Guidebook for Project Developers for Preparing Renewable Energy Investments Business Plans

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Valuable contributions were also made by participants in the Regional Training Workshop on Renewable Energy Project Development, Finance and Business Planning. The Workshop was held by UN ESCWA, in cooperation with the Energy Investment Company in Morocco and in partnership with UNECE, in the context of implementing the UN DA project, from 3 to 4 May 2016, in Rabat, Morocco. Information contained in this publication was used as a support for the training sessions and discussed.

1. Deltcho Vitchev also developed some of the material adapted in the Guidebook during his assignment with UNECE.

2. ESCWA (July 2015): A Guidebook for Project Developers for Preparing Energy Efficiency Investments Business Plans: https://www.unescwa.org/sites/www.unescwa.org/files/page_attachments/guidebook_ee-investments_businessplans.pdf

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Preface

Arab countries have an important potential of renewable energy resources, mainly solar and wind. Aware of this potential but also of the challenges associated with increasing energy demand, particularly electricity, most of these countries have started developing strategies and policies to promote the use of renewable energy technologies on a large scale. They announced future high renewable energy penetration targets in their mix and some of them have set up appropriate legal and institutional frameworks for developing projects in partnership with the private sector.

In order to meet these targets and accelerate the deployment of renewable energy, private developers and investors need to play an important role in the development process of relevant projects. In this regard, capacities of local developers and investors should be enhanced in order to help them to contribute effectively in reaching their respective countries' targets. The engagement of local developers will also help in allowing know-how and technology transfer to Arab countries, therefore increasing the local added value of renewable energy development.

This Guidebook has been developed by UN ESWCA with this aim. Its objective is to provide guidelines for local renewable energy project developers and investors in order to assist them in preparing bankable business plans for their projects.

This document focuses mainly on renewable energy projects for power generation. Direct use of renewable energy to provide energy services, such as heating, cooling and water-pumping, are not specifically covered. In these types of projects, renewable energy is used mainly to substitute the conventional energy sources and can therefore be treated in a similar way as energy efficiency from the point of view of economic and financial analysis. For these cases, it is recommended to refer to the guidebook developed by UN ESCWA on preparing energy-efficiency investment business plans[3].

The present Guidebook was based partially on the UN ESCWA guidebook developed for energy-efficiency project development[4], particularly the general information about financial analysis and business-plan preparation. For the theoretical concepts of financial analysis and approaches, the document is based mainly on the European Commission (EC) *Guide to Cost-Benefit Analysis of Investment Projects*[5], and other classic academic sources.

3. UN ESCWA (2015): A Guidebook for Project Developers for Preparing Energy Efficiency Investments Business Plan: https://www.unescwa.org/sites/www.unescwa.org/files/page_attachments/guidebook_ee-investments_businessplans.pdf

4. Ibid

5. EC (2014): Guide to Cost-Benefit Analysis of Investment Projects http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/cba_guide.pdf

1. Introduction

In cooperation with UNECE, UN ECSWA is implementing a UN Development Account Project entitled Promoting Renewable Energy Investments for Climate Change Mitigation and Sustainable Development. The objective of the project is to assist the two UN Regional Commissions (RCs) to strengthen capacities of their member States in order to attract investments in renewable energy (RE) projects in the context of climate change mitigation and sustainable development.

The project consists mainly in providing technical assistance and training to national decision-makers, potential developers and experts in business-plan development and financing of renewable energy facilities.

The development of this Guidebook on RE project investments is part of these activities. It aims at helping local project developers and investors to prepare bankable business plans for RE projects, particularly for power generation. It introduces standard procedures and approaches for preparing such documents and provides guidelines on project-cycle development from project identification to implementation and operation steps.

THE GUIDEBOOK IS ORGANIZED INTO SEVEN MAIN CHAPTERS, AS FOLLOWS:

1. General overview of RE technologies and their development status
2. RE project-development process
3. Business-plan development
4. Environmental and other benefits
5. Profitability calculation
6. Financing plan
7. Requirements of financial institutions

The Guidebook is provided with a comprehensive tool for the financial and economic analysis of RE projects.

2. General overview of renewable-energy technologies and their development status

2.1 Market status

The main technically mature RE technologies for power generation are:

Wind energy, both onshore and offshore;
Solar photovoltaic (PV);
Concentrated Thermal Solar (CSP);
Hydropower including large, medium and micro;
Biomass including both biogas and biofuel;
Geothermal for electricity generation.

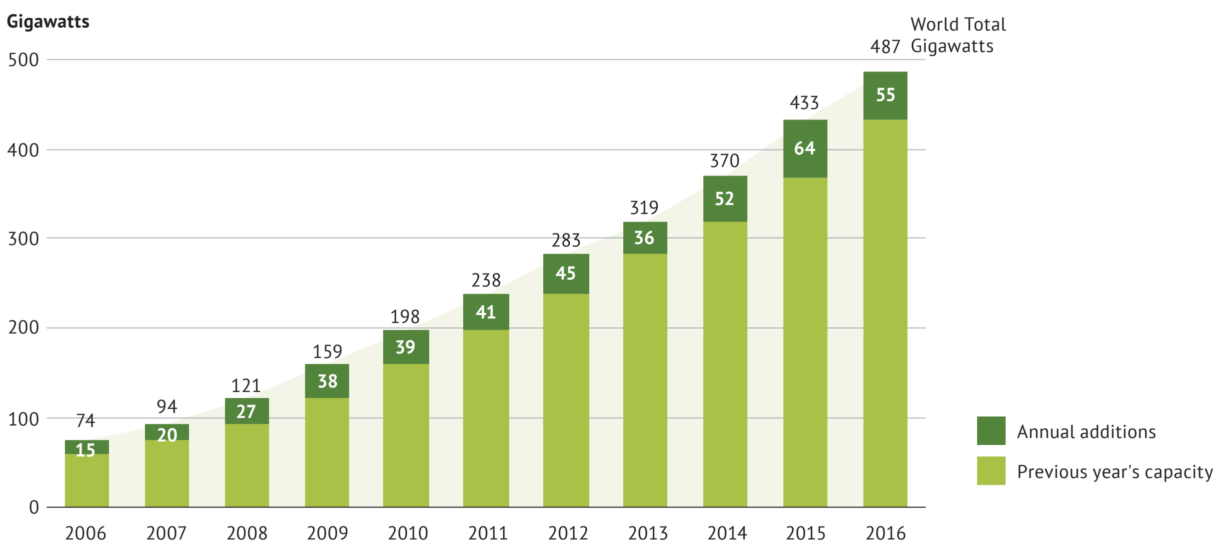
The most developed market worldwide is for wind, solar PV and CSP.

2.1.1 Worldwide renewable energy development

Wind energy is the most developed technology with a global installed capacity of about 487 GW in 2016 against 74 GW in 2006, as shown in Figure 1. The worldwide market was growing at an average annual rate of about 21% during that period.

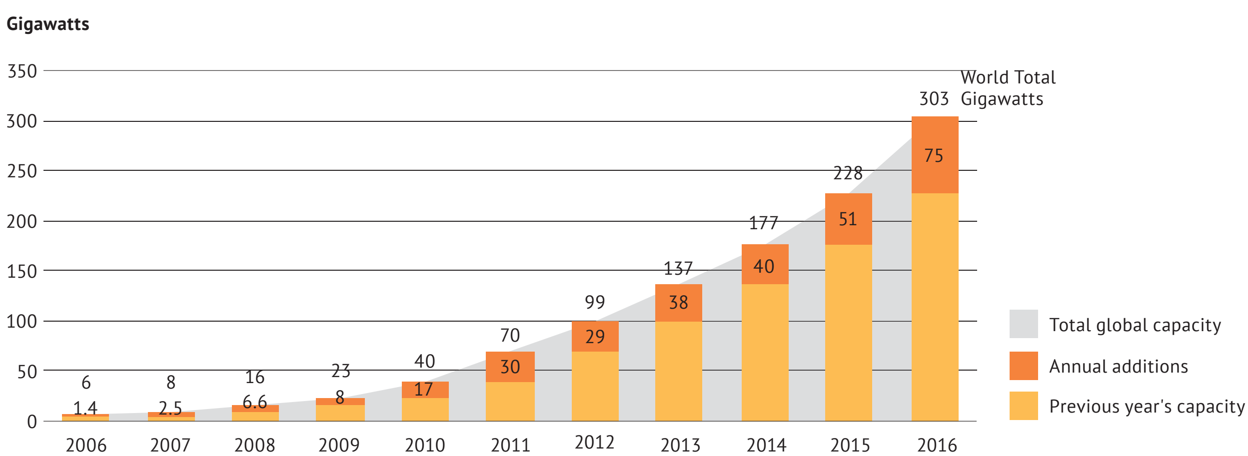
For solar PV, the worldwide installed capacity in 2016 is estimated at around 303 GWp against only 6 GWp in 2006. The worldwide market was growing at an average annual rate of about 48% during that period.

Figure 1: Global cumulative installed wind capacity and annual additions, 2006–2016



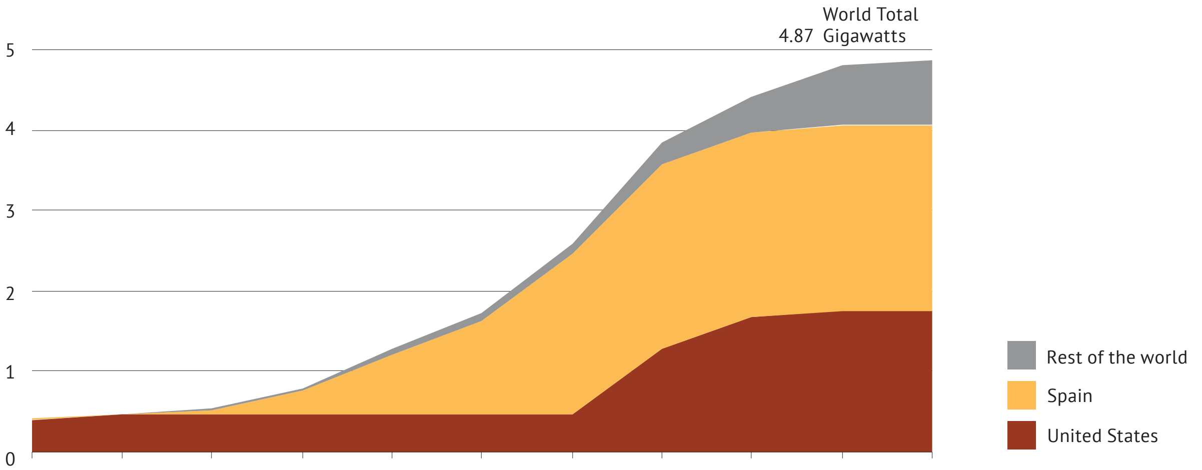
Source: REN21: Renewables 2017, Global Status Report

Figure 2: Global cumulative installed photovoltaic capacity and annual additions 2006–2016



Source: REN21: REN21: Renewables 2017, Global Status Report

Figure 3: Global cumulative installed CSP capacity, 2000–20016



Source: IRENA website: http://resourceirena.irena.org/gateway/dashboard/

CSP technology is still less developed with a total installed capacity of about 4.87 GW in 2016, mainly installed in Spain and the United States.

