ICADE BUSINESS SCHOOL

MÁSTER UNIVERSITARIO EN FINANZAS

PROJECT FINANCE: FINANCING OF A PHOTOVOLTAIC PLANT OF 750 KW

Autor: Maitane Rentero Valmala

Director: Ramón Cidón Martínez

Madrid
Junio 2017

Maitane
Rentero
Valmala

PROJECT FINANCE: FINANCING OF A PHOTOVOLTAIC PLANT OF 750 KW

INDEX

1. INTRODUCTION 6
2. OBJETIVES 7
3. METHODOLOGY 7
4. CONCEPTUAL FRAMEWORK: PROJECT FINANCE 8
5. PHOTOVOLTAIC SOLAR ELECTRIC: PROCCEDURES AND APPLICATIONS 10
6. ANALYSIS OF THE SPANISH MARKET 12
7. EXPOSITION OF THE PROJECT 15
   7.1. Situation of the project 15
   7.2. Costs and project budget 16
   7.3. Production estimation and revenues 17
   7.4. Expenses estimated 17
8. FINANCIAL-ECONOMIC MODEL 20
   8.1. Description of the model 20
   8.2. Debt service 21
   8.3. Financial statement Projections 23
   8.4. Results of the viability analysis 24
   8.5. Sensivity analysis 25
9. MAIN CONTRACTS 29
   9.1. Construction contract 29
   9.2. Operation Contracts 30
   9.3. Off-take Contracts 31
   9.4. Insurance Contracts 31
   9.5. Financial Contracts 32
   9.6. Supply Contracts 32
10. ANALYSIS OF THE MAIN RISK OF THE PROJECT 32
   10.1. Risks in the operation stage 33
   10.2. Risks in the construction stage 34
   10.3. Financial risk 34
   10.4. Technological risks 35
   10.5. Political risks 35
   10.6. Risk related to revenues, costs, and initial investment 36
11. METHODS TO MITIGATE DIFFERRENT RISKS 36
   11.1. Mitigation in the operation stage 37
   11.2. Mitigation in the construction stage 37
   11.3. Mitigation in the financial risk 37
   11.4. Mitigation in technological risks 38
   11.5. Mitigation of political risks 38
12. CONCLUSIONS 38
13. REFERENCES 39
   13.1. Books and articles 39
   13.2. Links 39

GRAPH INDEX

1.1. Graph. Scheme of different participants of a Project Finance……9
1.2. Graph. The distribution between the typology of different project finance. ……..10
1.3. Graph. Solar PV Capacity and Additions – Top 10 countries……..13

TABLES INDEX

1.1. Table. SWOF of Solar Energy in Spanish Market……..14
1.2. Table: Estimated budget for the project……16
1.3. Table: Estimated production for the project……17
1.4. Table: Total investment for PV Plant. ……18
1.5. Table: Estimated debt for the project. ……19
1.6. Table: Estimated EBITDA for the project. ……19
1.7. Table: Estimated Working Capital for the project. ……20
1.8. Table: Debt of the photovoltaic plant. ……22
1.9. Table: Debt Service Coverage Ratio of the photovoltaic plant. ……23
1.10. Table: Debt Coverage Min and Average. ……23
1.11. Table: IRR for Shareholders and Cash Flows. ……24
1.12. Table: IRR for Shareholders, DSCR min and average for scenario 1 and 2……27
1.13. Table: IRR for Shareholders, DSCR min and average for scenario 3 and 4. ……28
1.14. Table: IRR for Shareholders, DSCR min and average for scenario 5. ……28
1.15. Table: IRR for Shareholders, DSCR min and average for scenario 6. ……29
1.16. Table: Mitigation of risk, resume for the project. ……37

IMAGE INDEX

1.1. Image. Localization of the plot……15

Abstract

This project intends to study the ways of financing a Project Finance based on a photovoltaic plant making use of solar energy. On the one hand, the PF is based on the project's ability to generate positive cash flows and on obtaining a profitability for shareholders. Thus, the cash flows generated by the project must be sufficient to cover operating expenses and to repay the principal and interest of the debt incurred. On the other hand, the solar energy is in a moment in which the renewable energies begin to take off and need an economic boost based in a positive viability of the projects. And because of this, together, it becomes into an interesting project that can help in the future, in order to encourage projects based on renewable energies.

1. INTRODUCTION

In the past, Project Finance was used in projects with low technological risk, without country risk, defined as "*The possibility of non-payment caused by such buyer-country related problems as political instability, war, arbitrary government action and exchange inconvertibility, as opposed to problems that could be encountered by the buyer such as insolvency or bankruptcy*" - Global Negotiator (2016), neither market risk, which can be defined as "*The risk that an investment may face due to fluctuations in the market. The risk is that the investment's value will decrease. Also known as systematic risk, the term may also refer to a specific currency or commodity"* – Market Business News (2016).

Currently, Project Finance (here in advance "PF") focuses mainly in infrastructure projects, such as oil, gas or electricity, and especially in renewable energies, due to the growth in the recent years of the use of this ones (Tomás Casanovas Martínez, 2016).

Given the importance that this form of financing is acquiring during the last years and the predisposition of the companies for the PF, it is remarkable the consideration and the study of this one. Therefore, the main objective of this project is the study of the economic viability and its bankability of the installation and operation of a photovoltaic plant based on the capture of solar energy, transforming it into an electricity through the photoelectric solar panels.

For the analysis of the viability of this project, the chosen method is the analysis through the PF. This type of financing can only be applied to projects that generate foreseeable cash flows, so these generated cash flows become the only guarantee of the financing (Ramón Cidón, 2016).

On the other hand, a project based on photovoltaic energy has been proposed since it is a renewable and clean energy, which reduces the environmental impact compared to other types of conventional energies.

The project will be carried out in Spain, in Almeria as it is one of the areas with the highest solar radiation during the year. Spain is one of the world leading countries in R&D investment respect to solar energy and was world leading in the volume of investment in renewables. However, the regulation was modified some years ago which has created uncertainty to the investors that has produced a paralysis in the investment the last 5 years. Additionally, Spain is facing new problems due to the result of an international arbitration by the CIADI. The situation is changing thanks to the 2 auctions that the Spanish government has settled.

This is why, once the project situation has been chosen, it has been considered of great importance to emphasize other important concepts such as a depth analysis of the Spanish market regarding this type of energy, as well as taking into account the consideration of the risks linked to the project and the mechanisms to reduce them.

Finally, is important to highlight the use of tools such as the SWOT for the analysis of the Spanish market and for the project, taking into account weaknesses, opportunities, strengths and threats; as well as Excel programme for the calculation of the cash flows and the different scenarios that will help us to evaluate the viability of the project.

2. OBJETIVES

As I mentioned in the introduction, the main objective of this project is to determine the economic feasibility and bankability of a solar photovoltaic installation (called "PV"), whose purpose is to generate electricity and sell it to the market.

In addition, the description of how the plant operates is considered important for a better justification of the incomes and the expenses derived from it. As well as the analysis of the price of the electricity, so we could settle different market scenarios favourable, neutral or negative aspect.

The objective of the elaboration of a financial economic model will facilitate the handling of the variables, creating an interconnection between them. In this way, any modification will affect the others and the analysis will be more visual.

The location and orientation of photovoltaic modules, as well as the situation of the installation, is key for the profitability since it is determined the incidence of solar radiation on the modules and, therefore, the predicted production of the annual solar energy.

On the other hand, a deep risk analysis and a good risk allocation is essential for the project (Ramón Cidón, 2016).

Finally, all the previous research and analysis will help in order to take the decision of invest or not to invest in this project.

3. METHODOLOGY

The methodology will be based in the structure of the PF and will be established under the following facts:

The first one, a study of the operation of a PV will be carried out evaluating the most common costs and revenues. In the same way, an analysis with SWOT, will help us to better understand what weaknesses we have to mitigate in our project (risks), as well as the market threats we must face, but also the strengths that will drive our project to obtain profitable incomes and the opportunities that will benefit us in the future. For this analysis, it will be used articles, journals and publications of economic nature, and books about the fundamentals of PF.

The second one, it will to develop a financial Excel model. In this model, we will include the revenues and costs, as well as the projection of the cash flows, and the financial structure of the project, calculating the profitability measures such as the NPV, IRR and a sensitivity analysis and main ratios considered in a PF that will condition our decision.

