the observers to the existing land and scenery, and to the changes in these due to the introduction of the turbines, as well as on more general attitudes to wind energy.[184]

Unlike emissions of noise or pollutants, there are no absolute measures of either of these forms of potential visual impact. Indeed, there are no operational standards to date against which enforcement action can be taken. Nevertheless, there are some techniques for assessing visual impact that are frequently used within the planning process for wind farms. To measure objective impact, for example, it is possible to use topographical information to plot a zone of visual interference (ZVI) on a map. This illustrates the locations from which the development might be seen, although frequently vegetation and building effects are not taken into account. Perceived impacts are more difficult to quantify. Tools that are used for this purpose include photomontages (or video equivalents), where the development is superimposed on top of panoramic photographs of the landscape. Attitude surveys may also provide information for this purpose.[185]

In general, large potential impacts may occurs in areas of scenic importance, with high numbers of visitors, or near areas of high population density. In addition, deployment experience has shown that the perception of visual amenity impacts are reduced in places were the local community can see the benefits of a scheme. Public acceptance depends on education and participation on siting decisions. In general, the public should be provided with relevant information about general energy policies and trade-offs associated with alternative sources of energy.[186]

In conclusion, visual impacts are site-dependent and extremely localised in influence. They are normally important for residents and tourists up to an approximate distance of 6-12 Km, with the possible effects increasing as distance from the wind farm site decreases. In general, deployment of wind farms should be avoided in areas of scenic interest. At all sites, impacts may be mitigated by tree planting or other forms of attractive screening closer to the observer. Other points to be taken in account to minimise visual intrusiveness include colour selection, structures and layout of turbines.

- **Land use and habitat damage**

Although noise emissions and visual intrusion have been the main potential environmental issues usually identified with wind energy technologies, land use and habitat damage pose arguably less subjective potential problems. Critics of wind energy systems have charged that wind plants require

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[184] Berry, J.E., et al (1998). *Power generation and the environment-a UK perspective.* [Online] pp.158-159.

[185] Berry, J.E., et al (1998). *Power generation and the environment-a UK perspective.* [Online] pp.158-160

[186] Grubb, M. J., et al. (1993). *Wind energy: Resources, systems and regional strategies*. In Thomas B. Johansson et al (1993). *Renewable energy*. pp. 174-175

more land than conventional power plants because of the relative diffuseness of wind energy compared to fossil fuel sources.[187]

In truth, wind plants do have significant land requirements. A rule of thumb indicates that wind turbines should be separated between 5 to 10 rotor diameters to avoid interference. Thus, the total area of a wind farm can be considerable. However, the wind turbines themselves typically occupy less than 0.1% of the wind farm area, although this percentage increases to 1% if access roads and equipment housing are included in the estimations. For instance, a medium-sized turbine typically averages about 40 square meters of occupied land.[188]

Since wind farms are usually sited in agricultural areas or open landscapes where human activities have not developed, the land used for the wind farms may lead to the loss of farming land or natural habitats, respectively. The importance of this loss will depend on the agricultural, forestry or recreational value of the land prior to the wind farm construction, and on whether the land between the turbines can be used. The types of land use impact vary with the type of land, and may include the opportunity loss of agricultural production in intensively farmed land, effects on terrestrial ecosystems, especially in areas with very fragile ecosystems such as peat bogs, due to the disruption produced by the wind farm, and the loss of recreational amenities, such as hiking activities in the wilderness. In addition, land use may have severe effects in areas of archaeological importance or high conservation value, although the possibility of obtaining permission for wind farm siting in this type of area is unlikely.

- **Bird strike and disturbance**

Of the reviewed environmental issues so far, the potential effects of wind turbines on avian life are the ones were more conflicting assessments were found. In general, the main impacts on birds that are discussed in specialist literature are behavioural disturbance due to the physical presence of the turbines and collisions with rotating turbine blades. However, the assessment of the importance of these impacts varied significantly in different sources.