In February 2016, Morocco inaugurated the Noor solar thermal power plant in Ouarzazate. With 160 MW, the Noor I plant is the seventh largest CSP plant in the world after the first five plants in the United States and the Solaben plant in Spain. Its extension, planned in two additional stages (Noor II and Noor III), will increase its power to 510 MW[6], making it the largest solar plant in the world.

2.1.2 Reference costs

Capital cost (CAPEX) and operation cost (OPEX) influence directly the profitability of RE projects and have to be optimized as much as possible by developers.

As mentioned above, RE technology markets, particularly solar and wind, are growing fast, making prices decrease quickly. In addition to market-scale effect, the continual improvement of technology enhances these trends.

In order to help local developers, we provide hereafter some reference costs for both CAPEX and OPEX. These costs are given as indicative information, because the real costs changes from country to country and from site to site.

6. https://www.climateinvestmentfunds.org/projects/morocco-noor-ii-and-iii-csp

Table 1: Reference information for CAPEX and OPEX for RE technologies

RE technology	Capital cost (CAPEX) in USD/kW	Annual O&M (OPEX) in % of CAPEX
Hydropower - large plants	1,300–2,500	2.5
Hydropower - small plants	2,000–3,500	2.5
Solar PV – residential (rooftops)	1,350–4,200	1
Solar PV - Commercial	1,200–3,400	1
Solar PV - Utility	1,050–2,400	1
STE/CSP (6 hours storage)	5,100–7,500	1
Wind - onshore	1,050–2,400	1.5
Wind - offshore	3,300–5,000	3.5
Geothermal	1,600–6,700	2.5
Bioenergy	800–4,500	2.5–6.5

Source: http://www.iea.org/media/publications/mtrmr/Renewables2017Methodology.pdf

2.1.3 Operation conditions

The main specific operation conditions are the lifetime of the technologies and their capacity factors. The capacity factor is defined as the equivalent number of hours of full capacity working of the RE facility.

Table 2: Indicative operation conditions of RE technologies

RE technology	Economic lifetime in years	Capacity factor (full load hours/year)
Hydropower	35	2,200–6,600
Solar PV – residential (rooftops)*	20	1,050–1,500
Solar PV – commercial (*)	20	1,050–1,500
Solar PV - utility (*)	20	1,050–1,925
STE/CSP (6 hours storage)	25	3,250–3,370
Wind - onshore	25	1,900–2,950
Wind - offshore	25	2,950–3,850
Geothermal	35	7,450
Bioenergy	20–25	7,000

Source: http://www.iea.org/media/publications/mtrmr/Renewables2017Methodology.pdf
* Upper values for capacity factors based on values reported for Arab region[7]

7. IRENA (2016): Renewable Energy Market Analysis – The GCC Region: http://www.irena.org/DocumentDownloads/Publications/IRENA_Market_GCC_2016.pdf

2.2 Main development mechanisms

The feedback from international experience shows mainly four large categories of RE development mechanisms from which many variants can be drawn:

- Net metering (NM);
- Independent production based on feed-in tariffs (FITs);
- Competitive process based on public concessions;
- Self-generation with or without power wheeling system.

NET METERING

According to this mechanism, the consumer is allowed to install an RE facility connected to the grid, for the sole purpose of satisfying its own demand: in this case, the utility invoice for each billing period is the difference between the power produced and consumed. If the power produced for the billing period is higher than the electricity consumed, the PV system owner receives credits for the surplus of electricity produced, which will be accounted for, on a kWh basis, in other billing periods during the year, when electricity demand is higher than that produced. This balance tracking is usually reset at the end of the year and a final financial settlement is made for that year. This mechanism is widely used for rooftop PV for households through a special net-metering contract between the utility and the RE system owner.

In this scheme, the capacity of the installed facility is sized to cover only the power consumption of the RE system owner, who is only allowed to exchange electricity with the grid under the net-metering scheme agreement with the utility.

INDEPENDENT PRODUCTION BASED ON FEED-IN TARIFFS

In this case, RE investors develop RE facilities connected to the grid and sell the electricity to a single buyer which is the utility, with a tariff, known in advance, called a feed-in tariff (FIT). The tariff is usually fixed for a specified period of time and, in some countries, there are also capacity fees.

In some countries (e.g. Jordan), FIT is defined as a ceiling price and the developers must compete and propose tariffs under this limit.

COMPETITIVE BIDDING SYSTEM

Under such an arrangement, the relation between the developer and the utility is defined in an agreement called a power purchase agreement (PPA), that guarantees the tariff during the project period (20–25 years) and includes the conditions of relations between the two parties, such as tariff adjustment, obligations of the parties, type of contract (for example take-or-pay, pass-through), etc.

SELF-GENERATION

The developer builds the facility for the purpose of covering its own consumption. The electricity produced is injected into the grid and the user pays only the balance between the amounts of electricity produced and consumed. The surplus of electricity (if any) can be sold to the utility within a limit of percentage of the production (usually less than 30%) to avoid free-rider power producers.

To introduce more flexibility and encourage the use of renewable energy for their own consumption, some countries have introduced the electric power wheeling mechanism. It allows the user to install an RE system in different locations of the consumption facility and connect it to the electric grid (transmission or distribution). The user pays the grid-use fees, however.

2.3 Main specific factors affecting RE projects profitability

Table 3 presents, in simplified form, the main factors that affect directly the profitability and consequently the feasibility of RE projects for grid-connected electricity generation.

Table 3: Main factors affecting the profitability of RE projects for grid-connected electricity generation

Specific factors	Impacts on RE project profitability
Technology capital cost	The technology capital cost (CAPEX) affects the profitability of RE projects since higher CAPeX per MW will reduce the internal rate of return of the projects.
Technology operation and maintenance cost (O&M)	The technology O&M (OPEX) impacts the profitability of RE projects, by affecting the net cash flows and so the internal rate of return.
Capacity factor	The capacity factor depends on the renewable potential of the site but also on the effectiveness of the technology. The capacity factor affects directly the quantity of generated electricity and hence the incomes of the project.
Project lifetime	The project lifetime depends on the robustness of the technology and the length of operation. It affects the duration of cash-flow generation and the internal rate of return.
Feed-in tariff (FIT) and selling prices	The selling tariff (FIT, etc.) has a major direct impact on the incomes of the project and consequently on its cash flows and returns.
Power purchase agreement (PPA)	The PPA is a very important issue for RE projects connected to the grid, since it covers arrangements that affect directly the risk level of the project, such us: ○ The tariff and its indexation approach to inflation ○ The guarantee of the payments from the utility ○ The period of special tariff operation ○ The responsibility of each party, etc.

3. Project-development process

Renewable energy projects for power generation are generally long-term projects and their development should follow a particular process to be sure that every relevant aspect has been carefully considered before moving forward.

The key consideration during renewable energy project development is the balance between expenditures and risk to preserve project competitiveness and profitability. This process should follow eight main steps, from the identification of the project until its operation, and then decommissioning.[8]

Figure 4: Renewable energy project development process

Step 1: Identify the project idea

Key elements to be considered for renewable energy project identification.

TASKS	KEY ELEMENTS
Fix the objectives	Why is this project being developed? ○ Become more self-sufficient in energy ○ Reduce the energy bill ○ Protect against energy price increases ○ Sell energy and make money ○ Own the means of energy production
Analyse the general framework of the project	○ Policies related to investment and renewable energy ○ Financial incentives ○ RE Support Mechanisms: FIT, Net metering, etc.
Select the RE technology	Issues to be considered: ○ Type of energy needed (electricity, heat) ○ Availability and type of local renewable resources ○ Maturity and competitiveness of RE technologies
Stakeholder analysis	○ Identification of the parties involved in the project and their relative influences ○ Communication
Select a site	○ Identification of the site(s) suitable for the selected RE technology (key: location, quality of renewable resources, access, grid connection ...)
Initial assessment of project viability	○ First estimation of the cost of the project and the amount of energy likely to be generated

Step 2: Assess potential sites - Tasks included in the assessment of potential sites step

TASKS	KEY ELEMENTS
Establish a legal entity	○ Constitute or designate a legal entity taking the project forward
Secure initial funds	○ Identify funding options to support pre-feasibility work
Perform pre-feasibility study	○ Annual energy generation and income estimation ○ Initial estimates of capital, operation and maintenance costs ○ Environmental constraints. ○ Rough profitability assessment
Confirm grid availability	○ Check grid availability (for grid-connected projects)

8. Ricardo-AEA: Local Energy Renewables Toolkit. Scottish Government's Community and Renewable Energy Scheme

Step 3: Evaluate the project - Tasks included in the project-evaluation step

TASKS	KEY ELEMENTS
Secure the site	○ Obtain legal agreements for the use of the land where the project is to be installed.
Full feasibility study	○ Assess technical, financial and regulatory feasibility
Full environmental and social impact assessment study	○ Initial situation ○ Project impacts ○ Impact mitigation action plan
Identify the potential financing sources	○ Analyse the financing options ○ Identify the most appropriate financing sources ○ Check the interest of the financiers
Pre-planning consultation	○ Discuss the project with the planning authority to have a clear picture of the project

Step 4: Develop the project - Tasks included in the project-development step

TASKS	KEY ELEMENTS
Fix the final project size	○ Fix the size of the project using the results of feasibility study, planning consultation, grid constraints and environment impacts study
Check the financial viability	○ Confirm the project remains financially viable
Planning application	○ Prepare and submit a planning application for the project
Grid application	○ Make a formal grid application
Business-plan development	○ Develop full base case financial model ○ Develop a business plan including technical project description, financial appraisal, risk examination and sensitivity analysis.