4. CONCEPTUAL FRAMEWORK: PROJECT FINANCE

PF, with or without recourse limited to shareholders and with a return or amortization of the debt expected, according to the cash flows generated by the project. The investment must be defined in time, space and amount. The capacity to generate cash flows should be stable and predictable. Likewise, the viability has to be measured in economic, financial and technical terms and risk has to be analysable and measurable. Likewise, it must be guided by a vehicle company (SPV). An SPV is defined as a Special Purpose Vehicle "A special-purpose vehicle is established between a debtor and a creditor for the purpose of legally shielding the debtor from the creditor in case of payment difficulties" – Deutsche Bundesbank (2016).

It is essential to know what not a project finance is. For this reason, corporate financing means to finance o a company based on external guarantees, as well as the financing of working capital and the one that does not have stable or predictable flows would not be considered into this area. The "Modigliani and Miller" hypothesis show us that the financing scheme selected by the companies does not influence its final value, if certain assumptions are satisfied. These assumptions, which are the basis of an efficient capital market, are the absence of taxes, bankruptcy costs, agency costs, and asymmetric information. Even though, the capital markets are not fully efficient, financing and consequently, PF is particularly useful.

Given that PF has been chosen for the financing of project, we will have to know both the advantages and the disadvantages that will be required when analysing the feasibility of the project. As advantages it can be find that there is no recourse to the investor, there can be an increase of the investor profitability due to a higher leverage ratio, the possibility of risk sharing, periods of funding are longer, you can add more shareholders to the project, and it is accounted out of the balance sheet. It is easier to comply with the investment schedule and allow large investments to be made to companies that, because of the size of their balance sheet, could not do so, also maximizing the value of the project, reducing risks taken by partners due to any financial guarantees are required from promoters and detailed analysis of the project allows assigning the risks among the different participants. Once assigned, the dependency between the project and its promoters is only operative, not financing one. Moreover, debt is not consolidated (in certain circumstances), so it allows the design of legal and corporate schemes that avoid the consolidation of the debt of the Project in the Balances of the partners and it helps to not deteriorate the rating of the partners.

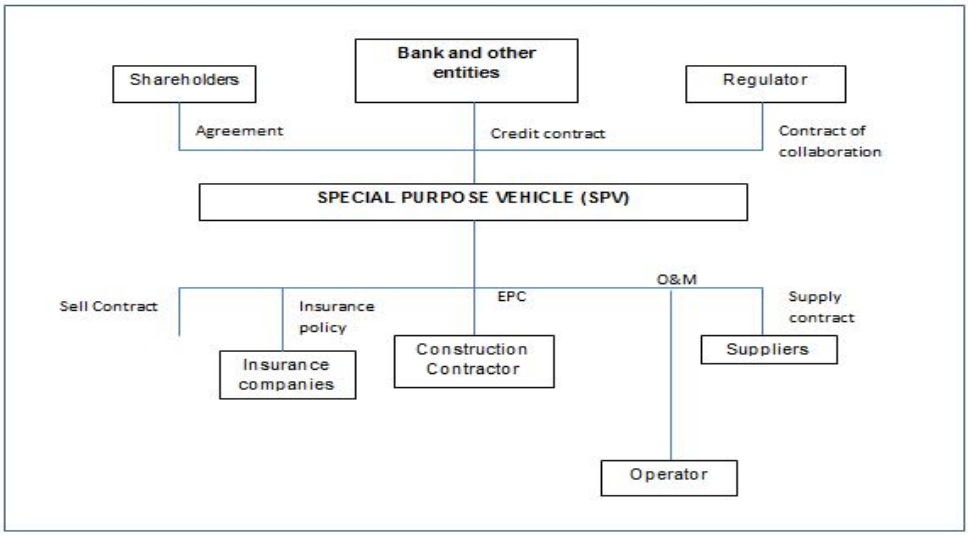
In the same way, the PF also has disadvantages which should be considered. For instance, the cost of funding could be greater, is more complex and requires more time to be closed than for example bonds or corporate lending, PF is not suitable for all the projects, some processes involving this type of financing can become hard, the covenants required sometimes can be inflexible and the funds raised cannot be used in other projects (Ramón Cidón, 2016).

The most relevant participants in these procedures are (Jesús González Torrijos, 2007):

1. **Grantee Entity:** The Public Administrations bidders of the project, directly or indirectly.
2. **Sponsor or Developer:** It is the bidder and developer of the project.
3. **Private Financial Institutions**: Those in charge of advising and providing the necessary funds to carry out the projects.
4. **Public Financial Institutions:** Those entities that depend on one or more public administrations participating in the project finance market.
5. **Advisors:** They cover the different and very varied aspects of each project, for instance:

    5.1. **Legal Advisors:** The focus on legal and taxation features and mind the documentation that can affect the economic part of the project.
    5.2. **Technical Advisors:** Their motivation is the study of the technical viability of the project, rightness of the technology used, operative costs and predictable forecasts.
    5.3. **Other Advisors:** Specialist aware of the environmental impact of the project.

6. **Shareholders**: Depending on the type of funding will be more or less involved. But the separation of the shareholder with the SPV, is made expressly so that they do not respond with the assets of the origin company.
7. **Regulator:** Regulators who are in charge of controlling and supervising all phases of FP.
8. **Insurance companies:** The risks must be analysed in order to establish the capital to ensure them.
9. **Suppliers:** Suppliers who are responsible for providing raw materials for the complete construction and completion of the project.

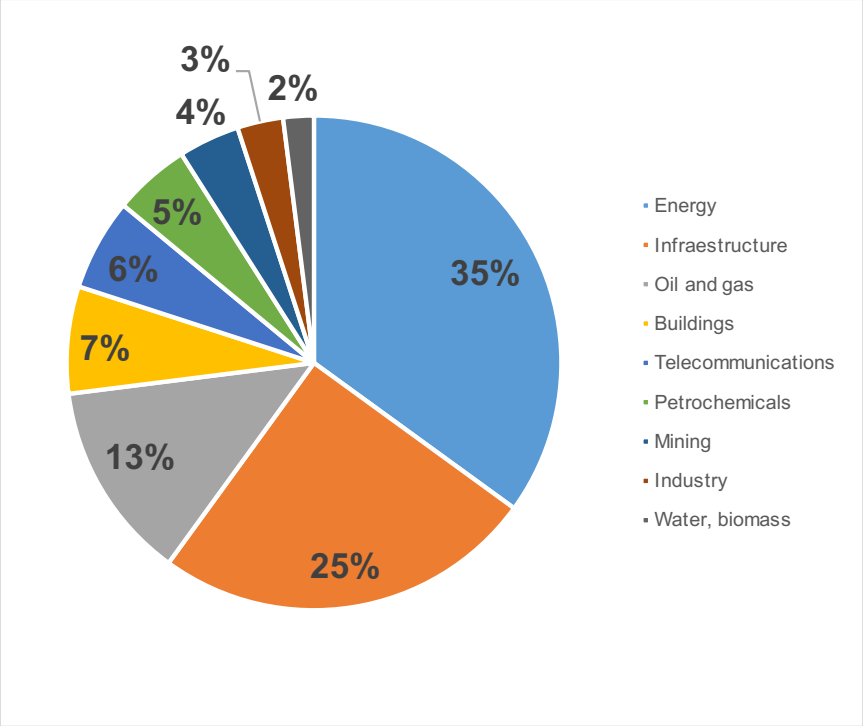


1.1 Graph. Scheme of different participants of a Project Finance. Source: Adapted. Tomás Casanovas, 2016.

Other variables to study during the analysis and the construction of financial model of the PF are the following: debt ratio, operative and investment costs, the inflation, the future electricity prices, Debt Service Coverage Ratio, to analyse the capacity of a project to reach enough cash flows for repay the debt, the term of the project, the interest rate, the margin, fees, repayment period and taxes (transmission and corporate) (Ramón Cidón, 2016).

5. PHOTOVOLTAIC SOLAR ELECTRIC: PROCCEDURES AND APPLICATIONS

Nowadays, the majority of PF that are closed out are those oriented to energy, infrastructures and oil and gas. This graph represents the percentage of PF of each sector:



1.2 Graph. The distribution between the typology of different project finance. Source: Adapted. Tomás Casanovas, 2016.

The 35% represents the financing of projects involved with energy. This energy concept involves the generation, transmission and distribution of energy, the hard industry, renewable energies, biomass, paper industry and hydroelectric industry. Due to the support received by the government to renewable energies is interesting to focus the project in this way.

Normally, in these cases, a public organism subscribes with the SPV a Purchase Power Agreement (PPA). The price is previously determined and it is used to guarantee stable revenues to predict the cash flows. In the case that this agreement exists, the plant sell its electricity to the market and the financing via PF is easier due to the volatility of the market (Tomás Casanovas Martínez, 2016).

