Environmental Due Diligence (EDD)

Of Renewable Energy Projects

GUIDELINES

for

Solar Photovoltaic Energy Systems

Release 1.0

UNEP
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BASE

Environmental Due Diligence (EDD) process for Solar PV Energy Systems

Definition and background

Environmental Due Diligence (EDD) is the collection and assessment of data relative to environmental conditions or impacts prior to a transaction to identify and quantify environment-related financial, legal, and reputational risks.

Banks have put in place a number of instruments to manage risk. One of these instruments is commonly termed a **Due Diligence** review. This term, as well as its practice, originates from the U.S. and 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. The environmental component of the due diligence procedure is referred to as environmental due diligence (EDD). Originally, lenders or investors used EDD to manage environmental risks and liabilities stemming from an investment decision. Recently, it has become a way for financial institutions to incorporate environmental and social considerations in their investment review process.

EDD has become largely standardised for many sectors, but not for all. There is a growing realisation in energy and environmental policy and research circles that procedures for environmental due diligence of Renewable Energy Technologies (RETs) are poorly defined and financiers must often adopt *ad hoc* procedures for environmental review. Although most renewable energy technologies are environmentally sound in theory, all of them can have negative impacts on the environment if poorly planned.

The Environmental Due Diligence process

The process consists of three stages (Figure 1)
1. Establishing the regulatory framework
2. Environmental appraisal
3. Monitoring the project after approval