Step 5: Financial closing - Tasks included in the financial closing step

TASKS	KEY ELEMENTS
Secure bridge funds	○ Identify if funding is required prior to financial closure ○ Set up prior financing
Select financing options for the project	○ Project finance ○ Corporate financing ○ Capital markets, bonds, etc.
Seek funding sources	○ Equity ○ Loan ○ Grants
Financial closure	○ Secure the financing of the project using the detailed business plan previously completed ○ Achieve the contractual arrangements with the financiers

Step 6: Implementation - Tasks included in the implementation step

TASKS	KEY ELEMENTS
Detailed implementation planning	○ Recruit a project manager or a team ○ Develop a comprehensive planning for the all the tasks related to the project implementation ○ Identify the risks of delay and how to mitigate them Organize the responsibilities
Choose suppliers	○ Identify potential suppliers of equipment and services ○ Choose suppliers through direct negotiation or competitive tendering
Follow and monitor the project implementation	○ Definition of progress indicators ○ Monitoring of progress ○ Reporting
Commissioning	○ Verification of the facility's running conditions ○ Suppliers' warranties and setting-up of guarantee ○ Check connection to the grid

Step 7: Operation - Tasks included in the project operation step

TASKS	KEY ELEMENTS
Fix an operation approach	○ Own operation ○ Outsourcing operation, etc.
Organize the operation	○ Recruit staff for the facility operation and train them ○ Define responsibilities ○ Set up the maintenance and operation rules and tools
Follow and monitor the project operation	○ Define operation indicators ○ Monitoring and reporting of the operation

Step 8: Decommissioning - Tasks included in the project decommissioning step

TASKS	KEY ELEMENTS
Facility removal at the end of the lifetime	○ RE project equipment should be removed at the end of the productive life (generally 15–25 years). ○ Cost of the facility removal should be included in the financial analysis
Recycling of the removed material	○ As part of the environment action plan, the removed equipment should be recycled, to the extent possible

4. Business-plan development

A business plan assesses the feasibility of the project and provides a detailed road map for its implementation. It is typically used to attract funding and business partners, but it is also a valuable management tool:[9].

A business plan may begin as a simple document, but as the project idea develops into an operational business, it can become a large and detailed document that includes all the information defining the RE business. It should answer the following important questions:

- Who is the developer?
- What are the products or services that will be provided?
- What is the ownership structure of the business and where will it be located?
- What is the market for the products or services of the project and how will the business attract customers?
- What are the projected financial items (assets, liabilities, revenue and expenses) and financing needs of the business?
- Is the project profitable and able to generate enough cash flow to repay the financiers?
- What resources, people and equipment does the business need during its start-up step and ongoing operation?
- What are the risks of the business and how are they going to be minimized?
- What is the timeline for the project?

The business plan of an RE project when presented to a financial institution is usually called an information memorandum. It should always be prepared in accordance with the standard procedures of the partner bank.

It usually includes the following sections:

- Executive summary;
- Profile and history of the developer;
- Project description;
- Business model;
- Financial assessment;
- Sensitivity analysis;
- Operations plan;
- Construction plan and timeline;
- Risk mitigation plan;
- Appendices/attachments (supporting documents for all sections).

8. Aboriginal Renewable Energy Fund / The Ontario Power Authority - Business Plan Guidelines http://www.ieso.ca/en/get-involved/indigenous-relations/renewable-energy-in-ontario

4.1 Executive summary

The executive summary provides a short (one to three pages), high-level overview of the project and the contents of the business plan. It outlines why the proposed business will succeed. Its purpose is to facilitate a quick understanding of the key elements concerning the project and the developer.

4.2 Profile and history of the developer

This section describes the project-developer profile and provides information about how the business idea evolved. It should also highlight any significant history of the developer, such as past RE development projects or other successful businesses. If the project-development company does not have this kind of history, this section may be brief, but can still explain how the organization was formed from the time that the idea was created and provide details of the persons involved. In the event the developer has a project partner, a description of the project partner's past involvement with similar projects (including a list of successful projects, their status (operational, under construction, etc.) should be included.

4.3 Project description

A description of the following should be included in this section:

- Technology and type of equipment;
- Size of project ;
- Description of the financial resources (source, availability, amount); if the developer has completed a resource assessment study, the results of the study should be summarized;
- Location and size of the site where project will be constructed. A map of the location and surrounding land is usually attached;
- Connection point to the transmission or distribution system;
- Description of the results of any project feasibility or design studies completed. The reports from any relevant studies may also be attached to the business plan, but an explanation of the key results should be included in the project-description section.

4.4 Business model

The business model should include details about the following:

- Location of business operation;
- Type of business ownership, structure and investment;
- Organizational chart of ownership structure to illustrate relationships between owners;
- Information about the project-management team and its experience with similar projects;
- Experience of owners, management and other key staff can be further elaborated by attaching detailed biographies or CVs to the annex of the business-plan document;
- Legal documents governing the business (partnership agreements, power purchase agreement with the utility, etc.).

4.5 Financial assessment

This section is a key part of the business-plan document. Based on the financial feasibility study, the developer will present the following key elements:

- Investment cost details by component, distinguishing the local and imported parts of the procurements;
- Financing needs for the project, including the need for working capital;
- Financial scheme of the project describing clearly the amount of equity and term debts;
- Terms of debts, including interest rate, reimbursement period and grace period;
- Financial profitability: presentation of the main profitability ratios of the RE project, such as net present value, payback, internal rate of return, debt service coverage ratio, etc. (see below);
- Other impacts of the project such as job creation, local pollution reduction, carbon-dioxide (CO2) emission reduction, etc.

4.6 Sensitivity analysis

The objective of this part is mainly to show the robustness of the project under different scenarios and its viability under varying assumptions made for the financial analysis.

During the evaluation of a project, values will have to be assumed for some of the project's external and internal aspects. These include factors outside management control, such as the cost of fuel or materials and economic factors such as inflation and market growth, and factors partially within management control, including current production costs, timing and production rate. Sensitivity analysis involves testing the assumptions used in deriving the cash flow to determine a variation of the assumption in a range of probable scenarios. For each area of assumption, there will be a range of plausible values for the parameter concerned. The financial evaluation of the project is not complete until financial parameters have also been calculated using the range limits of these assumptions.

One of the critical parameters to focus on for the sensitivity analysis is the amount of energy generated, since this determines the profitability of RE projects.

4.7 Operation plan

The operation plan addresses the issues that will affect the day-to-day running of the business during the complete lifetime of the project. It should take into the account the following considerations:

- Equipment needed to operate the facility other than RE generation equipment, for example: cleaning, security, computers and office equipment may be required;
- Staff that will be needed in terms of number of people and special skills;
- Training that may be needed to help staff acquire skills and/or qualifications needed to run the facility;
- Proposed use of outside contractors to operate and maintain the facility;
- Routine maintenance that will be required and any arrangements to perform maintenance (any agreements such as service contracts or guarantees and warranties should be attached to the business plan);
- Equipment replacement and renovation costs to be considered as additional investment during the lifetime of the project.

4.8 Construction plan and timeline

This should identify how the facility will be constructed. Components which should be included in this section are:

- Contracts for equipment procurement and facility construction;
- Construction budgets and schedules;
- Plans for interconnection with the transmission or distribution system (any reports or connection agreements should be attached to the business plan).

4.9 Risk mitigation plan

To prepare bankable investments of RE projects, it is necessary to identify and mitigate project risks. The investor should identify the major potential risks that could affect the success of the project. These risks could arise during the different project stages from planning to decommissioning. Once the developer has identified the risks, he will need to develop a plan for their minimization and mitigation.
The major risks to be considered in the plan are related to:

- Development
- Business model, including ownership and partnership arrangements
- Environmental and other regulatory approvals
- Financing
- Construction (timeline, cost and workmanship)
- Operation
- Power production and incomes
- Cost management
- PPA provisions (operational penalties, etc.)
- Technology
- Equipment issues, including purchase, operation and breakdown
- Site suitability/fit (climate concerns, etc.)

4.9.1 Investment risks

When assessing a potential project, investors attempt to assess the full range of risks that could negatively impact a project over the course of its life. These risks can occur at the permitting, site selection or construction steps, as well as later in the project's operating life due to amortization of the equipment (technical risk), changes in exchange rates (currency risk) or in regulatory conditions (regulatory risk).

Table 4 presents the typical risks that are included in the assessment of the business cases of RE investments.[10]

4.9.2 Risk management

A key principle of risk management is that risks should ideally be transferred to the party (or parties) best able to manage them. In practice, this means that investors typically attempt to offload risks that they have little or no ability to control or mitigate, such as extreme weather events (force majeure risk) or major geopolitical disruptions (geopolitical risk). The latter are often transferred to insurance companies, as no individual investor or counterparty (e.g. the engineering, procurement, construction company) is

10. KfW Development Bank / World Bank (2005), Financing Renewable Energy Instruments: Strategies, Practice Approaches, www.kfw-entwicklungsbank.de/Download-Center/PDF-Dokumente-Diskussionsbeitr%C3%A4ge/38_AMD_E.pdf

Table 4: Renewable energy project risks

Typical risks to be analysed in the assessment of RE investments	Description
Fuel supply risk	The risk that the fuel supply will be unreliable, resulting in the inability to generate energy in a predictable and dependable manner: this is particularly important in the case of biomass projects.
Performance risk	The risk that the power plant will not operate according to the contractually prescribed requirements in terms of time and quantity.
Demand risk	The risk that the energy that has been contracted for will not be needed as anticipated.
Macroeconomic	Risks as local currency devaluation, inflation or interest rates increase.
Environmental risk	Financial risk stemming from both existing environmental regulations and uncertainty over possible future regulations.
Regulatory risk	The risk that future laws or regulations or regulatory review or renegotiation of a contract will alter the benefits or burdens to either party.
Political	Political violence, expropriation or convertibility
Natural	Force majeure events
Other risks	The parties to an energy contract face numerous other sources of uncertainty, including the risk that the transmission system will be unreliable, and that a party to the contract will default on the contract, for example by entering into bankruptcy

able to assume and adequately hedge these risks. Similarly, there are certain risks over which government policymakers have little control and are traditionally left with private actors, such as project risk or construction risk.