Solar energy needs capture and storage systems to take advantage of radiation both directly and indirectly. In this first, glazing is used for the absorption of thermal energy. In the second case, solar radiation can be used to heat other fluids that circulate inside the thermal sensors. In the indirect case, it is relevant to highlight the use of PV. This type of energy transforms solar radiation into electricity by means of photovoltaic cells installed solar modules. This electricity can be used directly or can be stored in accumulators for later use.

PV has the cheapest construction and operation cost and has a low environmental impact which favours the corporate and social image of companies that make use of it. Also, it can be built in very short period (lower than 1 year). In the same way, it will not be able to dispose of waste that is harmful to the environment and therefore, the damage it does to people and the environment is quite small compared to others such as nuclear energy, for example. It can be distributed all over the world, and the costs involved are only maintenance.

Photovoltaic plants have a useful life of more than 20 years, which is a very appropriate period when carrying out a project finance. It is resistant to external climatic conditions and requires no complex maintenance, just cleaning and checking the condition of the batteries. It does not consume fuel, and you can always increase its capacity, increasing the power by installing new modules.

PV power plants are formed of different elements that must be known and evaluated before estimating costs. The essential element is the photovoltaic module, which converts the energy of the sun into electrical energy as a direct current. It is formed by the union of different panels, to give the installation of the necessary capacity. The next item is the Inverter. This converts the direct current of the system to alternating current, equal to that of the electric network. We will also need a load regulator, whose function is to join the solar panels and the consumption elements of the installation. It is also responsible for protecting the accumulators against overload and provides the DC voltage for the installation. It also sets the value of the nominal voltage to which the installation works.
Finally, the battery, which is only present in autonomous installations. This provides energy to the installation during periods without sunlight or without sufficient light and accumulates energy for installation (Javier María Mendez, 2007).

One important issue, that should be considered is that in European Union is used this technology. For the year 2010, the European Union imposed that 12% of the consumed energies should be generated from renewable technologies. Currently there are new targets set for 2030, and it is required that 27% is energy, which is a great opportunity to undertake a project of this type (European Commission, 2016).

Another thing that must be taken into account when carrying out these projects, are the aids and subsidies that are provided. Each year the IDAE and the ICO, organise a program of aid directed to renewable energies. This measure aims to facilitate access to the financing by reducing the level of guarantees that banks usually require for this type of operations. The financing conditions are a maximum loan amount per customer of 10 million euros, between Euribor plus 1.15 and 1.50% and a repayment term between 3 and 20 years and the risk coverage will reach 50 % (IDAE, 2016).

Bureaucratic procedures and legislation are an important support for the project. It is essential that the company be registered in the Tax for Economic Societies, be enrolled in the Special Regime for electric producers, make quarterly and annual declarations of VAT, in addition to the tax obligations to be imputed for income earned by production of electricity.

The current legislation adapted for photovoltaic plants is (UNEF, 2017):

Order ETU / 315/2017, of April 6, regulating the procedure for allocating the specific remuneration regime in the call for new installations for the production of electricity from renewable energy sources.

Royal Decree 359/2017 of 31 March, which establishes a call for the granting of specific remuneration to new facilities for the production of electricity from renewable energy sources in the peninsular electricity system.

Order ETU / 130/2017, dated February 17, updating the remuneration parameters of the type installations applicable to certain installations of electricity production from renewable energy sources.

Order ETU / 1976/2016, of December 23, establishing the electricity access tolls for 2017.

6. ANALYSIS OF THE SPANISH MARKET

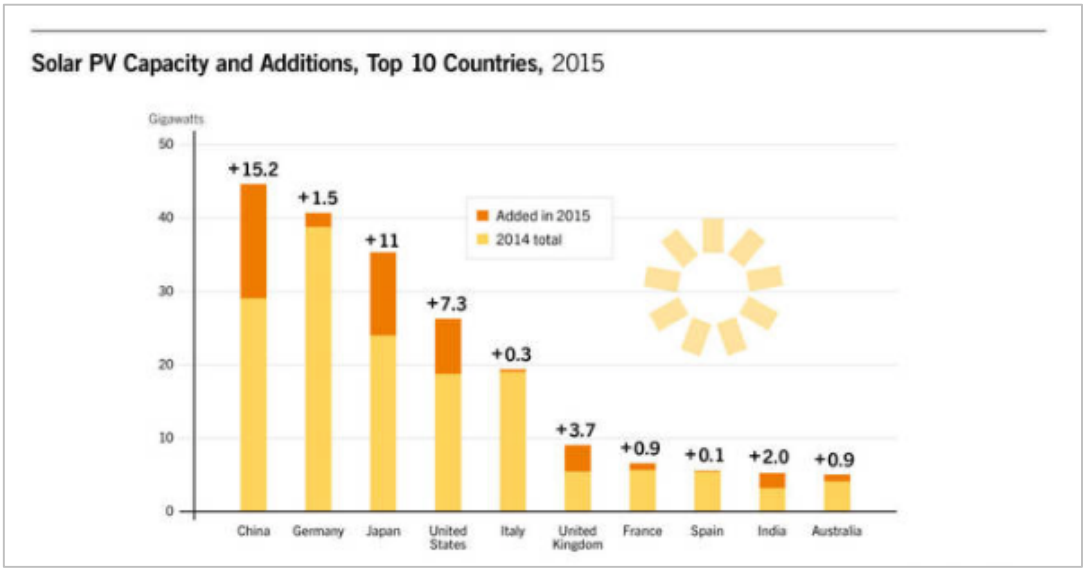
Before carrying out a project of this magnitude, it is interesting to know the benefits or difficulties that can lead us to establish in Spain and not in other countries. Undertaking an analysis of costs and prices compared to other countries places us in context of whether actually establishing the plant in this country will guarantee us a significant source of income and reduced costs.

According to an IEA report, the cost of installing photovoltaic solar energy systems in Spain is one of the cheapest in the world. Spain, is already one of the lowest cost options for electricity generation and has one of the cheapest prices for photovoltaic systems connected to the grid in industrial and ground installations, only surpassed by the Italian and German installation (IEA Report, 2015).

Regarding the prices of photovoltaic modules, Spain is on a par with Germany, although it is surpassed by the Chinese modules that are the cheapest in the world. Photovoltaic solar energy currently accounts for 3.8% of total electricity needs in Spain, placing Spain in the fifth position in the world ranking for penetration of photovoltaic solar energy (IEA Report, 2015).

Moreover, one of the latest analyses developed by the European Platform for Photovoltaic Technology suggests that prices will fall in Europe by 50% in the next 15 years. If this forecast is confirmed, the generation price of this energy source would be below the wholesale price of electricity, as in Spain that is already cheaper (European Platform for Photovoltaic Technology, 2016).

Even though, Spain continues to be the world leader in concentrated solar energy, in the last years has not added more capacity to this figure, and in early 2016 there were no projects in progress. The stagnation of this activity, forces companies in the sector to seek business in emerging countries. Morocco, South Africa and the United Arab Emirates are promoting such facilities, which also provide an opportunity to enhance local manufacturing, engineering and development (Renewables 2016 Global Status Report, 2016).



1.3 Graph. Solar PV Capacity and Additions – Top 10 countries. Source: Renewables 2016 Global Status Report, 2016.

Regarding the solar radiation that is collected in Spain, one of the main raw materials for the project, global solar radiation in Spain between 1985 and 2010 show an upward trend, with a significant increase of 2.3 percent per decade. Spain is one of the countries with the highest annual irradiance in Europe which makes solar energy more profitable in this country than in others. Regions such as northern Spain, which are generally considered to be unsuitable for photovoltaic energy, receive more annual irradiation than the average in Germany (Global and Planetary Change, 2015).

After analysing the graph, it is very good proposal to carry out the installation in Malaga due to the direct exposure to the solar radiation which can generate a great production of energy and become an important source of income. The installation costs are lower than in other countries, electricity prices are dropping which may lead to a higher demand for photovoltaic energy, and is still being stopped, although there are currently programs that support this type of renewable energy and a legislation that covers them (Global and Planetary Change, 2015).

After this analysis, as a support to verify that strengths and weaknesses could have the project and the market conditions that can be threatens or opportunities, a SWOT will be used.