Most European sources reviewed concluded that the impact on bird life appeared to be minor if the turbines are properly located, e.g. away from important ornithological sites. For instance, a referenced study conducted in the UK concluded that there is little reason to expect collisions for resident bird species in good visibility conditions. Another cited research project conducted in the Netherlands indicated that bird casualties from collisions with rotating blades on a wind farm of 1,000 megawatts are a very small fraction of the casualties from other human activities such as hunting, high voltage lines, and vehicle traffic.[189]

On the other hand, many of the sources from the United States painted a different picture of the situation, and generally advocated that the potential impacts of large-scale wind deployment on avian life remain a subject where research is needed. For instance, the National Wind Coordinating Committee (NWCC) prepared and published in 1999 a guidance document for studying the interactions between wind energy and bird life as a result of expressed stakeholder concern over the number of bird fatalities reported at the Altamont and Solano wind farms in California, with an estimated 230 birds dying annually in turbine collisions in Altamont alone. Nevertheless the introduction to the document indicates that this has been to date the only major commercial wind

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187 Gipe, Paul. (1993). *Wind energy- Experience from California and Denmark*. In Tim Jackson (1993). *Renewable energy*. pp. 82-83

188 National Technical University of Athens. (1997). *External costs of electricity generation in Greece*. [Online]. Available: http://externe.jrc.es/greece.pdf [July 30, 2002]. pp.164-165

189 UNDP. (2000). *World energy assessment*. p. 233

energy development in the US were significant mortality rates among bird species has been found.[190] The IEA study (1998) pointed out in relation to the mortality rates at the Altamont development that not only is this development the largest wind development in the world, with an approximate production of 1100 GWh/year, but that behaviour of the most affected species (the raptor bird) could also partly be accounted as a reason for the large mortality rate. These observations appear to give credence to the assessment that the potential for bird strikes depends highly on the location and that if wind farm siting is avoided in ecologically sensitive areas, areas with high avian migratory patterns, or other ornithologically valuable areas, this potential can be considerably mitigated.

- **Avoided emissions of air pollutants from global deployment**:

This is a potentially positive environmental impact, but it depends on whether large-scale deployment leads to the displacement of fossil fuel sources as well as on the fuel mix of the power plants that the wind turbine plant is working with. Estimates of avoided carbon dioxide emissions (the main greenhouse gas) from global deployment range from 170 and 360 Million tonnes in the year 2020 (WEC) to 1.4-2.5 gigatonnes of CO_2 emissions a year by the year 2025 (BTM Consult).[191]

- **Other**

Other environmental impacts discussed in relation to the operational stage of wind turbines include the following:

✓ **Electromagnetic interference (EMI)**: the rotation of the blades of a wind turbine can scatter electromagnetic signals, causing interference in a range of communication systems. Additionally, the signals can be reflected from turbine blades, so that nearby receivers pick up both direct and reflected signals. This problem is more relevant for metallic blade materials, which are strongly reflective, than for glass reinforced plastic blades, which are partially transparent to electromagnetic waves.[192] The types of communication that may be affected include television broadcasts, microwave links, VHF Omni-directional Ranging (VOR) and Instrument Landing System (ILS), both used for aircraft navigation. Eyre (1994) discussed this issue and concluded that problems with domestic reception of television signals can not always be avoided, although the interference tends to be in a small area near the vicinity of the plants (typically 2Km by a couple of hundred meters around the wind farms site), and can be cheaply resolved by using signal amplifiers, active deflectors, relay transmitters or cable television. For the other types of interference, guidelines usually exist that help planners to avoid these types of problems.[193]

✓ **Accidents**: Both occupational and public accidents may occur during the operational stage of a wind turbine, although accidents involving the public are extremely unlikely in wind farm developments. Problems that have been discussed include possible driver distraction, possible injury or property damage if part or all of a turbine detaches from the rotor while in operation, and epileptic fits triggered on susceptible people by frequencies above 2.5 and 3 Hz that could be induced if the rotors move at speeds above 50 revolutions per minute. There are no recorded

[190] The National Wind Coordinating Committee (NWCC) is an organization composed of different stakeholder involved in wind energy deployment. The committee identifies issues that may potentially affect the use of wind power and initiates dialogue among stakeholders. For more information see: NWCC [Online]. Available: http://www.nationalwind.org [July 30, 2002]