Investors and project developers rely on three primary solutions in order to mitigate risk:

- Retain the risk and attempt to mitigate it internally;
- Transfer the risk by allocating it to another party;
- Transfer the risk to an entity whose core business is risk management (e.g. an insurance company).

The decision depends on many criteria, such as:

- The consequences of particular risks are catastrophic or not;
- The risks are controllable at the micro level or not;
- The consequences are reversible or not;
- The risks are insurable or not;
- How much there is to pay for somebody else covering the financial damage resulting from a certain risk;
- The amount of resources to be spent to deal with all this.

Own risk management
Own risk management is a prerequisite for any investment and includes a series of steps, which would have to be carried out for each and every RE project:

- All risks are correctly identified, quantified as much as possible and assessed in their consequences for the project;
- Definition of risk-tolerance limits;
- Efforts are made to mitigate the risks; residual risks are properly allocated and managed.

Based on this analysis, it can be determined which risks will be managed internally and what kind of financial risk mitigation instruments are needed. All this may sound trivial but, in reality, can be extremely complex and time-consuming, involving substantial transaction costs, especially for RE projects.

Partners and standard approach for risk allocation
For risk allocation, it is important to note that a single asset or liability contributes with different amounts to the risk, depending on the portfolio of which it is a part. The proper allocation can thus contribute to the reduction of risk.

As for any other major project, the partner of the commercial contracts forms the basis of the security structure for an RE project. For RE projects, the typical principal contracts are:[11]

- Engineering, procurement and construction agreement (may be separated into more than one agreement);
- Biomass supply contract (if required);
- Operating agreement;
- Power purchase agreement;
- Shareholders (or joint-venture) agreement;
- Loan agreement.

Other important institutions to structure the risk allocation
- The host Government, which is chiefly responsible for creating the proper legal and institutional environment in which developers will feel reasonably protected;
- The development banks, which can help in different ways: by lending to the project while taking political risk, providing partial risk guarantee (PRG) products or political risk insurance cover;
- Export credit agencies (ECAs), which can cover part of the commercial risk;
- Professional risk-takers (e.g. insurance companies).

4.10 Marketing or consultation plan

The marketing plan typically provides details about how the business is going to attract customers for its products or services at levels that will ensure the business is successful. For RE projects, the developer can include information pertaining to the estimated benefits that will flow to the community as a result of the proposed project, such as:

- Environment benefits;
- Energy-bill reduction;
- Job creation;
- Productivity improvements;
- Technology transfer, etc.

11. KfW Development Bank / World Bank (2005), Financing Renewable Energy Instruments: Strategies, Practice Approaches, www.kfw-entwicklungsbank.de/Download-Center/PDF-Dokumente-Diskussionsbeitr%C3%A4ge/38_AMD_E.pdf

4.11 Appendices/attachments

The appendices contain documentation that supports the business plan. Each one should be referenced in the related section of the business plan and listed in the table of contents. Some appendices are listed below as examples:

- CVs of developer and project-management team;
- Engineering diagrams;
- Maps of facility and surrounding land;
- Property contract or leasing contract, if applicable;
- Approval documentation;
- Partnership or management agreements;
- Renewable resource assessment;
- Technical feasibility study;
- Environmental impact assessment;
- Equipment service contracts;
- Detailed term sheets or financing agreements with lenders;
- Pro forma financial statements.

5 Environmental and other benefits

This section presents the main co-benefits from RE projects and how to calculate them.

5.1 Benefits of renewable energy projects

The types of benefits that come from RE projects are many and varied. It is important to recognize those which can be:

- Directly quantified in monetary terms, such as savings in raw materials, fuel and electricity savings, reduced labour, etc.;
- Those which may be only indirectly quantifiable, including improved product quality or marketability, and which might produce a benefit in terms of increased sales.

There may also be other benefits, which are not quantifiable at all in monetary terms, but may have a bearing on the project. These include aspects such as safety, improved working conditions and some environmental benefits.

The benefits likely to arise from a RE project include:

- New or increased energy generation;
- Improved efficiency of generation;
- Lower energy consumption;
- Lower fuel costs;
- Lower water costs;
- Lower labour requirements;
- Reduced maintenance;
- Reduced greenhouse-gas emissions;
- Reduced harmful emissions;

- Improved health and safety;
- Reduced environmental fees;
- Better quality of services.

Other types of economic benefits which may result from the project should be made explicit:

- Export promotion. Will the project result in an increase in exports or support exports and therefore result in net gains to the company, local community and nation?
- Job creation. How many jobs will be created directly and indirectly by the project?
- Social and economic impacts. How will the project improve the social and economic environment of the local community?
- Productivity improvements. Will the project result in enhanced performance and increased productivity of plant and workers?
- Technology transfer.Will the project involve the transfer of technology to and from the local community?
- Management development. Will the project involve the enhancement of skills, knowledge and competence of the workforce?

5.2 Evaluation of benefits for the national economy

5.2.1 Fuel-saving

Renewable energy technologies provide savings of fuels for electricity generation. Annual fuel energy savingfrom RE projects is calculated as follows:

$$PE = El \times Sc$$

where:
PE = the fuel energy saving in tonnes of oil equivalent (toe)
El = quantity of electricity generated by the RE project (in MWh)
Sc = national specific consumption of fuel by the electricity sector (in tonnes of oil equivalent (toe)/MWh)

5.2.2 Energy-bill reduction

Energy-bill reduction is an indicator from the point of view of a country and is an estimate of the monetary value of the energy saving. It is calculated by multiplying the primary fuel savings by their respective international prices. The calculation formula can be set using the following:

$$B = PE \times Pi$$

where:
B = the energy-bill saving in USD
PE = the primary fuel saving in toe
Pi = the international price of the fuel in USD/toe

5.2.3 Direct job creation

Two types of jobs are created by RE projects: non-permanent and permanent.

- The non-permanent jobs are those created in the country during the construction of the project, including experts, planners, construction workers and logisticians. These quantities are expressed in man-months;
- The permanent jobs are those for all employees required for the operation and maintenance of the project and are expressed in persons.

The estimation methods of job creation depend largely on the project size, RE technology and local integration of the technology and should be part of the feasibility study.

One may include jobs created indirectly through the manufacture in the country of the goods used for RE project construction. These are much more difficult to estimate and can be only calculated at macroeconomic level for the overall RE sector.

5.3 Greenhouse gas emission mitigation

The amount of reduced GHG emissions during a given period is defined as the product between the amount of fossil energy saved during the period and its respective emission factor, defined in tonnes of carbon dioxide equivalent (tCO_{2e})/toe, which depends on the type of energy product saved (electricity, fuel, natural gas, etc.) used in the country.

For reasons of simplification, this calculation of GHG emission reduction is made on the basis of the default emission factor provided by the Intergovernmental Panel on Climate Change (IPCC). Hence, for a given year, the reduction of GHG emissions is calculated by the following formula:

$$E = PE \times EFi$$

where:
E = GHG emission reduction from the project (tCO_{2e})
PE = energy saving of the primary fuel (toe)
EFi = GHG emission factor of the fuel (tCO_{2e} / toe), according to the default values of the IPCC.

6 Profitability calculation

To decide whether or not to invest in an RE project, an estimation of the economic value or profitability of the project is required, which is generally calculated through a financial model. The economic analysis process can be summarized in three steps:

- Collect and/or estimate and forecast all the costs and revenues associated with the project during its lifetime and convert them to cash flows;
- Set different probable scenarios and calculate financial indicators to determine profitability;
- Analyse the results from the perspective of the different holders of capital.

This analysis is based on the calculation of the future cash flows of the project. The financial indicators used most often to evaluate the profitability of RE projects from the point of view of the project developers are:

- Net present value (NPV);
- Internal rate of return (IRR);
- Capital enrichment ratio (CER);
- Payback period;
- Levelized cost of energy (LCOE).

6.1 Basic concepts

6.1.1 Capital expenditure

Capital expenditure (CAPEX) is the amount of money that a business uses to purchase major physical goods or services to expand the company's abilities to generate profits. For RE projects, CAPEX includes all necessary initial costs to implement the project:

- Power-generation equipment: costs of hardware as the generator, blades and tower for wind-energy projects; panels and inverters for PV projects, etc.;
- Land costs (if purchased);
- Preparation work: studies, infrastructure, site preparation, installation, etc.;
- Interconnection: all project costs relating to the grid connection, such as the construction of transmission lines, transformers, permitting costs with the utility, etc.
- Development: all costs relating to project-management, studies, engineering, permitting, contingencies, etc.;
- Reserve, contingencies and financing: costs relating to financing, such as legal fees, interest during construction, due diligence costs, etc.

6.1.2 Operating expenses

Operating expenses (OPEX) are the ongoing costs that a company pays to run its basic business. For RE projects, OPEX are commonly defined as the expenditure related to O&M. It includes spare parts, auxiliary cost, insurance, labour costs, grid fees, taxes and maintenance contracts.

Investors and operators in RE usually distinguish two main types of O&M costs:

- Fixed O&M costs (expressed as a percentage of investment cost). They usually include the fixed maintenance of the RE plant (powertrain or turbine-maintenance agreement, facilities, maintenance, etc.) plus the costs associated with the maintenance and operation staff, including administrative staff;

- Variable O&M costs (expressed in USD cents/kWh produced). Variable generation costs include any cost incurred by the fact that the plant is running and generating electricity: fuel costs, insurance costs, emission rights, variable maintenance, etc. Many investment models and simulations consider fuel, insurance and emissions costs as separate items, however. This facilitates the evaluation of their impact on generation costs.

Table 5 presents data for O&M costs reported for a range of wind projects in Organisation for Economic Co-operation and Development (OECD) countries.