WEAKNESSES	THREATENS
• Higher cost of funding for PF. • Strong and inflexible covenants to the project. • Complexity of the Project. • The time that small and medium-sized photovoltaic installations must wait for electricity companies to homologate and buy their production. • Energy is produced while there is light and depends on insolation.	• Regulatory changes that have affected the sector. • Currently paralyzed sector in Spain. • High competitiveness between countries like Germany and China. • Retroactive reduction or elimination of TIRs, limit the number of hours of operation and impose significant tolls on the use of the electricity network. • Very strict requirements are required in the country at the time of implementation. • "Sun Tax", 95% of electricity consumption is governed by the Tariff of Last Resort (TUR), which is centrally set by the government.
STRENGHTS	**OPORTUNITIES**
• PF without recourse to the investor. • Favourable procedure for being clean and not producing pollution. • Higher leverage, which can increase investor profitability. • It does not consume fuel, because it obtains its energy from the Sun. • Risk shared among the parties. • Environmental impact practically nil. • The systems have a long service life (more than 20 years) and long periods of funding. • The maintenance of photovoltaic systems is simple and has very low costs. • PF accounted out of the balance sheet. • Installation of individual photovoltaic systems is simple and fast. • Can be integrated into the structures of new constructions, but also into those already existing. • There is no dependency on suppliers. • The installation time is less for a photovoltaic system. • The visual impact of solar parks.	• Lower costs of the materials. • Lower prices in solar energy which increase competitiveness. • Technical support provided by a set of reference laboratories in trials, as well as by R & D groups. • Spain is one of the countries with more increasing solar radiation registered. • Plan for Renewable Energies 2011-2020, which envisages a reactivation of the photovoltaic sector and the development of renewables well above 20%. • Recovery of the Spanish economy. • Andalusia has enough land for implantation.

1.1. Table. SWOF of Solar Energy in Spanish Market. Source: Own.

7. EXPOSITION OF THE PROJECT

7.1. Situation of the project

One of the most important things is to choose the site of the photovoltaic plant installation site. Two essential pillars have been taken into account: the amount of solar radiation, the availability of land to install the plant and the connection to energy network. Respect to the first, Malaga has a high direct average solar radiation (5 kWh / m2 approximately), in comparison with other provinces such as Seville, Cadiz or Cordoba that register values lower than the 5 kWh. For instance, in the north of Spain even if the connection to energy network is good, there is not enough solar radiation to generate the production to obtain a good profitability of the project. If we decide to develop the project in UK or France the problem is the same with the solar radiation, adding the problem of establish the project outside of Spain that requires more investment (Agencía Andaluza de la Energía, 2017).

On the other hand, most photovoltaic plants are located in Seville, Granada and Cordoba, so Malaga is a land that remains unexploited and we can take advantage of it. In addition, given the high availability of land that this province has and a very good connection with electricity network due to the close there is a transformation centre, this justifies the decision to establish the plant there.

The Andalusian Administration has carried out a study in which it appears that approximately 43.2% of the electrical energy consumed by the Andalusians is of renewable origin and has the support of the local Administration. The photovoltaic energy is included in the Energy Strategy of Andalusia 2020, which establishes as one of its objectives to increase to a 25% the gross final consumption of renewal energy, exceeding by 5 points the target set by the European Union for 2020.

Since the interest of the project is to establish about 3,000 photovoltaic modules, a large space is needed to place them. So it is decided to settle it on a plot of 20,000 m2 in Lagunillas, Archidona.

1.1 Image. Localization of the plot in Lagunillas, Archidona. Sourse: GMaps.

7.2. Costs and project budget

Based on the research of different project plans and budgets of a similar scope and on an estimation of the necessary materials, as well as in the building lot permissions. It has been made a projection of what could be the final budget for the installation:

- Regarding solar panels, 3,000 modules have been estimated so that the project reaches a power of 0.75 KW. We have chosen photovoltaic panels whose price amounts rise to 525,000€.
- Another material for the construction of the photovoltaic plant for 10,000€.

- In this case, the project needs a connection with the electric line. The total value for this is 25,000 euros.

- Finally, the budget set for the building lot as dig ditches (1,000m3) and concrete (500m3) for a value of 41,320 euros. And the building permits for 10,000 euros.

- The land that has a rent value of 60,000 euros per year.

- We need to hire an advisor to do the assessment of our project. The estimated value for this service is 53,500 euros.

To make the budget more complete and clearer in order to calculate the total budget, a table in excel has been used as follows:

Description	Units	Price	Amount
Solar Panel 315W 24V Monocrystalline Atersa	-	-	525,000 €
Another materials	-	-	10,000 €
Construction Procedures - Dig, Concrete	-	-	41,320 €
Legalization and management of construction (licenses...)	-	-	10,000 €
Connection with electric line	-	-	25,000 €
Land	-	-	60,000 €
Advisory	-	-	53,500 €
TOTAL BUDGET FOR THE PROJECT			**724,820€**

1.2 Table: Estimated budget for the project. Source: Own and AutoSolar.

Developing an analysis of the budget table we can say that almost 90% of our total cost is centred on the installation of the modules and accessories that complement this one. Followed by the transformation cost that implies an 8% and the lowest cost is centred on construction and legal procedures.

7.3. Production estimation and revenues

The estimated revenues for the photovoltaic plant depends on two factors: the energy production and the price established by KWh.

Thanks to the JRC system of the European commission we can calculate the monthly production (Ep) of KWh that will generate the 750 KW plant. Therefore, the estimation based on this application is as follows:

For the estimation it is important to include the estimated losses due to temperature and low irradiance: 10.5%, spending local ambient temperature, estimated loss due to angular reflectance effects: 2.5%, other losses as cables, inverter etc.: 14.0% and combined PV system losses: 25%. As the table shows, after May, the three following months of summer are the ones that register the higher solar radiation production.

Once the production has been calculated, we can calculate the revenues using the selling price per KWh. For the next few years we will include the CPI and a deterioration adjustment of solar panels. Currently, according to the OMIP, it is proposed a toll of 41 euros for each MWh consumed from the solar panels.

In order to calculate the increase in electricity tariffs in successive years, the CPI will be taken as a reference. For the initial scenario an estimation for 2017 would be the applied, which is a 1.5%.

The production estimation has been based in the capacity in Kw, the production of hours per year that have been estimated in 2,100 hours per year and the availability of 98%. The total production is 1,544 Mwh.

Net Production capacity	
Capacity in kW	750,00
Production Hours per year	2,100
Access	98%
Total Production	**1,544 MWh**

1.3. Table: Estimated production for the project. Source: Own.

7.4. Expenses estimated

In addition to income, we need to predict the expenses that we will have to assume in order to be able to make the subsequent valuation of cash flows. The expenses that we will take into account will be the expenses related to operations and maintenance, rent of the land, cost of insurance, wages and salaries, and supplies.

- Insurance cost valuated in 2,537 euros (based in the capital budget)

- Monitoring cost valuated in 890 euros (based in capital budget).

- O&M Costs based in revenues (5%).

As a summary, below there is a table including the main costs that will be necessary for the calculation of the total investment. The total investment rises to 695,729.

Solar Panel Cost and other materials	525,000
Construction procedure	10,000
Legalization ad licenses	41,320
Connection with electric line	10,000
Land	25,000
Advisory	60,000
DRSA	683,854
Capitalized Interest	2,831
Structuring Fee	9,044
Total Investment	**695,729**

1.4. Table: Total investment for PV Plant. Source: Own.

Related to working capital:

- Payables Outstanding Days. Days payable outstanding tells how long it takes a company to pay its invoices from trade creditors, such as suppliers. : 45 days.

- Average Collection Period. The average collection period is the approximate amount of time that it takes for a business to receive payments owed in terms of accounts receivable: 67 days.

Related to Financing Conditions:

- Structuring Fee: 2.5%
- Maximum Leverage or the maximum size of a trading position permitted through a leveraged account.: 52%
- The margin that it is going to be applied during construction: 0.75%
- The margin that it is going to be applied during operation: 1.10%
- Repayment Period: 18 years
- Euribor Swap: 1.10%
- DSCR: 1.8x
- Requirement DRSA: 45%
- Cash Sweep: 20%

Also, with the financial conditions and initial data we can calculate the equity and the debt that the project needs to support.

BALANCE SHEET		
Equity	333,950	333,950
Project Finance Debt	361,779	361,779
Total	**695,729**	**695,729**

1.5. Table: Estimated debt for the project. Source: Own.

The equity is based in the contributions of the partners and the profits generated by the company. In this case, the amount is based in a 48% of the total financing of the project, and the other 52% will be financed by debt. The total amount is composed by both counterparties for 695,729 euros.