[191] UNDP (2000). *World energy assessment*. p. 233

[192] Eyre, N.J. (1995). *Externalities of energy, ExternE project. Volume 6. Wind and hydro, Part I, Wind.* European Commission. pp. 1-121

[193] Eyre, N. (1994). *CEC project on the external costs of fuel cycles-The environmental costs of wind energy.* Cited in: IER (1997). *ExternE National Implementation Germany-Final report.* [Online]. Available: http://externe.jrc.es/ger.pdf [July 30,2002]. p. 51

occurrences of these types of events, and thus they have not been generally considered in specialist literature.

D. END OF LIFE

Impacts from the end of life stage are generally not considered in specialist literature. Because all components are conventional, decommissioning wind turbines poses few difficulties. This process entails the removal of scrap material and cabling, and of the concrete bases. Provided that suitable disposal methods are employed, that recycling of materials is performed when possible and that the concrete bases are properly removed or buried, there should not be any residual waste or land contamination.[194]

[194] UNDP (2000). *World energy assessment*. pp. 233-234

Appendix 5: Environmental review procedures of additional financial institutions

1.Environmental review procedures of the European Bank for Reconstruction and Development (EBRD) [195]

Currently, none of the EBRD financial institutions focus specifically on renewable investments, although the Bank is involved in a study aimed at identifying opportunities for investing in the renewable energy sector. Therefore, the environmental review procedures that would be followed for renewable energy investments are based on the general environmental appraisal procedures that have been established for the Bank's financial institutions. [196]

As a further aid for the review process the EBRD has prepared a manual entitled "Environmental Risk Management for Financial Institutions", which contains all the procedures, tools and guidance materials that the Bank has developed to date. Among the tools included in this manual is a set of sub-sectoral environmental guidelines that help credit/investment officers identify major environmental activity risks, important management actions, and essential aspects of environmental due diligence. So far, these guidelines do not cover renewable energy projects, although there is one guideline developed for crop plantations that could be adopted for energy crop conversion systems. [197]

The environmental review process involves three main actors: the project sponsor, who has the responsibility for providing sufficient environmental information on which the Bank can base its investment decision; the Operation Leader (OL), who has the overall responsibility on behalf of the Bank for the environmental review procedure and for incorporating relevant environmental findings during the investment decision process; and the Environmental Appraisal Unit (EAU), a specialised Bank unit that conducts the practical EDD activities.

The environmental appraisal comprises several stages that cover the four basic phases of an EDD procedure depicted in figure 15. These phases are similar to the IFC phases that were detailed in the previous section, although the EBRD has different project categories, different environmental investigation requirements, as well as its own environmental investigation format.

During the initial review stages, the EAU carries an environmental screening of the proposed project based on information provided by the project sponsor (e.g. preliminary environmental investigations). This screening identifies the types of environmental information that may be required for assessing environmental risks and liabilities, regulatory compliance, adverse environmental impacts, as well as opportunities for environmental benefits, or for the incorporation of environmental enhancements (e.g. opportunities for cleaner production or energy efficiency).

During the screening process the project is classified into one of the EBRD project categories. The project categories of the EBRD are A, B, and C, which are similar to the corresponding IFC project

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[195] Unless otherwise noted, the main source for this section is: EBRD. (1996). *Environmental procedures*. [Online]. Available: http://www.ebrd.com/enviro/index.htm [August 21, 2002]

[196] Schmidt, Alke (SchmitdA@ebrd.com) (July 24, 2002). *Re: Environmental due diligence procedures for renewable energy investments*. E-mail to Gloria Argueta (Gloria.Argueta@student.iiiee.lu.se)

[197]This manual is an executable file that may be accessed on the EBRD website at http://www.ebrd.com/enviro/index.htm (July 29, 2002)

categories. [198] In addition, an existing operation may be classified as 1 (if it requires an environmental audit), or 0 (if does not require an environmental audit).