Table 5: O&M costs for wind projects in OECD countries

Countries	Variable O&M costs (2014 USD/kWh)	Fixed O&M costs (2014 USD/kW)
Austria	0.04	
Denmark	0.0152 - 0.019	
Finland		37–40
Germany		67
Italy		49
Japan		75
Netherlands	0.0137–0.0179	37
Norway	0.0211–0.039	
Spain	0.0284	
Sweden	0.0105–0.0348	
Switzerland	0.0453	

Source: IRENA (2015)

6.1.3 Cash flows

The cash flow of an RE project represents the estimated sum of money that will be paid or received each year during the entire life of the project. Cash flows can have three different activity sources: operation, investment, and financing. Cash flows from operating activities include all revenues captured, minus operating and maintenance expenses and interest and income taxes paid. Investment activity cash flow includes capital expenditures; financing activity cash flow includes repayment of debt principal and dividends.

6.1.4 Inflation rate

Inflation rate is the percentage of increase in general level of prices over a period. It represents the rate at which the purchasing power has eroded over a period. Central banks and governments keep track of inflation rates and change monetary and fiscal policies accordingly. Together with unemployment rate, interest rate and gross domestic product (GDP) growth rate, inflation rates provide indicators as to the health of a given economy. The general economy-wide inflation rate is calculated as the percentage of change in the Consumer Price Index (CPI) over a period using the following formula:

$$\textbf{Inflation rate} = \frac{\textbf{Current period CPI} - \textbf{Prior period CPI}}{\textbf{Prior period CPI}}$$

More specific inflation rates can be calculated, according to their intended use.

For the financial analysis of projects, we generally assume that inflation rate is constant over the project life period and for all goods and service inputs. If the annual rate of energy price increase is somehow known, however, it is recommended applying for the energy price in the financial modelling an annual increase rate net from the general inflation rate.

Data on inflation are officially provided by statistical institutes. Table 6 shows the inflation rates of certain countries in 2016.

Table 6: Inflation rates in Arab countries in 2016

Country	Inflation rate 2016 (%)	Country	Inflation rate 2016 (%)
Algeria	6.4	Morocco	1.6
Bahrain	2.8	Oman	1.1
Egypt	10.2	Qatar	2.7
Iraq	0.4	Saudi Arabia	3.5
Jordan	-0.8	Sudan	17.8
Kuwait	3.2	Tunisia	3.7
Lebanon	−0.8	United Arab Emirates	1.8
Libya	27.1	Yemen	5.0
Mauritania	1.5		

Source: IMF, World Economic Outlook Database, April 2017

6.1.5 Discount rate

Because money is subject to inflation and has the ability to earn interest and an investor incurs a risk when investing in something that will generate cash in the future, one unit of money today is worth more than the same unit tomorrow. Discounting, then, is the act of determining how much less one unit of money will be worth in the future. For example, an investor who invests a sum of money today may discount the value of the expected dividends and determine how much (in today's money) he would have received some years later.

To compensate for this shortfall and future risk, investors demand remuneration from such future cash flows as a fraction r_{real}, called real discount rate. From the investor's point of view, the choice of discount rate is a key variable of the valuation of the future cash flows of the RE project and can significantly change the financial analysis results. The discount rate generally reflects the cost of capital, so it will take the market interest rate for a comparable term, increased with a risk premium.

Discount rate will therefore depend on the type of investor (households; rich, poor, medium class/private or public investor) and on the country (level of country risk, cost of the financial resources in the country, etc.). For the capital cost, the reference can be:

- Money – market rate – for short durations;
- Treasury bonds – rate for longer durations.

The discount rate can also be adjusted to take into account the inflation rate, *i*. In this case, the adjusted discount rate (real discount rate) is evaluated, based on the nominal discount rate and inflation rate using the following relationship:

Nominal discount rate = [(1 + real discount rate) * (1 + inflation rate)] – 1
Nominal discount rate ≈ real discount rate + inflation rate

6.1.6 Weighted average cost of capital

The weighted average cost of capital (WACC) is the rate that a company is expected to pay on average to all its security holders (creditors, bondholders, etc.) to finance its assets. WACC is commonly referred to as the firm's cost of capital. It has to be noted that it is mostly dictated by the structure of the capital and external market. Companies raise money from a number of sources: common equity, preferred stock, straight debt, convertible debt, exchangeable debt, warrants, options, pension liabilities, executive stock options, governmental subsidies, etc. Different securities, which represent different sources of finance, are expected to generate different returns/liabilities. WACC is calculated taking into account the relative weights of each component of the capital structure. The more complex the company's capital structure, the more laborious it is to calculate WACC.

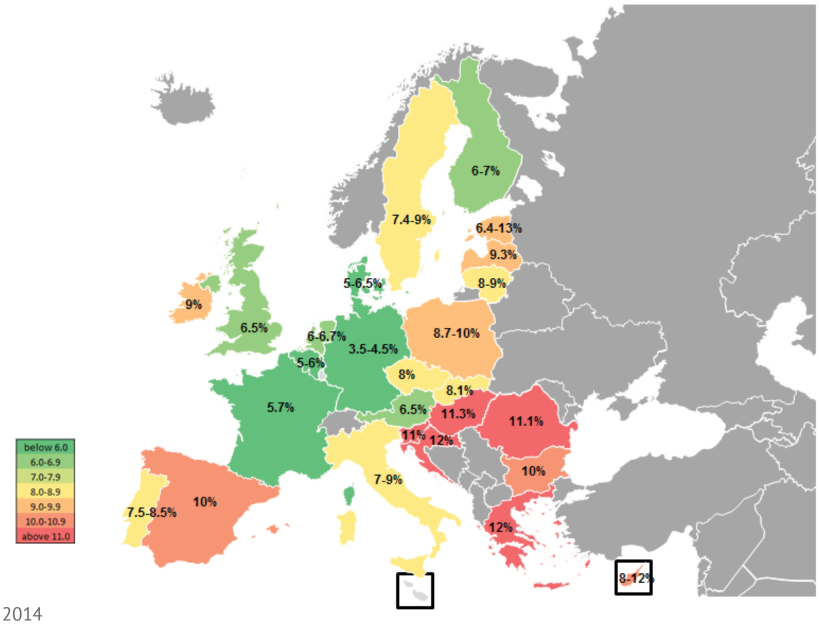
Companies can use WACC to see if the investment projects available to them are worth undertaking, i.e. the return from the project is higher than the cost of the capital invested in it by the company. In the case where the company is financed with only equity and debt, the average cost of capital is computed as follows:

$$\mathrm{WACC} = \frac{D}{D+E} K_d + \frac{E}{D+E} K_e$$

where:
D = total debt
E = total shareholder's equity
K_e = cost of equity
K_d = cost of debt.

As an example, the map in Figure 5 presents the average WACC for onshore wind for EU countries in 2014.

Figure 5: Average WACC for onshore wind for EU countries in 2014



Source: DiaCore, EU, 2014

6.2 Calculation of profitability indicators

6.2.1 Net present value

Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows. It is one of the most reliable measures used in capital budgeting because it accounts for the time value of money by using discounted cash flows in the calculation.

NPV is calculated by the following formula:

$$NPV = \sum_{t-1}^{T} \frac{C_t}{(1+r)^t} - C_0$$

where:
C_t = net cash inflow during the period, t
C_o = total initial investment costs
r = discount rate
T = number of periods during which the project is expected to operate and generate cash inflows (in years for RE projects)

The first indication of the profitability of RE investment is that it shows a positive NPV. The condition NPV = 0 allows the limit of profitability of a project to be defined. For the practical calculation, Excel software provides an integrated formula for the calculation of the NPV with the following syntax: = *NPV (discount rate, Val_1, Val_2, …,Val_n)*, where *Val_i* are the values to be discounted.

Table 7: Example of net present value calculation based on a provisional cash flow

	A	B
1	**Year**	**Cash flow (USD)**
2	0	(450,000)
3	1	106,000
4	2	179,960
5	3	31,441
6	4	30,404
7	5	29,368
8	6	28,333
9	7	27,300
10	8	26,267
11	9	25,235
12	10	24,203
13	11	23,172
14	12	22,140
15	13	177,590
16	14	176,557
17	15	175,525
18	16	174,491
19	17	173,457
20	18	172,421
21	19	171,384
22	20	170,344

Extract of Excel sheet

Example: NPV calculation

Project: Solar PV Plant
Capacity: 1 MW
Discount rate: 9%
Excel formula:

= NPV (9%; B2:B22)

Result:

NPV = USD 266,590

6.2.2 Internal rate of return

The internal rate of return (IRR) is the discount rate that makes the NPV equal to zero. From the definition of IRR, the profitability on an investment leads to the following rule: the project is profitable if its IRR is higher than the WACC.

Otherwise, the project will generate a negative NPV and should therefore not be carried out because it would lead to economic losses for the investor.

The IRR on equity invested is an indicator that is particularly important to owners and equity investors, because it gives an indication of the potential profitability of the project by comparing it to the profitability that would be obtained by placing the funds corresponding to the initial investment I in n years at a rate of interest equal to the WACC.

Table 8: Example of internal rate of return calculation based on a provisional cash flow

	A	B
1	**Year**	**Cash flow (USD)**
2	0	(450,000)
3	1	106,000
4	2	179,960
5	3	31,441
6	4	30,404
7	5	29,368
8	6	28,333
9	7	27,300
10	8	26,267
11	9	25,235
12	10	24,203
13	11	23,172
14	12	22,140
15	13	177,590
16	14	176,557
17	15	175,525
18	16	174,491
19	17	173,457
20	18	172,421
21	19	171,384
22	20	170,344

Extract of Excel sheet

Example: IRR calculation

Project: Solar PV Plant
Capacity: 1 MW

Excel formula:

= IRR (B2:B22)

Result:

IRR = 16%

6.2.3 Capital enrichment ratio

Capital enrichment ratio (CER) or profitability index (PI), also known as profit investment ratio (PIR) and value investment ratio (VIR), is the ratio of pay-off to investment of a proposed project. It is a useful tool for ranking projects because it allows the developer to quantify the amount of value created per unit of investment.