So, with these data we could calculate the EBIT with the revenues and costs:
Considering that the CPI is 1.5%, and the initial electricity price is 41 euros per MKh, we can appreciate that the price is increasing during the time by the influence of the CPI. Sold energy is based in the total production of the energy. The multiplication of these three variables will be the total of the revenues. For the operating cost, we have to consider insurance, monitoring and O&M cost and multiply them by the CPI. Once obtained the data, if we subtract the cost from the revenues we obtain the EBITDA for the next cash flows.

	Revenues	**Operating Cost**	**EBITDA**
1	0.0	0.0	0.0
2	63,283.5	1,517.3	64,800.8
3	64,232.8	1,540.1	65,772.8
4	65,196.2	1,563.2	66,759.4
5	66,174.2	1,586.6	67,760.8
6	67,166.8	1,610.4	68,777.2
7	68,174.3	1,634.6	69,808.9
8	69,196.9	1,659.1	70,856.0
9	70,234.9	1,684.0	71,918.8
10	71,288.4	1,709.2	72,997.6
11	72,357.7	1,734.9	74,092.6
12	73,443.1	1,760.9	75,204.0
13	74,544.7	1,787.3	76,332.0
14	75,662.9	1,814.1	77,477.0
15	76,797.8	1,841.3	78,639.2
16	77,949.8	1,868.9	79,818.8
17	79,119.1	1,897.0	81,016.0
18	80,305.8	1,925.4	82,231.3
19	81,510.4	1,954.3	83,464.8
20	82,733.1	1,983.6	84,716.7
21	83,974.1	2,013.4	85,987.5

1.6. Table: Estimated EBITDA for the project. Source: Own.

As the periods pass through, it can be seen how the plant generates a higher EBITDA, reaching a maximum figure of 85,987.5.

Likewise, we need to calculate the working capital for our future forecasts, once calculated the revenues if we multiply it by the payables outstanding days and the operating cost by the average collection period.

	Accounts receivable	Accounts Payable	Working Capital
1	0.00	0.00	0.00
2	11,777.76	189.66	11,588.10
3	11,954.43	192.51	11,761.92
4	12,133.75	195.40	11,938.35
5	12,315.75	198.33	12,117.42
6	12,500.49	201.30	12,299.19
7	12,688.00	204.32	12,483.67
8	13,071.49	207.39	12,864.10
9	13,267.56	210.50	13,057.07
10	13,466.58	213.65	13,252.92
11	13,668.57	216.86	13,451.72
12	13,873.60	220.11	13,653.49
13	14,081.71	223.41	13,858.29
14	14,292.93	226.76	14,066.17
15	14,507.33	233.62	14,273.71
16	14,724.94	237.12	14,487.81
17	14,945.81	240.68	14,705.13
18	15,170.00	244.29	14,925.71
19	15,397.55	247.95	15,149.59
20	15,628.51	251.67	15,376.84

1.7. Table: Estimated Working Capital for the project. Source: Own.

8. FINANCIAL-ECONOMIC MODEL

8.1. Description of the model

The model created is based on an initial data, the EBITDA calculation, the P & L calculation, the debt calculation and finally the cash flows and a balance sheet.

For the first section the following values have been considered: The capacity in KW, the production of hours per year and the percentage of accessibility to energy. Also included the initial budget in which the project is valued, about € 724,820. As well as operational costs such as insurance and monitoring. Other important variables are the depreciation of the useful life of the project and the price of euro per MWh that will help us to estimate our revenues. It is important to also include the financial conditions and the average days of collection and payment for the subsequent calculation of working capital.

Regarding the second Cash Flow Statement tab, it has been decided to include information that will mainly be useful when calculating the latter. As well as the capital and debt breakdown of the project and working capital respect. The DRSA has been included, the most important component to take into account since this is the debt coverage:

The debt is dimensioned assuming some FC and setting some levels of coverage. The project should generate more cash flows than are necessary to meet the debt service. Working capital is an indicator of the liquidity of a company, since it measures the ability of a business to deal with its closest debts.

In the third tab, EBITDA is calculated. For this, the price of electricity is used, and the amount of energy sold and to these two, the CPI is applied. Costs include insurance, monitoring and O & M. Continuing with the structure, for the following P & L calculation, previously calculated income and costs are used. Once, we calculate the EBITDA, we take into account the depreciation with respect to the 20 years that we had previously fixed and this way obtains the EBIT. To the latter you add the financial costs and finally subtract the taxes and finally, you get the results.

Regarding the debt, it is used an interest rate swap which can be defined as a multi-period term contract in which an interest rate is fixed in the contract, the transaction is settled in each sub period by comparison. Between the interest rate indicated in the contract and the type of settlement that reflects the market situation.

We opted for the contracting of this type of instrument derived from hedging interest rate risk to soften interest rate swings, reduce credit risk and, in turn, reduce liquidity risks.
There is an influence of the interest rate swap, and of the reference index taken, in this case the EURIBOR a 6 months. The Euribor is used in addition to IR Swap for financing.

With both we calculate the margin, that later and using the percentage that corresponds to each one will be calculated the margin that will be applied during the construction (only the first year) and the following until the end of the useful vid of the project. Knowing the amount of project debt, we calculate the repayments of the loan. Also, using interest and the fixed amortization table we also calculate the structured debt.

Once the debt has been calculated, we already have enough information to calculate the Cash Flows. So we use Working Capital, DRSA, Capex (or initial investment) and taxes. In this way we obtain the Free Cash Flows that can subsequently be discounted at a WACC rate that is around 7% for the sector. Free Cash Flows before paying debt and before Dividends have also been calculated. The valuation will be based on the level of DSCR min and a half, on IRR shareholders and on VAN. That will serve us to evaluate the different cases.

8.2. Debt service

The debt service coverage is to have, in time and in time, sufficient liquid resources to meet the payment of both interest and debt repayment. Thus, debt service coverage analysed from the generation of resources (income statement) seems to be made from the result before interest and taxes.

Normally, the debt service coverage ratio should be higher than the unit. In another case the situation is not sustainable. For example, in an exercise it may turn out that the ratio is less than unity and it is possible to deal with debt servicing without problems. Maybe because he has taken new debt. Or maybe because some non-current asset has been disposed of. But evidently such a situation cannot be repeated indefinitely. The DSCR is calculated as the coefficient between free cash flow before servicing the debt and the debt service itself. The ratio required in each project depends fundamentally on the risk analysis of the project. The entities that offer financing to the project establish a ratio of coverage of the service of the minimum debt of 1.

The ability to generate cash that a company has is an indication of its solvency, since through cash it can meet its payment commitments. The debt service coverage ratio compares the available cash flow over a period, with debt service (repayment of principal plus interest payment). Consequently, debt service coverage tells us if it is able to afford its payments to creditors, and indirectly therefore, to be profitable and viable for its shareholders.

In the case of our project, if we analyse the ratio, less in the first year than clearly the initial disbursement and the need for financing allow that the unit cannot be reached, since it eliminates the 0.96. This may mean that the project has good solvency to meet the payment of the requested funding. The average is 1.85 for the project.

	Required Balance	Withdrawal	Endowment	End Balance
1	12,533.73	12,533.73	0.00	12,533.73
2	12,370.45	12,533.73	-163.28	12,370.45
3	12,204.30	12,370.45	-166.15	12,204.30
4	12,035,28	12,204.30	-169.03	12,035.28
5	11,863.38	12,035.28	-171.90	11,863.38
6	11,688.61	11,863.38	-174.77	11,688.61
7	11,510.96	11,688.61	-177.64	11,510.96
8	11,330.44	11,510.96	-180.52	11,330.44
9	11,147.05	11,330.44	-183.39	11,147.05
10	10,960.79	11,147.05	-186.26	10,960.79
11	10,771.65	10,960.79	-189.14	10,771.65
12	10,579.65	10,771.65	-192.01	10,579.65
13	10,384.76	10,579.65	-194.88	10,384.76
14	10,187.01	10,384.76	-197.75	10,187.01
15	9,986.38	10,187.01	-200.63	9,986.38
16	9,782.88	9,986.38	-203.50	9,782.88
17	9,576.51	9,782.88	-206.37	9,576.51
18	0.00	9,576.51	-9576.51	0.00

1.8. Table: Debt of the photovoltaic plant. Source: Own.

	DSCR
1	0
2	0.96
3	1.42
4	1.47
5	1.52
6	1.58
7	1.64
8	1.70
9	1.76
10	1.83
11	1.90
12	1.97
13	2.05
14	2.13
15	2.22
16	2.31
17	2.41
18	2..51

1.9. Table: Debt Service Coverage Ratio of the photovoltaic plant. Source: Own.

DSCR Mín	DSCR Average
0.96	**1.85**

1.10. Debt Coverage Min and Average. Table: Debt Service Coverage Ratio of the photovoltaic plant. Source: Own.

8.3. Financial statement Projections

For the calculation of our initial projections, the 750 kW capacity is used, an estimated production of 2,100 hours per year and a 98% availability, resulting in a total production of 1,544 MWh. The price is 41 euros per MWh, which may be decisive when establishing the sensitivity analysis, given the volatility of the energy price would be interesting to see how a variation in the price may change our projections.