Once the project has been screened and categorized, the Bank may require the performance of the pertinent environmental investigation, which is responsibility of the project sponsor. The main types of environmental investigations carried out on EBRD operations are EIA, environmental analyses, and environmental audits.[199] Some operations will require combinations of these investigations, depending on the project complexity and environmental sensitivity. Environmental investigations should address impacts on health and safety and socio-economic impacts, as well as environmental impacts. The EBRD provides the formats for the environmental investigation reports that must be prepared by the project sponsor. These formats detail the issues that must be covered in the environmental investigation process.

Based on the results of the environmental investigation, the project sponsor develops an Environmental Action Plan (EAP), which will document the key environmental issues, the actions that will be taken to address these issues, the implementation schedule and an estimation of the associated costs. The EAP must be approved by the Bank's investment review team (including the OL and the EAU) before the investment is approved.

The EBRD has a public consultation policy that applies mainly to 'A' type projects, although the project sponsor must ensure that all national requirements for public consultation in the host country are met, regardless of the project category. [200]

As the project progresses to the negotiation of environmental covenants between the project sponsor and the Bank's operation teams, the project's OL must ensure that all relevant findings of the environmental appraisal process are adequately reflected in the legal documentation drafts, and that these have been reviewed and approved by the EAU prior to the negotiations.

The last stage of the pre-investment EDD is the final environmental review performed by the EAU. The review is based on the findings of the environmental investigation, the results of the public consultation and site visits that may have been conducted by the EAU. The final environmental review is documented in an Environmental Review Memorandum (ERM), which is submitted to the Operation Committee. The Operation Committee conducts the final review, and if the project passes this stage, it is sent to the Board for the final decision.

Finally, if the EBRD board approves the project, the post-investment decision EDD continues with project monitoring (to ensure that the project complies with environmental covenants and regulatory standards), and evaluation of the project's environmental performance.

2.Environmental review procedures of the Inter American Investment Corporation (IIC) [201]

The Inter American Investment Corporation is one of the six major programs of the Inter American Development Bank (IDB). The other programs are the Multilateral Investment Fund, the Technical Cooperation, the Private Sector Department, the IDB loan program and the special trust funds.

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[198] A sample list of 'A' level operations is included in Annex 4 of the Bank's environmental procedures. For more details see: EBRD. (1996). *Environmental procedures*. [Online].

[199] An environmental analysis is performed for operations or activities that may have significant environmental impacts, but for which these impacts may be readily identified, assessed and mitigated.

[200] The Bank's public consultation procedures are included in the Environmental Appraisal document in Annex 1. For more details see: EBRD. (1996). *Environmental procedures*. [Online].

[201] Unless otherwise noted, the main source for this section is: Miller, Angela (August 7, 2002) Telephone interview

Currently, the IIC does not have specific environmental review measures put in place for renewable energy projects. Therefore, a RET project being considered for investment would undergo the general steps established in the Corporation's environmental and labour review procedure.[202]

In comparison to the IFC or the EBRD, the IIC is a relatively small organization that specialises in providing financing for small and medium sized enterprises. Therefore, it does not have the resources to develop its own sectoral guidelines. Instead, the Corporation relies on internationally recognized best practice guidelines, which are chosen depending on the type of operation that is being assessed. For instance, IFC guidelines such as the PPAH are used for reviewing energy projects.

There are three main actors involved in the environmental review procedure: the project sponsor, the Environmental Unit (EnU) team assigned to the project, and the investment officer (IO). When required, the EnU (which is headed by an environmental advisor) will seek necessary technical assistance from specialists within the IDB Environment Protection Division and/or from external consultants. The environmental advisor has the overall responsibility for determining whether a project complies with national environmental laws, regulations and standards, or to make the IIC management aware of any issues that are inconsistent with these requirements.[203]

The IIC review procedure also covers the four main EDD phases depicted in figure 15.