CER is calculated by dividing the present value (PV) of the project's future cash flows by the initial investment:

$$\mathbf{CER} = \frac{\textbf{PV future CF}}{\textbf{Initial investment}}$$

A CER greater than 1 indicates that profitability is positive, while a CER less than 1 indicates that the project will lose money:

- If CER > 1: the project can be accepted;
- If CER < 1: the project should be rejected.

Table 9: Example of capital enrichment ratio calculation based on a provisional cash flow

	A	B
1	**Year**	**Cash flow (USD)**
2	0	(450,000)
3	1	106,000
4	2	179,960
5	3	31,441
6	4	30,404
7	5	29,368
8	6	28,333
9	7	27,300
10	8	26,267
11	9	25,235
12	10	24,203
13	11	23,172
14	12	22,140
15	13	177,590
16	14	176,557
17	15	175,525
18	16	174,491
19	17	173,457
20	18	172,421
21	19	171,384
22	20	170,344

Example: CER

Project: Solar PV Plant
Capacity: 1 MW
Discount rate: 9%

Excel formula:
= -NPV (9%; B3:B22)/B2

Result:

CER = 1.65

Extract of Excel sheet

6.2.4 Payback period

Payback period is the time in which the initial cash outflow of an investment is expected to be recovered from the cash inflows generated by the investment.

The payback period gives an indication of the liquidity for the projects that would return money early. In addition, it can be a measure of risk inherent in a project since cash flows that occur later in a project's life are considered more uncertain. The disadvantage of the payback period is that it ignores any benefits that occur after this period and therefore neither measures the project profitability nor takes into account the time value of money.

The formula to calculate the payback period of a project depends on whether the cash flow per period from the project is constant or not. In the case where it is constant, the formula to calculate the payback period is:

$$\textbf{Payback period} = \frac{\textbf{Initial investment}}{\textbf{Cash inflow per period}}$$

When cash inflows are uneven, we need to calculate the cumulative net cash flow for each period and then use the following formula for payback period[12]:

$$\textbf{Payback period} = A + \frac{B}{C}$$

where:
A = number of years after the initial investment at which the last negative value of cumulative cash flow occurs;
B = absolute value of the negative cumulative cash flow at the end of period A;
C = cash flow during the year A+1.

Two options are used for calculating the payback period: the simple payback period and the discounted payback period:

- **The simple payback period:** cash inflows are expressed as a constant value (the time value of money is ignored);

- **The discounted payback period:** cash inflows are discounted; the discounted cash inflow for each period is to be calculated using the formula:

$$\textbf{Discounted cash inflow} = \frac{\textbf{Actual cash inflow}}{(1+r)^n}$$

where:
r = discount rate
n = period to which the cash inflow relates.

The project is considered profitable when the discounted payback period is less than the duration of the economic life of the project.

11. This formula can only be used to calculate the soonest payback period, i.e. the first period after which the investment has paid for itself. It cannot be used if the cumulative cash flow drops to a negative value sometime after it has reached a positive value. This formula ignores values that arise after the payback period has been reached.

Table 10: Example of payback period calculations

	Undiscounted		Discounted (D. Rate = 9%)	
Year	Cash flow (USD)	Cumulative net Cash flow (USD)	Cash flow (USD)	Cumulative net Cash flow (USD)
0	(450,000)		(450,000)	
1	106,000	(344,000)	97,248	(352,752)
2	179,960	(164,040)	151,469	(201,283)
3	31,442	(132,598)	24,279	(177,004)
4	30,404	$102,194)	21,539	(155,465)
5	29,368	(72,826)	19,087	(136,378)
6	28,333	(44,493)	16,894	(119,484)
7	27,300	(17,193)	14,934	(104,550)
8	26,267	9,074	13,183	(91,367)
9	25,235	34,309	11,619	(79,748)
10	24,203	58,512	10,224	(69,524)
11	23,172	81,684	8,980	(60,544)
12	22,140	103,824	7,872	(52,672)
13	177,590	281,414	57,926	5,254
14	176,557	457,971	52,834	58,088
15	175,525	633,496	48,188	106,276
16	174,491	807,987	43,949	150,225
17	173,457	981,444	40,081	190,306
18	172,421	1,153,865	36,552	226,858
19	171,384	1,325,249	33,332	260,190
20	170,344	1,495,593	30,395	290,585

Extract of Excel sheet

Undiscounted payback period =	**7.7 years**
Discounted payback period (discount rate = 9%) =	**12.9 years**

6.2.5 Levelized cost of energy

The levelized cost of energy (LCOE) is the ratio of lifetime costs to lifetime energy generation, both of which are discounted back to a common year using a discount rate that reflects the average cost of capital. It is given in unit of currency per unit of energy produced and it can be used to effectively compare different technologies, taking into account the project's lifetime costs; it is very helpful for decision-making, especially for utilities: The lower the LCOE, the higher the return for the investor.

For project developers, it might be a good indicator to compare the competitiveness of the RE project with the existing infrastructure.

The following formulas can be used to calculate LCOE:

$$\text{LCOE} = \frac{\textit{Total Life Cycle Cost}}{\textit{Total Lifetime Energy Production}}$$

$$\text{LCOE} = \frac{\sum_{t=1}^{n} \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{E_t}{(1+r)^t}}$$

where:

I_t: Investment expenditures in the year t
M_t: O&M expenditures in the year t
F_t: Fuel expenditures in the year t
E_t: Electricity generation in the year t
r: Discount rate
n: Life of the system

Table 11: Example of calculation of levelized cost of energy

	A	B	C
1	**Year**	**Total expenditure (USD)**	**Electricity generation (MWh)**
2	0	450,000	
3	1	104,000	1,752
4	2	104,800	1,743
5	3	178,113	1,735
6	4	178,978	1,726
7	5	179,878	1,717
8	6	180,814	1,709
9	7	181,787	1,700
10	8	182,800	1,692
11	9	183,852	1,683
12	10	184,947	1,675
13	11	186,086	1,666
14	12	187,270	1,658
15	13	32,021	1,650
16	14	33,301	1,641
17	15	34,634	1,633
18	16	36,019	1,625
19	17	37,460	1,617
20	18	38,958	1,609
21	19	40,516	1,601
22	20	42,137	1,593

Extract of Excel sheet

Example: LCOE

Project: Solar PV Plant of
1 MW capacity
Discount rate: 9%

Discount expenditure:
Excel formula: = NPV (9%; B2:B22)
Result: **USD 1,547,366**

Discount expenditure:
Excel formula: = NPV (9%; C3:C22)
Result: **15,466 MWh**

LCOE = USD 1,547,366/15,466 MWH
LCOE = USD 100.05 per MWh

6.3 Conditions for profitability

Several financial indicators are useful for assessing the viability of the project, including IRR, NPV, CER and payback period.

The developer can use other indicators to confirm the profitability of the project and make the choice between the options of its realization but, in every case, the selection criteria should satisfy the following conditions:

- NPV > 0
- Discounted payback period < n (economic observation period)
- IRR of the project > WACC
- CER > 1
- LCOE lower than other conventional technologies

These indicators have to be calculated for reference-case situations but also for the case when some key assumptions change. In fact, since no project goes exactly according to initial plan, sensitivity analysis is required. This is referred to as a "what if" analysis in an interactive process that considers the effect changes in factors such as revenues, incentives and sources of funding will have on project viability.

Sensitivity analysis begins with a base-case situation, which is developed by using the most likely values for each input. A specific variable is then changed, both increasing and decreasing it from the most likely value, while keeping other variables constant. The corresponding change in some measure of performance, such as IRR, NPV or LCOE, is recorded for each change in input.

In general, three scenarios are observed: the best, the base, and the worst cases. The best case corresponds to the best change possible (but the change has to be realistic) of the selected parameters (costs and revenues of the project).

Financial ratios of interest to the debt providers
While the ratios and indicators described above are important to the developers and investors, they are of lesser importance to the debt providers.

As the primary concern of the debt providers is that the project has and maintains sufficient security to repay the loan in case of default and that there is sufficient cash to service (repay) the loan, the financiers would be interested to see that the debt service coverage ratio and loan life coverage ratio are satisfactory to them.

- The debt service coverage ratio (DSCR) is the cash flow available for debt service divided by the total debt service requirement, where:
  - Cash flow available for debt service (CFADS) = revenues − operational costs − taxes (for a period);
  - Total debt service requirement = the amount of debt payable for a period, including principal and interest;
  - DSCR usually required is above 1.20.

- The loan life coverage ratio or loan life cover ratio (LLCR) is most commonly used in project finance. Unlike period-on-period metrics, such as DSCR, LLCR provides lenders with a measure of the number of times the project cash flow over the scheduled life of the loan can repay the outstanding debt balance.
  - An LLCR of 2.00 means that CFADS, on a discounted basis, is twice the amount of the outstanding debt balance;

- LLCR = NPV (CFADS over loan life)/debt balance;
- The discount rate used in the NPV calculation is usually the cost of debt, also known as the weighted average cost of debt.

Maintaining a Debt Service Reserve Account (DSRA) is required in almost every project finance deal. The primary purpose of DSRA is to protect lenders against unexpected volatility or interruption in CFADS. Usually, lenders require that the project company maintains at least six months of debt repayment reserve.

7 Financing plan

RE project financing usually comes from three main sources: equity, loans and grants.

- **Equity.** Equity is the capital raised from shareholders. It carries the highest level of risk. Significant equity contributions are required from the sponsors in case of riskier projects, or when the cash flows result in low DSCR. Sponsors should have a majority shareholding or adequate operational control;

- **Loan (debt).** A loan or debt is an amount of money provided by a third party to the project that must be repaid either during or at the end of its agreed term, plus interest over the period of the borrowing. The majority of loans are provided by banks. Tax authorities treat interest payments as a cost and this means the project company can deduct interest when calculating its taxable income;

- **Grant.** A grant is an amount of money provided by a third party to a project. Grants are usually provided to projects that are commercially not profitable and do not need to be repaid.

The financing plan sets out how the initial cost will be funded. Usually, senior debt lenders will provide only 70%–80% of the total cost and require the sponsor to bring the rest as equity, junior loans, subordinated debt and mezzanine finance. The maximum feasible debt/equity ratio will need to be negotiated between lenders and equity holders. That depends on the expected cash flows i.e. whether there is sufficient cash in the early period of the loan to meet both debt service and expected dividends.