Related to revenues, that are the largest source of our Cash Flows, they increase slightly throughout the project period, staying between 54,617.91 and 67,581.18. The fact that it generates positive income is a good indicator that the project can be profitable. As revenues increase, costs are pro-cyclical and follow the same movement gradually increasing. Although really, the costs generated by the photovoltaic plant are not very remarkable since they are kept in a range of between 1,500 and 2,100 at most. This generates that EBITDA is logically positive for all years and is set in figures very similar to revenues, since the costs do not cause a very important mismatch in the figures.

The projections obtained indicate that EBITDA increases as project years increase from 64,800 in the second year to 86,000 in the last year. The working capital, since it depends on the days that the collections are received and the payments are paid, during the first year and the last year, the figure is quite remarkable (11,588 and 15,376.84), maintaining a range of maximum 227 for other years. The DRSA we calculated above is used as a cover, and it is decreasing as the years go by. The Capex that has been used is the initial investment in fixed assets, in this case the value is 11,875.40.

For the first year, Free Cash Flow is negative and that is because the company has not started its business and has made a strong initial investment, so it makes sense that as of year 2, CFs will increase. With regard to financial costs, as we can see, it decreases slightly over the years in the same way as the project debt payments. After subtracting the debt, we obtain the CFs after the payment of debt, which in comparison with the former the first is greater with respect to the debt and the others decrease. If the capital is added, the CFs are obtained before repaying dividends.

Finally, it is observed that the CFs under the influence of the debt are smaller. Even so, during the 20 years of the project can be observed that positive flows are generated, which can give us indications that the project could be profitable.

8.4. Results of the viability analysis

In order to evaluate the results, it is convenient to know the different methods that are used when establishing whether a project is profitable or not.

The Internal Rate of Return (IRR) is the rate of interest or profitability offered by an investment. That is, it is the percentage of profit or loss that an investment will have for the amounts that have not been withdrawn from the project. It is a measure used in the evaluation of investment projects that is closely related to the Net Actualized Value (NPV). It is also defined as the value of the discount rate that makes the NPV equal to zero, for a given investment project.

	Cash Flows	IRR Shareholders
1	-333,949.98	11%
2	26,765.17	
3	39,027.55	
4	39,886.30	
5	40,758.38	
6	41,643.96	
7	42,543.19	
8	43,456.21	
9	44,383.18	
10	45,324.26	
11	46,279.60	
12	47,249.37	
13	48,233.73	
14	49,232.84	
15	50,246.89	
16	51,276.02	
17	52,320.43	
18	53,380.29	
19	65,904.64	
20	66,736.67	
21	67,581.18	
22	15,376.84	

1.11. Table: IRR for Shareholders and Cash Flows. Source: Own.

The internal rate of return (IRR) gives us a relative measure of profitability, that is, it is going to be expressed as a percentage. In this case, the IRR for shareholders is 11% which is more than 0% and shows us that the project is profitable and even generates value for shareholders and investors.

The Net Present Value (NPV) is to update the charges and payments of a project or investment and calculate their difference. To do so, it brings all the cash flows to the present moment by discounting them at a given interest rate. The NPV is going to express a measure of project profitability in net absolute terms, that is, in monetary units. It is a method that is used for the valuation of different investment options. This method is also known as Net Present Value (NPV), net present value or net present value (NPV).

For simplicity let's just call it NPV. The NPV serves to generate two types of decisions: first, to see if investments are feasible and secondly, to see which investment is better than another in absolute terms.

The decision criteria will be as follows:
NPV> 0: will generate profits.
NPV = 0: Indifferent.
NPV <0: will generate losses.

To calculate the NPV it is necessary to apply the WACC as the discount rate. The WACC for the sector ranged between 7% and 9% rate. The weighted average cost of capital, WACC (Weighted Average Cost of Capital), is the weighted average cost of the two cost resources that a company has; Financial debt and equity.

The WACC is basically the sum of the cost of debt and the cost of equity, calculated as a weighted average according to its percentage in the value of the company. Therefore, in order to calculate the WACC, the cost of the financial debt (Kd) and the cost of own funds (Ke) must be known beforehand that we will use directly in the WACC formula. Discounting the cash flows at a rate of 7%, we obtain a NPV of € 144,036.15 €, which is greater than 0 and that determines that it is a project that will generate benefits.

Related to the Payback is a criterion for evaluating investments that is defined as the period of time required to recover the initial capital of an investment. It is a static method for the evaluation of investments. By means of payback we know the number of periods (usually years) that it takes to recover the money disbursed at the beginning of an investment. Which is crucial when deciding whether to embark on a project or not. Regarding the payback, we can say that the initial investment recovers at 9 and a half years.

8.5. Sensivity analysis

Compliance with the ratios has a special relevance, since they show the degree of compliance with the economic hypotheses that were used in the Base Case for the projection of the financial statements. Failure to comply with the minimum levels agreed in financing agreements with banking entities will initially result in the declaration of early repayment of the total debt, in order to avoid this situation which implies a total rupture of the project, which Generally agreed is the contribution of funds by the shareholders up to an amount that re-establishes the required minimum levels of ratios.

As an initial thesis, we can say that in a PF operation, the estimated cash flow is the main guarantor of the financing, however there are always risks difficult to define that makes necessary the contribution of a certain level of guarantees to the promoters of the project.

Once created a model based on the elements that determine the base case, a sensitivity analysis is necessary to be performed in order to determine how the project's profitability varies with changes in some of its most significant and volatile parameters.

Consequently, we have created 6 different scenarios are in which we are going to determine the variation in IRR, NPV and in the payback of the investment.

- Scenario 1 and 2: Negative and positive price variation

According to The Iberian Energy Derivatives Exchange, solar energy prices are expected to come down with what we are going to create a scenario in which prices fall to 27 euros per MWh. It can also be compensated with a rise in inflation, given that we are in an economic recovery phase and inflation is expected to rise. In this way, we present a first scenario in which the price is reduced to 27 euro per MWh and the CPI increases slightly to 1.6%.

In relation to income, we can observe how the alteration of this variable causes that the range of income is reduced since for the first year it obtains approximately 41,000 euros and for the last year of useful life they reach 55,300. This will also affect the DSCR and cash flows.

With respect to the EBITDA that we obtain in comparison with the base case, this continues to be positive for all years, but is considerably reduced, considering figures from 41,000 to 55,300 for the last year of useful life. This means that the cash flows are lower than the base case and therefore the figures for the DSCR are still lower than 1.

The project does not have sufficient solvency to meet the financing. The minimum DSCR is 0.58 and the average DSCR is 1.19, which does not meet the minimum required.

Given this variation in Cash Flows the IRR for shareholders has reached 6% in this case, but although it is greater than 0, the coverage ratio was not enough. In the case of the NPV, the figure that comes out is negative, -23,285.71 € by discounting it to 7% of WACC, which indicates that the project will not generate revenue.

Given the volatility of the price of electricity, we imagine a case in which the price amounts to 62 euros per MWh and inflation is maintained at the 1.6% we had set for the previous case. The first thing that affects is the income, making it increase considerably reaching the 127,000 euros of income until the last year of life of the plant. This is reflected in the EBITDA and consequently in the cash flows, since the costs will increase slightly by the CPI but hardly the difference is appreciated.

Regarding the CSR, we can say that it exceeds 1%, remaining within a range of values that reaches up to almost 3% of coverage ratio. The minimum DSCR would be at 1.53 and the average DSCR at 2.83. This indicates that maintaining a price of 62 euros, solvency for financing would exceed the unit.

For this case, the IRR for shareholders has reached 18% in this case, that is greater than 0 that in combination with coverage ratio set a profitable project. In the case of the NPV, the figure that comes out is positive by discounting it to 7% of WACC, which indicates that the project will generate revenues, 395,018.94 €.

Case 1	Case 2
IRR Shareholders	**IRR Shareholders**
6%	18%
DSCR Mín	**DSCR Mín**
0.58	1.53
DSCR Average	**DSCR Average**
1.19	2.83

1.12. Table: IRR for Shareholders, DSCR min and average for scenario 1 and 2. Source: Own.

- Scenario 3 and 4: Negative and positive variation in availability

In the following scenario, it is suggested that there are technical or maintenance problems with the availability of the plant and that, for that reason, it drops to a figure of 70%. In this case what directly affects is the production of energy, which would reach 1,000 MWh compared to the 1,500 that reached in the base scenario.