At an early stage, the IO provides the EnU with information concerning any kind of environmental review that has already been conducted with respect to the operation. The EnU assesses the information and categorizes the as a type IV, III, II, or I. Categories IV, III, and II are similar to the IFC categories A, B, and C, with category IV corresponding to category A, and so on. Category I projects are designed specifically to have a positive impact in improving environmental quality.[204]

Once the project has been screened, it goes through an internal review by the IIC's investment /credit review staff. If the project passes this review, the EnU prepares terms of reference for the EA, which document the information requirements and appropriate guidelines and policies against which the project will be reviewed. The terms of reference are provided to the IO, who then communicates them to the project sponsor. The project sponsor has the main responsibility for preparing and submitting the necessary EA during the project appraisal process, although the EnU can provide guidance as required. In general the EA is only required for categories IV and III. [205]

Depending on the category of the project, the EnU has specific activities related to the project appraisal process. These activities include site visits (particularly for categories IV and III), and desk reviews of the EA and other information provided by the project sponsor. As part of the IIC's policy, during the project appraisal stage the EnU must review labour compliance aspects, including occupational health and safety issues.

Once the project appraisal is concluded, the EnU prepares an analysis of the environmental issues of the project, its potential impacts, as well as the mitigation measures (including an estimation of their projected costs) that need to be implemented in order to address these impacts. This report is sent to an IIC investment and credit review committee for a second phase review. If the project passes this

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[202] These procedures are available on the Corporation's website: IIC. (1999). *Procedure for environmental and labour review of IIC projects.* [Online]. Available: http://www.iadb.org/iic/english/policy/042799_projectreview.htm [August 24, 2002]

[203] IIC. (1999). *Procedure for environmental and labour review of IIC projects.* [Online].

[204] IIC. (1999). *Procedure for environmental and labour review of IIC projects.* [Online].

[205] IIC. (1999). *Procedure for environmental and labour review of IIC projects.* [Online].

review, it is sent to the IIC Board for a final review process. During the final review, the IIC board asks questions related to all aspects of the project (i.e. financial, economic, social, technical and environmental issues). The EnU answers the questions related to the environmental aspects of the project.

Based on the results of the final review, the Board decides whether the project will be approved or not. A certain number of days prior to the Board's final decision, the public disclosure policy of the IIC requires that an investment review summary, including a review of the environmental aspects of the project, be posted on the Internet. The EnU must prepare the environmental section of the public disclosure document.

If the project is approved, the IIC requires the project sponsor to prepare an Environmental Management Plan (EMP), which must be submitted to and approved by the EnU before the first loan disbursement may take place. The EnU will review the EMP, make recommendations and suggest changes as necessary. Once the EnU is satisfied with the proposed EMP, it is annexed to the loan agreement documents, and the loan disbursement may proceed as agreed.

After the project is approved, the EnU continues to supervise and monitor the project during its implementation and operation, until the loan is served, or until the project is no longer included in the IIC project portfolio.

3. Environmental review procedures of the German Investment and Development Company (DEG) [206]

The DEG is a government finance and consulting corporation for German Development Policy. The DEG has a mandate for supporting sustainable economic activity, and therefore the institution requires an environmental and social review of all potential investments.[207] Thus, RET projects reviews follow the general procedures established by the institution for all its projects.

The DEG's environmental and social review procedure is based on that of the IFC (see section 4.2.1), and the institution generally tries to adhere to IFC standards and guidelines. In some cases, the BMZ's Environmental Handbook (see section 4.2.2) may also be used. In addition, the DEG has prepared guidelines to benchmark the compatibility of their investments with DEG's social and ethical policies. These guidelines cover aspects such as forced labour, protection for working minors, equal rights, worker health and safety, and socially relevant project effects like relocation or land use rights.[208]

There are three main actors involved in an environmental review procedure: the project sponsor, who has the main responsibility for providing the necessary information to demonstrate that a project complies with environmental standards, the DEG's Environmental Department (EnD), an in-house special consulting unit with similar obligations as the IFC's Environment and Social Development Department, and the project's Investment Manager (IM), who is responsible for the overall investment review procedure.