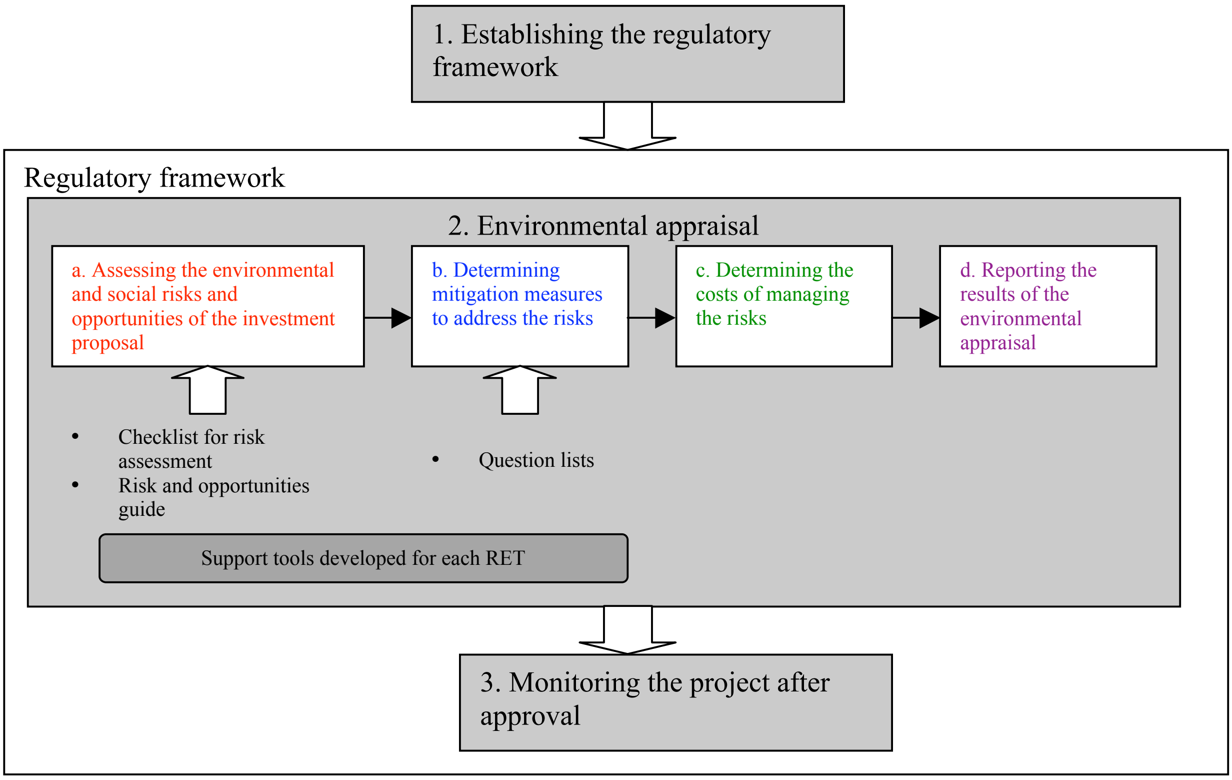

Figure 1: Procedure for environmental due diligence of RET investments

1. The first stage of the procedure is establishing the relevant regulatory framework for the project, including national regulations, international standards, and good practice guidelines.

The environmental laws provide the background for determining the main issues that should be considered during the environmental appraisal process. 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. Two timeframes must 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 must operate.

2. The second stage is the core of the entire process. It comprises four main steps: a) assessing the environmental risk; b) determining mitigation measures; c) estimating the cost of risk management; and d) reporting the results.

To facilitate the first two steps of this stage a number of new EDD tools are proposed. These tools are intended to complement, not replace, any EDD 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 the possible environmental and/or social issues related to a particular investment. The analyst should incorporate additional issues as needed.

3. The third stage is the monitoring and environmental evaluation of the project. This procedure serves two main purposes: a) to ensure that the project sponsor complies with the applicable environmental standards and various environmental components of operations included in legal agreements; b) to keep track of ongoing environmental impacts associated with project operations and of the effectiveness of any mitigation measures.

EDD Guidelines for Solar Photovoltaic Energy Systems

The guidelines for EDD of Solar PV energy systems follow the three stages shown in Figure 1.

1. Regulatory framework for the project

The regulatory framework for the guidelines consists of the current and anticipated national and regional laws, international standards, and best practice guidelines.

2. Environmental appraisal of the project

This stage comprises **four main steps:** a) assessing the environmental risk, b) determining mitigation measures, c) estimating the cost of risk management, and d) reporting the results.

a) Assessing the environmental and social risks and opportunities of the project

The objective of this task is to provide an initial evaluation of the environmental risks and the opportunities presented by a particular small-scale hydroelectric project. The expected outcome of this step is a matrix that provides the analyst with an estimate of the risk potential of a project with respect to a number of potential environmental issues.

Two tools have been developed to aid the investment analyst in this task.

Table 1 provides a list of potential environmental issues that may be associated with a small-scale hydroelectric project. The issues have been divided into four categories: effluent emissions, on-site contamination and hazardous materials issues; biodiversity protection issues; worker health and safety issues; and environmental issues sensitive to public perception. The table provides a checklist of information that an analyst may use to determine the risk potential of each issue for the project in review. This information may be contained in the documentation provided by the project developer, for example in an EIA or other type of environmental assessment report that may accompany the proposal; or it may be ascertained during on-site field visits, stakeholder meetings, etc. Other possible sources of information include media reports, telephone conversations, electronic or post mail, etc. In any case, the responsibility for providing relevant information to the satisfaction of the analyst rests ultimately with the project developer/sponsor.

In some cases, the table also provides best practices and/or mitigation measures that could be planned, proposed or carried out on-site to manage a particular issue. It is important to note, however, that these best practices/measures are generic and therefore only meant for illustrative purposes.

Other important information to be used to assess the risk potential of a small-scale hydroelectric energy system include:
- impending environmental legislation that may affect the project;
- the environmental liability regime of the host country; and
- project sponsor characteristics including previous compliance problems and history of accidents.