Relating to income, we can appreciate how the variation of this variable causes that the range of income is reduced since for the first year it obtains approximately 45,000 euros and for the last year of useful life they reach 60,000. As previously mentioned, this will also affect the DSCR and cash flows.

The EBITDA that obtained in comparison with the base case, this continues to be positive for all years, but is considerably reduced, values range from 45,200 to 60,000 for the last year. In this case, also means that the cash flows are lower than the base case and consequently the figures for the DSCR are still lower than 1. In this scenario, the project does not reach the solvency to assemble the financing. The minimum DSCR is 0.65, slightly higher than in the previous scenario, and the average DSCR is 1.30, which does not meet the minimum required.

The variation in Cash flows causes that the IRR for shareholders has reached 7% which it is greater than 0, but as previously mentioned, the coverage ratio was not enough. In the case of the NPV, the figure that comes out is positive, 4,032.14 € by discounting it to 7% of WACC, which indicates that the project will generate revenue.

On the other hand, if the plant were to be 100% available without any maintenance problems, capacity could be maximized up to 1,575 MWh. This is reflected in an increase in revenues from the base scenario, as well as a consequent increase in EBITDA, as costs are hardly affected, and an increase in value in Cash Flows.

If we look at the DSCR we can observe how the range continues to be greater than 1 minus the first year of investment. Which is solvency for financing. The minimum is a 0.98 and the average ratio is at a 1.89.

Case 3	Case 4
IRR Shareholders	**IRR Shareholders**
7%	12%
DSCR Mín	**DSCR Mín**
0.65	0.98
DSCR Average	**DSCR Average**
1.30	1.89

1.13. Table: IRR for Shareholders, DSCR min and average for scenario 3 and 4. Source: Own.

Moreover, this variation in provokes that the IRR for shareholders has reached a 12% which it is greater than 0, but the same percentage as if the plant has a 98% of availability, In the case of the NPV, the figure that comes out is positive by discounting it to 7% of WACC, which indicates that the project will generate revenue, 154,036.44 €.

- Scenario 5: Variation in the maximum leverage

This would be the case where maximum leverage would place it at a level of 30% instead of a level of 52%. This means increasing the maximum size of a trading position through a leveraged account.

Relating to income, we can't appreciate any variation of this variable causes that the range of income is maintained in the same level since for the first year as in the base case. With the EBITDA happens the same. The variation here, is the amount of financing that is going to be lower that in the base case because the need of financing is minor that in the first case. This will impact in the financial costs and in the debt payments that will affect the cash flows.

Analysing the DSCR we can observe how the range is greater than 2 minus just in the first year of investment that means that exists solvency for financing. The minimum is a 2.14 and the average ratio is at a 3.73.

Related to the IRR for shareholders has reached 9% which it is greater than 0 in combination with a good coverage ratio. In the case of the NPV, the figure that comes out is positive, 65,445.99 € by discounting it to 7% of WACC, which indicates that the project will generate revenue.

Case 5
IRR Shareholders
9%
DSCR Mín
2.14
DSCR Average
3.73

1.14. Table: IRR for Shareholders, DSCR min and average for scenario 5. Source: Own.

- Scenario 6: Variation in the DRSA requirement

In the event that we increase the requirement of the DRSA ratio from 45% to 75% (what Caul supports greater coverage for the project), the DRSA will increase us for the required balance and for the end balance, which will affect directly in the cash flows since to include this variable increases considerably. As the same case as it happened before, the income maintains the same as in the base case because but EBITDA will increase if we consider a higher DRSA.

Related to the DSCR we can observe how the range is greater than 1 minus just in the first year of investment that means that exists solvency for financing. The minimum is a 2.42 and the average ratio is at a 4.

The IRR for shareholders has reached 9% which it is much greater than in the base case, in combination with a good coverage ratio. In the case of the NPV, the figure that comes out is positive by discounting it to 7% of WACC, which indicates that the project will generate revenue, 104,732.24 €.

.

Case 6
IRR Shareholders
9%
DSCR Mín
2.42
DSCR Average
4.00

1.15. Table: IRR for Shareholders, DSCR min and average for scenario 6. Source: Own.

9. MAIN CONTRACTS

As the EOI defines, a contract is considered a set of negotiations for a "Project Finance" operation that are reflected in a series of documents, among which "contracts" represent the most important part, particularly when there are disagreements and differences in criteria (claims, defaults, costs,), in order to delimit responsibilities and compliance.
Through these will be: to ensure the flow of income and its use in meeting the financing obtained, ensuring adequate control and management, give security to financial institutions and lenders, to assure to the Administration of the realization of the project in the established terms (conditions and terms), additional guarantees (on assets, promoters, ... etc), product service guarantees and administration.

They represent the main axis:
• Construction contracts.
• Contracts for the supply of material and / or raw material.
• The purchase and sale of product and / or service contracts.

9.1. Construction contract

Inside the construction contract, the most common is the “turn-key” contract. The builder assumes the risk of increases in the construction costs, promising to end the work in within the agreed term and cost. This contract takes a penalty system in case of non-fulfilment.

There are other types of construction contracts that share the allocation of these risks between builder and SPV. This would be the case of a contract where a construction price is established with a specific variation margin, from which the builder assumes any deviation.

The contract of EPC incorporates the duty of construction and put into function the project in a closed time and price. In this way, the contractor (that at the same time, may be participated by the sponsors) is responsible for designing, building and putting into functioning the project in a certain time, with a determined characteristics and returns and with a fixed price. This contract EPC "turnkey", complemented many times with guarantees of ending by the contractor (also known builder o "Epics") as end or quality endorses (bank guarantees at first requirement), allow the risks that arise in the construction or delay in the project to be assumed by the builder, that is the best equipped company o assume such risk.

The penalties are the following:
• Up to a maximum amount for breach of the guaranteed returns (of production or consumption)
• Up to a maximum amount for delays in the starting date of the operation of the project (because from that moment, the project would need cash flows, – inflows- to pay the financial companies, that would not be available for this delay).
• Up to the total price of the contract EPC if the breach of production or operation are above more expensive limits (Ramón Cidón, 2016).

9.2. Operation Contracts

The typical contract to secure this supply is the "supply or payment contract" that compels the commodity supplier to provide with the specified quantities or compensate the SPV for the damage. This type of contract is key in combined cycle projects or biomass, whose essential raw material is natural gas/straw and a lack of provision stops the power generation.

Buy sell contract of the product or service use: one of the characteristics of the PF is that the cash flows generated by the project must be predictable and steady, as well as enough to face the debt repayment. That gives a key importance to the estimation of the demand for the product or service and the analysis of the payment to the licensee.
Operation and maintenance contract: through this contract, the SPV transfers the operation risk of the plant to an external agent of the business activity. The operator must assume the responsibility for the operation of the project during the contract period that will cover at least the repayment period of the financial liabilities.

Related to operation and maintenance contract, the SPV transfer the functions and responsibilities of the operation stage of the project to an operator or manager (that can be linked to the sponsors) so this operator is obliged to make all the operation and predictive maintenance tasks of the project, with a closed price during a determined period of time (reviewable depending on the CPI), assuming the operator a number of disposal or minimum production guarantees of the project. By the signature of the O&M contract, the risk by the eventual contingencies of malfunctioning is mitigated by the SPV (being assumed by the operator) and, consequently, the financial companies may calculate in a more certain way the flows available to the SPV during the life of the project, avoiding they are reduced by such malfunctioning (at least, until the part guaranteed by the operator) (Ramón Cidón, 2016).

9.3. Off-take Contracts

Through off take contracts, the public sector intends to purchase, finance lease and lease, with and without option to purchase, of goods and personal property, in our case the sale of solar energy.

- Hedging agreement: As BBVA source indicates, edging or hedging contract is the completion of a financial activity to reduce or eliminate potential losses that can cause financial investments. It is usually done with financial derivatives. It is not very different from when we make an insurance contract. This is a common process for many investors, but it is also useful in many companies that try to cover their risks in one way or another. The most common form of hedging is to use financial derivatives, such as futures, options or swaps. However, hedging risks with financial products is not exclusive to financial institutions or investment banks, but many companies or individuals do, even if not with derivatives. In a way, hedging is not too different from when we make an insurance transaction. For example, car insurance for theft. We want to protect ourselves from an event that may end up happening and that we can not control (to steal the car) so that if it happens we do not lose the value invested in it. Companies also take risks that they can not insure, to cover potential losses they can contract a financial derivative. For example, let's assume a company that manufactures electronic components whose components come from the United States and pay in dollars and sell them in Europe in euros.