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[206] Unless otherwise noted, the main source for this section is: Weiler, Wolfgang (August 28, 2002) Telephone interview

[207] DEG. (n.d.) [Online]. Available: http://www.deginvest.de/english/home/frameset_frame_back.html [August 31, 2002]

[208] DEG (n.d.). *Guidelines on social compatibility of DEG business.* [Online]. Available: http://www.deginvest.de/english/home/company/our_mandate/guidelines_social/index.html [August 31, 2002]

Investment applications at the DEG follow a pre-screening process with the objective of determining whether a project complies with the bank's development policies, and other initial financial, environmental, ethical and social mandates. If the project passes this first stage, the EnD performs an environmental screening of the investment using initial information documents provided by the project sponsor. With this information, the EnD classifies the project into A, B, or C categories, which are defined in the same way as the IFC's. The EnD prepares a short written description of the project and of its initial assessment that is included in a document called "qualified investment inquiry", submitted to the DEG's managing directors, who decide if the investment goes on to the following stages. If the ED receives confirmation from the managing directors, it starts with the environmental due diligence process. In order to obtain information for this process, the EnD relies on question lists, which are either sent directly to the project sponsor or handed in to the IM. There are basically two stages of inquiry: Initially, a very general environmental questionnaire, also including social aspects, is sent. This questionnaire requests for environmental studies (e.g. EIA, environmental audits, or other) depending on the category of the project, environmental project descriptions, the project's compliance with social aspects, etc. Using the answers to this questionnaire, a more detailed list of questions is tailored specifically for the project. This second questionnaire is given to the IM, who passes it on to the project sponsor.

After having received and analysed all the information, the EnD prepares a final environmental review report, which is given to the Board for the final investment review stage. During the Board's review the EnD answers any environmental related questions that may come up, and generally gives advice to the Board about the project's environmental issues and about any contractual environmental clauses included in the agreement covenants.

Once a project is approved for financing, the DEG ensures the project's continued environmental soundness through standard contractual clauses (including requirements for compliance with relevant international, national and local standards, World Bank standards and so forth), which must be kept by the project sponsor during the loan term. In addition, the DEG will perform an independent audit of the project every two years, to assess its environmental performance.

Appendix 6: World Bank's OPs applicable to RET projects

The following table summarises the main World Bank operational policies that are applicable to IFC environmental review procedures.

Policy	Description
OP 4.01, Environmental Assessment	This policy states that all projects proposed for financing require an EA to ensure that they are environmentally and socially sound and sustainable.
OP 4.04, Natural Habitats	This policy affirms a commitment to promote and support natural habitat conservation and improved land use, and the protection, maintenance, and rehabilitation of natural habitats and their functions in its project financing. IFC does not support projects that involve significant conversion or degradation of critical natural habitats.
OP 4.09, Pest Management	IFC supports the use of biological or environmental control methods rather than the use of pesticides where there is a need for pest management. Where pesticides are required, this policy sets forth the criteria for their use.
OP 4.10, Indigenous Peoples [forthcoming]	Pending finalization of this OP, IFC projects must comply with the World Bank's ON 4.20, Indigenous Peoples, as appropriate in a private sector context.
OP 4.11, Safeguarding Cultural Property [forthcoming]	Pending finalization of this OP, IFC projects must comply with the World Bank's OPN 11.03, Cultural Property, as appropriate in a private sector context.
OP 4.12, Involuntary Resettlement [forthcoming]	This policy is applied wherever land, housing or other resources are taken involuntarily from people. It sets out the objectives to be met and procedures to be followed for carrying out baseline studies, impact analyses, and mitigation plans when affected people must move or lose part or all of their livelihoods.
OP 4.36, Forestry	IFC involvement in the forestry sector aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty, and encourage economic development. IFC does not finance commercial logging operations or the purchase of logging equipment for use in primary tropical moist forests. This policy is now under review.
OP 4.37, Safety of Dams [forthcoming]	This policy sets forth IFC's requirements for projects where dams are to be constructed. The policy covers dams for mine tailings, dams containing other material such as ash from power plants, and water storage dams.
OP 7.50, Projects on International Waterways	This policy sets forth required agreements and notifications regarding projects that are situated on international waterways.

Source: IFC. (1998). *Environmental and social review procedure*