The financing plan should identify each source of financing for the project, together with the amount of such financing and include all sources of funds allocated to the coverage of the project costs: loans, credits, equity contributions, grants and internally generated funds from the declared project entity.

Revenues must cover first the operational costs of the project. They will also serve to repay the debt financiers, through principal and interest payments. After debt repayment, and if the financial ratios allow it, equity financiers will also be paid through dividend payments for the shareholders.

7.1 Financial instruments for renewable energy projects

Several financial instruments can be used to finance RE projects, depending on their size, complexity, level of profitability, level of risk and type of technology implemented. They can even sometimes be combined to optimize the resources, reduce the risk or meet the investment capacity of the developer. In this section, we look at the nature of the basic financial instruments – debt, equity, subordinated debt and other instruments – introduced to address specific gaps in financing RE projects.

7.1.1 Equity financing

Equity financing refers to the acquisition of funds by issuing *shares* of common or preferred stock in anticipation of income from dividends and capital gain as the value of stock rises.

Equity financing can also come from professional venture capitalists. Venture capital is a specific subsegment of private equity investment, which entails investing in RE energy. Venture capital investors obtain equity shares in the RE project company and generally play a significant role in the management and technical aspects of the company.

Private equity is essential for large-scale project developers because of the high amount of own capital required. Several public agencies and funds have developed finance mechanisms that provide equity investment opportunities for sustainable energy businesses and projects, often leveraging large amounts of investment from other private financing sources.

Depending on the viability and financial robustness of the project and the financial strength of the developer, the minimum required by the bank's share of own capital or equity will range from 20% to 30% of the total investment cost (it can be as high as 50% for certain projects). However, 30% is the most common share required by financial institutions to contribute to the financing of RE projects.

7.1.2 Senior debt

Senior debt is the debt which must be serviced before any other debt or equity in the project. This is generally a precondition of loans by large local or international banks over the assets of the project (in project finance), which can include the contracts for sale of outputs from the project. It may also be secured over the assets of the project sponsor, however.

Because the debt ranks highest in priority for repayment and is secured over assets, it has the lowest risk of the commercial financing instruments for the lenders and hence usually represents the cheapest source of capital. The interest rate will be based typically on the interest rates prevailing in the market for the currency in question, plus a margin depending on the perceived risk of the project.

7.1.3 Leasing

Leasing is a common way of dealing with the initial cost barrier. Leasing is a way of obtaining the right to use an asset (rather than the possession of this asset). In many markets, leasing finance can be used for small RE installations, even when the installation lacks collateral value. Leasing companies – often bank subsidiaries – have experience with vendor finance programmes and other forms of equipment finance that are analogous to renewable energy.

From the lessee's standpoint, there are essentially two main types of leases: capital lease and operating lease. Under a capital lease, a lessee is required to show the leased equipment as an asset and the present value of lease payments as debt on the balance sheet. Operating leases are not capitalized on a company's balance sheet and lease payments are treated as an expense for accounting purposes. The period of contract is less than the life of the equipment and the lessor (investor) pays all maintenance and servicing costs. Leasing is the most common form of equipment manufacturers' vendor financing, which is often applied in the case of cogeneration equipment, for example.

7.1.4 Mezzanine financing (subordinated debt finance)

Mezzanine financing, sometimes called subordinated debt financing, is capital that sits midway in repayment priority between senior debt and equity and has features of both kinds of financing. Subordination refers to the order or priority of repayments: subordinated debt is structured so that it is repaid from project revenues after all operating costs and senior debt service has been paid. There are much fewer sources of subordinated debt than there are of senior debt or equity, so it is often considered to be specialty financing.

Subordinated debt financing is generally made available directly from insurance companies, subordinated debt funds, or commercial financing institutions (CFIs). These funds are loaned based on the amount and predictability of cash flow exceeding that required to service senior debt.

Subordinated debt funds can be undertaken in partnership with senior lenders. Alternatively, a subordinated credit facility can be provided to a CFI which acts as senior lender; the senior lender then on-lends to the project, blending together the subordinated debt together with its senior debt provided from its own resources. The borrower sees one single loan, but the senior lender applies loan payments to repay the senior debt component on a priority basis.

For sustainable energy project developers, subordinated debt financing is cheaper than what would be available on the equity market, does not usually involve sacrificing any control of the company and can allow companies to raise sufficient capital to meet the debt-equity requirements of senior lenders. Subordinated debt is considered as a complementary or alternative solution to portfolio guarantees. It can substitute or reduce the amount of senior debt. This will improve the loan-to-value ratio and the debt service coverage ratio for the senior lender, thereby reducing risk and strengthening the project's financial structure from the senior lender's viewpoint.

Subordinated debt instruments have proved to be most successful when operating in mid- to well-developed capital markets, where equity and debt instruments are well established. Given that subordinated debt finance can be regarded as a hybrid of debt and equity, it can improve a company's credit rating and put it in a better position to acquire further debt and equity investment. Because of the high return requirements, mezzanine finance instruments mostly address companies with stable cash flows and high growth expectations.

7.1.5 Project financing

Unlike conventional debt financing, that relies on an individual company's credit-worthiness, project financing relies only on a project's cash-flow expectations and spreads the risk between the different actors. Importantly, project finance is often based on a complex financial structure where project debt and equity are used to finance a project, rather than the balance sheets of project sponsors.

Usually, a project financing structure involves a number of equity investors, as well as a syndicate of banks that provide loans to the operation. The loans are most commonly non-recourse loans, which are secured by the project assets and paid entirely from project cash flow, rather than from the general assets or creditworthiness of the project sponsors, a decision supported in part by financial modelling.

The ratio of debt to equity is much higher in project finance than in corporate financing: as previously indicated, a project with 70%–80% debt and 20%–30% equity is common in project financing.

7.1.6 Vendor financing (equipment supplier/vendor credit)

In order to support their marketing efforts, many general equipment manufacturers have established either captive or third-party vendor financing relationships. Vendor financing helps the manufacturer sell a product by facilitating the financing of a customer's purchase. Vendor financing occurs when a financier provides a vendor with capital to enable an offer of "point-of-sale" financing for equipment. Leasing is the most common form of vendor financing.

Under a vendor-financing scheme, there are two types of arrangements: one between vendor and financier; and the other between vendor and customer. The former defines the terms that can be offered to the customer such as rates, length of term and necessary documentation.

The vendor/customer agreement defines the repayment terms of the loan. For RE equipment, these agreements can be structured such that the customer payments are lower than the value of energy savings associated with the new equipment.

If vendor financing is done by a third party, that party has typically done the work necessary to become comfortable with the technical aspects of the product, as well as its collateral value. Vendor financing is often supported by export credit agencies, which, in addition to seller or buyer credit, provide political and commercial cover.

7.2 Disbursement and repayment plan

In a given project, the equity is often the first part of the financing to be disbursed, proving the commitment of the project holder, which reassures the other financiers. The bank asks the project holder to verse the equity in a "non-accessible" bank account and then pays the suppliers' invoices after the bank authorization. In some cases, a pro rata (proportional) disbursement method is applied.

Once the equities are disbursed, the bank disburses the loans on the base of invoices provided by the suppliers and after their verification. Banks usually have their reference prices or use the lender's engineer to verify them and can refuse an invoice if they consider that the cost is much higher than the known prices. Regarding the loan reimbursement, the calculation is usually based on a disbursement schedule, depending on the terms of the loan agreement (see calculation tool).

The repayment period (loan duration or tenor) is also negotiated in the loan agreement and has to conform to the country's banking regulation, the investment cost and the lifetime of the project. For RE projects, it usually ranges from 3 to 10–15 years, sometimes with a grace period of 1–2 years. During the grace period, the borrower pays only the loan interest, but there is a possibility to "capitalize" the accumulated interest during this period by adding it to the loan principal.

For the lenders, it is very important to check in the project business plan that the activity generates enough cash flow during the loan period to allow the credit repayment. In other words, the yearly cumulative cash flow must be higher than the yearly principal and interest repayment amount of the loan. The usually required minimum DSCR must be above 1.3. If, for any year or period, this condition is not satisfied, the borrower has to show that he will be able to cover the loan repayment from external (other than project) resources.

8 Requirements of financial institutions

8.1 Project documentations required by financial institutions

8.1.1 General documentation

A loan applicant must develop a project-presentation package for potential financiers, regardless of the loan-application format. A standard package includes the documentation listed below.

- **Letter of application** from the applicant to the bank

- **Financial information on the applicant**
  - Applicant's audited financial statements for past three years (if available);
  - Tax returns for the past three years;
  - Applicant's articles of incorporation and corporate resolution in case of a private company;
  - Financial analysis report that indicates the financial health of the applicant: current assets/current liabilities; long-term debt ratio (total long-term debt/(total long-term debt + shareholders equity); debt
    to equity ratio (total liabilities/(total liabilities + shareholder debt)); DSCR (the ability to service debt, defined as annual cash flow before interest and taxes divided by the interest and principal payment; total debt ratio (annual cash flow before interest and taxes divided by the total loan);
  - Information relating to creditworthiness such as assets for collateral and any credit guarantees.

- **Project documents**
  - Business-plan document, including financial model;
  - Technical feasibility study;
  - Financial feasibility study;
  - Environment and social impact study, if required;
  - Any other relevant documents for the project, such as legal authorization, partnership agreements, etc.

8.1.2 Specific documentation for renewable energy projects

For RE projects, financiers will usually require the following evidence from the developers:

- **A report of an independent expert that confirms:**
  - The technology employed by the project is commercially viable;
  - The reasonableness of budgetary assumptions;
  - The absence of serious environmental issues;
  - Compliance with all necessary permits or approvals;
  - That financial projections are realistic.

- **A power market report** (if the project has significant uncontracted offtake), setting forth expected market conditions over the course of the loan;

- **An environmental site assessment** (at least a "Phase I" report concluding that no further environmental investigation is necessary);

- **An insurance report from the lenders' insurance consultant;**

- **A commodity management plan** (in the case of biofuel facilities and other projects where appropriate);

- **Evidence that the required equity component of the project has been contributed or will otherwise be available when required;**
- **Copies of all third-party and government approvals and permits.**

8.2 Creditworthiness appraisal

The main objective of a financial institution is to minimize the risk regarding the loan provided to the developer. For that reason, when the RE project is presented for financing, the financial institution will examine a number of criteria in order to assess whether the project is worth financing from the point of view of the lender.