The risk potential of each issue is to be rated using the following key:

Risk Rating Key:

Key	Definition	Characteristics
L	Low/no risk potential.	Information availability: Excellent (the issue is well documented) Environmental impact: Little to no negative environmental impact in case of occurrence Probability of occurrence: Low to non-existent Mitigation/compensation measures: Readily available and considered in proposal
L-M	Low to moderate risk potential.	Information availability: Excellent to good (the issue is adequately documented) Environmental impact: Temporary/reversible damage in case of occurrence Probability of occurrence: Low (estimated at less than 20%) Mitigation/compensation measures: Readily available and considered in proposal
M	Moderate risk potential	Information availability: Good (documentation is adequate, but may require improvement (e.g. clarification, addition)) Environmental impact: Temporary/reversible damage in case of occurrence Probability of occurrence: Estimated between 20-40% Mitigation/compensation measures: Readily available, but not considered in proposal
M-H	Moderate to high risk potential	Information availability: Requires improvement (there is little or no documentation pertaining to the issue, or the information requires clarification or addition) Environmental impact: Potential for adverse impacts, although to a lesser degree than **H** issues (e.g. impacts may be site-specific, mostly reversible, or with readily available mitigation measures). Probability of occurrence: Estimated between 20-60% Mitigation/compensation measures: Available, not considered in proposal
H	High risk potential	Information availability: Requires improvement (there is little or no documentation pertaining to the issue, or the information requires clarification or addition). Environmental impact: Potential for adverse impacts (the issue may become critical if not managed, e.g. it could affect more than the project site, pose irreversible environmental damages, affect sensitive flora, fauna, human communities, etc.) Probability of occurrence: Higher than 40% Mitigation/compensation measures: Not available from technical/logistical/financial/legal perspective/ or available but not considered in proposal

The second table, **Table 2**, is a matrix in which the user can enter the appropriate letter (i.e. L, L-M, M, M-H, H) according to his/her estimation of the risk each issue presents for the project in review. The purpose of the table is simply to provide a snapshot of the environmental and social risks of a particular project and their corresponding risk rating at a particular point in time. This risk rating can help the investment analyst decide further actions in the EDD process.

Table 2 also presents a column of potential environmental opportunities of a project, to present a more balanced view of the environmental impact (both positive and negative) that may be attributed to a particular project.

The assessment of a certain risk potential will depend on the results of the review of relevant information, as well as on the analyst's experience and common sense.

How to use the tables:

Table 1 contains a list of potential risks as well as information to help estimate the risk potential. Once the analyst makes this estimation, the appropriate letter is filled in Table 2.

Template of Table 1: Checklist for environmental risk assessment

Risk	Information to look for
1. Risk 1	Information 1
2. Risk 2	Information 2
3. ...	...
...	

Risk rating
L, M, H
to be entered here

Template of Table 2 (Matrix):

Activity	Environmental and social risks					Environmental opportunities
	Issue 1	Issue 2	Issue 3	Issue 4	Issue 5	
	1.					
	H	L				
	2.					
	M	M-H				

Table 1: Checklist for environmental and social risk assessment of a PV system

Aspect	Information to look for
Effluent emissions, on-site contamination, hazardous materials issues	
1. Toxic and hazardous materials used for production of PV cells	• Type(s) of PV cells manufactured: Type and quantity of chemicals used as feedstocks, doping agents, solvents, and transport agents, technology involved in their production, steps in the production process, etc. • Status of compliance with internationally accepted hazardous materials (hazmats) management guidelines (e.g. IFC's Hazardous Material Management guidelines) • Manufacturer experience (e.g. industry reputation, standing in local community, accident history, worker compensation claims, technological rating (e.g. state of the art? Older equipment and/or facilities?) etc.) • Maturity of the technology • Compliance with local, national and/or international laws and regulations concerning hazmats (storage, processing, transportation, etc.).
2. Atmospheric emissions of toxic substances due to incineration during decommissioning of PV systems	• Chemical content of PV cells used in project: Silicon modules pose fewer decommissioning problems than cadmium containing modules. • Decommissioning plans for the project: disposal methods proposed, recycling opportunities considered for end of life stage, PV cells collection schemes available for decommissioning purposes.
Biodiversity protection issues	
–	–
Worker health and safety issues	
3. Occupational health hazards during manufacturing of PV cells	• Type(s) of PV cells manufactured: Type and quantity of chemicals used as feedstocks, doping agents, solvents, and transport agents, technology involved in their production, steps in the production process, etc. • Toxicity and health hazards posed by chemical substances used in PV manufacturing process (e.g. phosphine used in amorphous silicon cells is very toxic and poses a severe fire hazard through spontaneous chemical reaction). • Status of compliance with internationally accepted hazmats management guidelines (e.g. IFC's Hazardous Material Management guidelines) particularly regarding worker health and safety, personnel training, and preventive measures regarding life and fire safety, including but not limited to compliance with insurance requirements, emergency procedures in place, compliance with local building and fire codes, provision of protective clothing, goggles and footwear, and periodic medical examinations. • Compliance with general international, local, and national health and safety regulations. • Outstanding worker compensation claims.
4. Occupational health hazards during operation of PV system	• Compliance with international, local, and national health and safety regulations • Training of personnel • Emergency plans in place • Outstanding worker compensation claims
5. Public health hazard during manufacturing of PV cells	• Type(s) of PV cells manufactured: Type and quantity of chemicals used as feedstocks, doping agents, solvents, and transport agents, technology involved in their production, steps in the production process, etc. • Toxicity and health hazards posed by chemical substances used in PV

	manufacturing process (e.g. phosphine used in amorphous silicon cells is very toxic and poses a severe fire hazard through spontaneous chemical reaction) • Site of production facilities: proximity to populated areas, upwind or downwind location from populated centres • Status of compliance with internationally accepted hazmats management guidelines (e.g. IFC's Hazardous Material Management guidelines) particularly regarding the actions taken by the manufacturer to involve the local community and raise its awareness • Manufacturer experience (e.g. industry reputation, standing in local community, accident history, technological rating (e.g. state of the art? Older equipment and/or facilities?) etc.) • Maturity of the technology • Compliance with local, national and/or international laws and regulations concerning hazmats (storage, processing, transportation, etc.). • Outstanding private claims regarding health issues imputed to the manufacturing process
Environmental issues sensitive to public opinion	
6. Soil and/or groundwater contamination due to improper disposal of batteries	• Type of solar PV system in review: this issue is not relevant for systems that do not have energy storage capacity (e.g. grid connected systems or stand alone systems with no energy storage) • Compliance with any existing local regulations for recycling or special disposal of batteries • In the absence of local regulations, disposal plans proposed or carried out for the environmentally safe disposal of batteries, including battery collection, storage and recycling schemes
7. Land use	• Type and scale of scheme: land use would only be significant for large grid-connected power stations. For roof-top mounted and building integrated schemes, as well as for small stand-alone systems for remote applications, land use is not a significant aspect. • Land use replaced by PV system: agricultural, recreational
8. Visual impact	• Type of scheme: Large grid-connected power stations cover more land area and therefore have a higher risk for visual impact than roof-top mounted schemes. • Site location: placing building integrated systems in facades of historic buildings or building with cultural value can have significant aesthetic impact. • Protests concerning project's visual impact.
9. Soil and/or groundwater contamination due decommissioning of PV systems	• Chemical content of PV cells used in project: Silicon modules pose fewer decommissioning problems than cadmium containing modules. • Decommissioning plans for the project: disposal methods proposed, recycling opportunities considered for end of life stage, PV cells collection schemes available for decommissioning purposes.

Table 2: Environmental and social risks and opportunities guide for a PV 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**	
Manufacturing of PV cells	1. Toxic and hazardous materials used for production of PV cells		3. Occupational health hazard	5. Public health hazard	
Operation			4. Occupational health hazard	6. Public health hazard 7. Land use 8. Visual intrusion	Avoided CO_2 and other air pollutant emissions from deployment
Decommissioning	2. Atmospheric emissions of toxic chemical substances due to incineration			9. Soil and groundwater contamination	

b. Identifying risk management measures

Once the environmental and social risks of the project have been assessed, the next step is to identify what measures would be needed to eliminate, reduce, or manage those risks. In the case that the project sponsor has recommended measures for managing potential risks, the analyst must decide whether the measures are acceptable. If no or only inadequate risk-mitigation measures have been recommended, the project developer must modify the project to ensure satisfactory risk management.