8.2.1 Analysis process

Credit analysis is the process of evaluating an applicant's loan request or a corporation's debt issue in order to determine the likelihood that the borrower will live up to his/her obligations. In other words, credit analysts examine the financial history of an applicant in order to determine creditworthiness. A key element of credit analysis is the prediction of the likelihood that a firm will face financial distress.

From a financial institution's point of view, conducting a proper evaluation of the borrower is the most important part of the overall RE project appraisal. No matter how strong an investment project may be from a technical and financial point of view, lenders will always want to check the overall creditworthiness of the potential borrower. Profitability estimates and cash-flow projections therefore will be analysed not only for the specific RE project, but also for the company as a whole.

Appraisal of an RE investment project always requires a detailed analysis process that covers the following:

- Promoter creditworthiness appraisal (credit analysis);
- Technical appraisal;
- Financial appraisal;
- Environmental appraisal;
- Legal appraisal.

For the technical, environmental and legal appraisals, lenders rely on expert opinions conveyed in the technical studies and due diligence files. Although banks sometimes have appropriate internal expertise, they use, in most of the cases, external consultants to review the documents presented by the borrower and answer questions such as:

- Are the projected energy generations realistic? Is the basis of calculation appropriate?
- Which technology will be used for the RE project? Is this a proven technology or an innovative – and therefore riskier – one?
- Are there any drawbacks, such as impact on production or production schedules during implementation of the investment project?
- Are pollution levels going to decrease/increase after the implementation of the project and, if so, is there a need for environmental clearance?
- Prior to loan disbursement, legal due diligence is needed to ensure that all licenses, permits and clearances have been obtained and that the loan agreement and security package are in accordance with the bank's standard lending procedures.

8.2.2 Components of the credit analysis

Regardless of where you seek funding, a prospective lender will review your creditworthiness. A creditworthiness appraisal requires a detailed analysis of the borrowers' financial position and debt-servicing ability, a thorough understanding of their background and the purpose of the loan and an evaluation of the collateral pledged. The basic components of credit analysis – the five Cs – are described below to help you understand what the lender will be looking for when appraising your loan application.

- **Capacity** refers to your ability (from technical, financial and managerial points of view) to run the business and return the loan. Capacity to repay is the most critical of the five factors. The prospective lender will want to know exactly how you intend to repay the loan. The lender will consider the cash flow from the business, the timing of the repayment and the probability of successful repayment. Payment history on existing credit relationships is considered an indicator of future payment performance. Prospective lenders also will want to know about contingent sources of repayment.

- **Capital** refers to the long-term sustainability of your company and its sources of finance. Capital also refers to your own money invested in the business and is an indication of how much you/your company have at risk should the business fail. Prospective lenders and investors will expect you to have contributed from your own assets and to have undertaken personal financial risk before asking them to commit any funding.

- **Collateral:** the lenders will check the strength and safety of the proposed security package in case the anticipated means of repayment fails (cash flow lower than expected). Collateral or guarantees are additional forms of security that lenders request. Giving a lender collateral means that you pledge an asset (mortgage on real estate, pledge on equipment) to the lender with the agreement that it will be the repayment source in case you cannot repay the loan. A guarantee, on the other hand, is when someone else signs a guarantee document promising to repay the loan if you cannot. Some lenders may require such a guarantee in addition to collateral as security for a loan.

- **Conditions** focus primarily on the intended purpose of the loan (whether the money will be used for working capital, additional equipment or inventory) and concomitantly on the market and how the company performs in the market. The lender will also consider the local economic climate and conditions both within your industry and in other industries that could affect your business.

- **Character:** the lender will review the integrity of the business and its management and form a subjective opinion as to whether or not you are sufficiently trustworthy to repay the loan or generate a return on funds invested in your company. In the case of a large company, the shareholders' and managers' reputation and experience in business will be carefully reviewed. In the case of a small business, the quality of your references and the background and experience levels of your staff will be taken into consideration.

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Annex: Project presentation template

General and financial information for renewable energy projects

1. Contact Information

First name(s)	
Last name(s)	
Title	
Organisation	
Address	
PO Box	
Country	
Telephone	
Fax	
E-mail	
Web page	

2. Project profile

Project name	
Location of project: - City	
- Region	
- Country	
- Site location name and coordinates	
Project sector: *Solar, Wind, Hydro, Biomass, Geothermal, Solar Heating/Cooling, Equipment and Services*	
Type of technology	
Size (kW, m^2, etc.)	
Grid connected	
Annual generation (MWh)	
Storage type	
Status of project	
Expected GHG emission reduction (tonnes CO2 equivalent)	
Total projected investment (million USD)	
Investment currency	

Source(s) of revenue stream *(PPA, FIT, production and investment tax credits, etc.)*	
Ownership	
Financing required (million USD):	
Type of financing required	
Already submitted to a financial entity	
Has financing been secured?	

3. Detailed project status

Has the land been acquired?	
Have all required permits been acquired? Has a technical feasibility study been performed?	
Has an environmental impact assessment been performed?	
Has a demand assessment and willingness-to-pay study been performed?	
Is the grid connection and access ensured?	
Is the revenue stream ensured?	
What is the current status of the financing process?	
Estimated date of financial closure (dd/mm/yyyy) *(if already submitted to a financing institution)*	
Estimated start of construction (dd/mm/yyyy)	
Estimated start of operation (dd/mm/yyyy)	

4. Outline financing plan of the project

	Type (in kind/equity/cash)	**Currency**	**% of total**	**Interest rate** (cost of capital %)
Owner's equity				
Other equity				
Bank loans, local				
Other loans (senior/ mezzanine)				
Grants				
What kind of guarantees were used (company/bank/utility/government)?				

5. Resources and tariffs

Projected project output (kWh/year generated or saved)	
Projected project output (units/year, if production)	
Projected project life	
Source of the output data. Independent study, by whom? What probability P50/P90?	
Is off-take agreement secured and when does it expire?	
Off.take entity	
Off-take tariff/Price USD/kWh or USD/unit and in the currency in which it will be paid.	
Capacity/energy tariffs in the country/market – USD/MW and USD/kWh	
Details of the energy/equipment/services purchaser(s)	
Is the tariff/price linked to the Retail Pricing Index or the Power Pricing Index?	
Ability to integrate project into existing infrastructure	
Evidence that the Government/off-taker supports the project	
Evidence of risk to the project, competitors	
Creditworthiness of sponsor	
Creditworthiness of purchaser	

6. Supply resources

Are the generating/manufacturing resources available on site?	
The cost of the resources/raw materials per kWh or per unit of production/output?	
Will the project be connected to the grid or to an isolated grid?	
Has the technology supplier been determined?	
Creditworthiness of supplier of technology	
Equipment degradation assumption in percentage	

7. Land

Has the project been secured by a land agreement or similar?	
Topographical study	
Environmental and Social Impact Assessment	
Is the land occupied?	
Resettlement requirements	
Local community compensation	
Cost of land	
Transmission and power/products evacuation cost	
Title of land plots, or land leases	
Contract(s) for transfer of the land	
Any other studies?	

8. Major contracts

Power Purchasing Agreement/Purchasing Agreement	
Supply contract	
Land title	
Shareholders' agreement	
Operation and maintenance agreements	
Government support agreement	
Concession agreement	
Procurement agreement	
Engineering agreement	
Construction permits	
Connections to utilities, road permits	
Draft contract for developer to construct project	
Other similar agreements, warranties or guarantees	

9. Financial input

Total project cost	
Timing of the project	
Cost of construction	
Months of construction	
Completion bond	
Foundation cost/site infrastructure	
Generation assets/machinery	
Insurance	
Connection	
Engineering/procurement/construction management	
Contingency	
Generation/production capacity	
What is the project's projected source of cash flow? Amount/year?	
Is this under a fixed contract and if so, for how many years?	
Projected project output (KWh/year and/or unit USD/year)	
Amount pre-spent, development cost/feasibility study	

10. Variable expenses

Operation and management cost per kWh or unit of production	
Consumables	
Transport	
Land lease	
General and administrative expenses	

11. Fixed expenses

Administration cost per year	
Operation and management fee per year	
Insurance expenditure	
Personnel expenses	
Security and social programmes	

12. General financing

Taxation and duties	
Reserves	
Annual investments	
New/renewal of equipment	
Funding priority	
Target sponsor equity	
Dividends	
Short-term debt	
subordinated debt and in how many tranches?	
Senior debt and in how many tranches?	
Preferred debt-repayment method – equal repayment, amortizing debt	

13. Barriers and challenges

National framework

Difficult macro-economic conditions	
(e.g. high public debt ratio, economic and/or political instability)	
Difficult investor climate causing high investment risk	
(e.g. weak legal framework, bureaucratic barriers)	
Lack of legal framework for renewable energy generation	
Lack of funding demand from the renewable energy sector	
(e.g. due to insufficient data on renewable energy resources or lack of interested project developers)	
Subsidized energy prices for consumers, causing low competitiveness of renewable	
Lack of suitable electricity grids or grid connection procedures for grid for connected medium/large scale renewable energy generation projects	
Insufficient support mechanism for renewable energy projects	
(e.g. lack of feed-in-tariffs, tax incentives and others)	
Others (please specify)	

Project development

High transaction costs for project development and due diligence	
Insufficient quality of project proposals	
Lack of commercially attractive projects	
(i.e. demand exists, but projects show low profitability)	
Others (please specify)	

Financing sources

Lack of funding sources available for the renewable energy sector	
Lack of attractive funding conditions	
Others (please specify)	

Project sponsor

Insufficient equity by project sponsors	
Lack of expertise by project sponsors	
Insufficient guarantees and collateral by project sponsors	
Creditworthiness of contract off-takers	
Others (please specify)	

14. Additional information

Main objective of the project:

Stakeholders involved:

Impacts (positive and negative; socioeconomic, environmental, etc.):

Critical success factors:

Potential showstoppers:

Additional comments:

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