Risk management measures may be identified through industrial or sectoral best practices, international or other widely used/accepted standards, etc. As mentioned in the previous section, Table 1 includes some mitigation/compensation measures, although the measures included in the table should not be considered as complete or exhaustive, but merely indicative.

The following question list may provide some assistance in determining the extent of compliance of the project with regulations, standards, and best-practice guidelines and protocols for risk management. The question list has been constructed in a modular form, with the first module containing general questions that should be answered for all projects, while subsequent modules should be applied only if considered necessary or relevant.

Table 3: Question list for a PV system

Level	Question
LEVEL I: All projects	1. Has the PV project complied with all legislated requirements for operation, receiving all necessary licences and permits? (Operational permits; permits for road construction and for electricity transmission and distribution, when applicable; local building and fire codes, requirements from local and national governmental authorities, etc.)
	2. Is the manufacture of PV cells carried out in accordance with the principles (i.e. 1) Screening to determine the characteristics and threshold quantities of hazmats, 2) Establishment of a hazmats management program that includes the adequate training of personnel, worker health and safety, the preparation of emergency preparedness and response plans in case of accidents, among other actions, and finally 3) Actions to involve and raise community awareness) established in internationally accepted guidelines for the processing, transportation, storage, production and disposal of hazardous materials, such as the IFC's Hazardous Materials Management Guidelines?
	3. Are prevention and mitigation measures for worker health and safety considered at the generation plant? (Emergency plans, basic medical facilities on site, sanitary facilities, etc.)
	4. Are there proper operation and maintenance routines at the generation plant?
	5. Is the project operator prepared to deal with emergency situation involving public health threat to the local community (e.g. alerting and evacuation routines)?
	6. Are best decommissioning practices proposed for the disposal of the PV systems, especially concerning the disposal of the PV cells?
	7. Have all moderate and high risk issues identified in the previous stage, other than those that may have been covered in questions 1-6, been appraised and have mitigation measures been proposed?
Level II: Optional	8. Has an environmental impact assessment report, an environmental audit, or any similar environmental assessment been prepared with respect to the project? Is one required?
	9. Has a site visit been planned? Is one required?
	10. How can the environmental liability regime of the host country affect the financial institution?
	11. Have there been any protests or complaints about the project? If so, what have they focused on?

	12. 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

When the mitigation measures have been determined, the next step is to estimate the cost of the risks and their management. This includes both the real cost of the mitigation measure itself, as well as the potential costs associated with 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). Estimating such costs is important even if the financial institution or investor may not be directly responsible for them: first, any unforeseen costs can compromise the financial viability of the proposal; and secondly, the financial institution could be held liable under certain liability regimes. How exact the cost calculation should be and the level of detail is up to the analyst.

The analyst must also take into consideration any future liabilities that could occur as a result of changed environmental legislation, regulations, and standards.

Costs should be determined 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 EDD review in a report that can be used during the investment decision process. The final report should include at a minimum the following information:

- Brief description of the project
- General information about 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 measure affects the project's financial viability
- Environmental opportunities (potential benefits of the project)
- Any missing information that may be significant for 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

3. Monitoring the project

If the project has been approved, the final stage of EDD is the monitoring stage. For this purpose, specific provisions should be included in the legal documentation, for example, the requirement of 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 or investor 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 on an annual or semi-annual basis should be sufficient.

Significant changes in the project (e.g. projected expansions, changes in technology), changes in the type of finance (e.g. from loan to equity), and/or foreclosures should **always** be preceded by a re-assessment of environmental risk. This is in order to determine whether the changed project 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 loan has been repaid, the financial institution or investor has divested its equity share in a company, or the operation has been cancelled.

Disclaimer

The UNEP Guidelines on Environmental Due Diligence of Renewable Energy Projects are intended to serve as a practical tool for identifying and managing environmental risks associated with renewable energy projects. They are not meant to supplant national or local environmental or permitting requirements. The EDD Guidelines are to be considered work in progress and UNEP and BASE will continue to improve and refine the Guidelines to make them as suitable and useful as possible for reviewing renewable energy projects.

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