- Take-and-pay agreement: Bilateral, written and forward contract, in which the buyer agrees to pay a percentage of the contracted gas, regardless of whether it is consumed. The seller agrees to have at the disposal of the buyer 100% of the quantity contracted.

- Long-term sales agreement: As the information funded for contract, this is a legal template is a supplier to sell products or materials to a purchaser at pre-determined prices with minimum / maximum annual quantities, all sales being made against purchase orders. This is a fairly balanced agreement between supplier and purchaser with 11 clauses over 7 pages with a number of schedules. The clauses cover duration, quality of products, quantities and ordering procedures, delivery, risk and ownership, price and payment, termination and force majeure (Ramón Cidón, 2016).

9.4. Insurance Contracts

Insurance is a very important contract related to mitigation of risks or hedging, and as a result, insurance costs are high in this type of project. This may result in an underestimation of the costs of the project as all insurance requirements will not be taken into account as the insurance required by the lenders is not in order. Insurance contracts are carried out in first to cover the entire construction period, including the launching and testing period and after that, is related to the annual renewal of insurance once the project is underway (Ramón Cidón, 2016).

Types of insurance:
• Construction damage
• ALOP
• Civil liability
• LOP
• Civil liability
• Overwhelming force.

9.5. Financial Contracts

In our case, we need this type of financial contract to hedging. The Interest Swap Agreement is an agreement between two parties to exchange the flows of payments as interest derived from a financial transaction over a theoretical principal amount and over a certain period of time. A swap is considered a derivative instrument, since it is composed of the aggregation of "simple" financial instruments.

The SWAP can be equated as a multi-period term contract, in which an interest rate is fixed in the contract, the transaction is settled in each sub - period, by comparison between the interest rate indicated in the contract and the type of settlement Which reflects the market situation. These instruments are OTC (Over The Counter), that is, made to measure of the parts. The purpose of the swaps is, smoothing the fluctuations of interest rates, reduce credit risk and reduce liquidity risks (BBVA, 2016)

9.6. Supply Contracts

The supply contract is made up of one party that is obliged to perform periodic benefits of contracts of supply and services or things in favour of another party, in exchange for a consideration. We can say that there are different types of supply contract: In which the employer is obliged to deliver a plurality of successive goods and for a unit price.
Those for the lease and acquisition of telecommunications equipment and systems and the assignment of the right to use the devices and programs except the contracts of acquisition of programs to measure. Those of manufacture where the services or things must be elaborated according to specific characteristics previously fixed (Ramón Cidón, 2016).

10. ANALYSIS OF THE MAIN RISK OF THE PROJECT

EOI defines the risks in the FP as the difficulties with which it will be encountered and a project can be started without having first made a detailed assessment of the risks and have obtained an acceptable mitigation of the same with the parties to involve Promoters, Administration, Financial Institutions and Insurance Companies.
The lower the degree of protection or trust of the lenders and insurers in the project itself, the greater the degree of involvement of the promoters in the capital project, outside resources, guarantees, etc. For those it is of total recklessness to assume risks such as follows. Risk management is facilitated by requiring project promoters to submit plans. Such measures may generate tension between the flexibility desired by the promoters and the risk management procedures required by the financial institution.

The most important step is the identification and risk analysis where the project promoters should prepare the feasibility study. The financial institution will carefully review the study and may commission external consultants to supplement it.

The issues that will be of particular interest are proper verification of the cost estimate and project cash flows. Some risks are analysed using financial models to determine the sensitivity of the project's cash flows, and in particular the project's ability to meet repayment of the loan. Different scenarios will be examined to consider the impact on the project of variables such as inflation, interest rate, devaluation rate, sales prices, and price of inputs (Javier F. Del Carpio, 2014).

There is an important need of risk allocation after the identification and analysis of the risks, these are assigned to the participants involved through the negotiation of a contractual scheme. Ideally a risk should be assigned to the participant who is in the best position to bear it, who is better able to manage, control, and insure against risk. Likewise, risk should be assigned to those who have the financial capacity to deal with. It has been observed that financial institutions attempt to broadly allocate uncontrollable risks and ensure that each participant has an interest in adapting to such risks. Generally, commercial risks are allocated to the private sector, and political risks to the state sector.

Finally, the risk management that should also be managed with the possibility that a risky event may occur in order to minimize its consequences. Financial institutions need to have more information and greater control of the project, in those cases in which they face the possibility of assuming greater risks. This situation forces them to become involved and monitor the project more closely.

10.1. Risks in the operation stage

The operational risks in the project finance may be given for the strict reasons. Related to market risks, the main causes can be: Goods and services supply risk, risk in the quality of the consumed commodity, Risk of low demand of the product or service produced by the Project. In case of operative risks, the main causes can be: Fall in the forecasted production risk, operations above the cost and technical obsolescence risks, transport risk in the cost of products, project management risk. Also there can exist risks that can affect the income flow and the operative costs. For example, shortage or extra charges, and market risk (Javier F. Del Carpio G, 2014).

Risks associated with reserves and or resources as the risk associated with a mining project, a railway project, a thermal power plant, or the concession of a motorway. For example, it is assumed that there is a risk that there are not enough reserves for the power station, in this case.

Operational risk, these are general risks that may affect project funds flows due to increased costs or factors that may affect the project's ability to generate the quantity and quality of goods or services that it has been predicted to offer during life of the project. Operational risks include the level of expertise and resources of project promoters, inefficiencies in operations or shortages of skilled labour (Javier F. Del Carpio G, 2014).

Obviously, the loan can be paid if the product offered to the market has acceptance, and allows to generate a stable flow of funds. The best mechanism to minimize commercial risks is to enter into sales contracts with buyers who are financially sound (Ramón Cidón, 2016).

10.2. Risks in the construction stage

The main risk is associated with the completion of the work. The assignment of risk associated with the completion of the work is of vital importance for any project. This phase carries great risk for the financial institution. The construction faces the danger of not completing the works within the established deadlines, or according to the established budget, or as a result of other technical or labour difficulties.

For instance, if there is a delay or abandon risk by the builder, extra charges above the agreed price risk, infrastructure, land and transport risk, wrong technical design risk, subsoil quality risk. Other risks are those ones associated with participants. These are the risks associated with the project promoters or with the borrowing institutions. The question is whether they have sufficient resources for the administration of the construction and operation of the project; and whether they are efficient to solve any problem that might arise.

Technical risk, of technical difficulties in the construction and operation of the plant and the project teams. Institutions prefer to minimize risk by using technologies that have been tested.

Or risk associated with devaluation that include those risks that: The increase in the type of currency in which the loan is requested, this situation will increase the costs of imported inputs; or a decline in revenues in local currency. Mechanisms to minimize risks include: Establishing that income and expenses are carried out with the same type of currency; to enter into contracts for the protection of fluctuations in the exchange rate.

Also, the risks associated with regulations. These are the risks associated with the possibility that the licenses or authorizations granted by the government to build or operate are not granted, or that the project is subject to very high tax rates, patent payments, or very demanding requirements for the supply or Local distribution. Such risks can be minimized by carrying out legal consultations before initiating project activities.

Finally, risk of force majeure. This risk is the consequence of events that may prevent construction or operation temporarily. Minimizing these risks: Consider all risks associated with the project, assigning the risks to other participants as much as possible, requesting the necessary insurance policies (Ramón Cidón, 2016).

10.3. Financial risk

Regarding financial risks, the most common cases have to do with the contract, collections, sureties / sureties, insurance and exchange.

For instance, the interest rate risk; the risk derived from the exposure of financial income or expense to adverse movements in interest rates that may result in an increase in the expected net financial expense and the exposure of other non-financial income or expenses to adverse movements in interest rates that may result in a lower net profit.

Also, the exposure of the price or fair value of fixed rate debt to adverse movements in interest rates that may mean a cost of debt above the market, and consequently a higher latent value and the movements in the cost of debt may arise from the market situation (interest rates) and or variations in the credit quality (rating), which will result in an increase in the financial expense through the margin of financing operations.

Another type or financial risk is the exchange rate risk or the risk derived from the fluctuations, against the currency of accounting, of the currency parities in which they are implemented for instance, the debts, which can affect the cost of servicing the debt. Likewise, charges and payments for supplies, services or investments, which may have an impact on income and operating expenses; income and expenses that, in other countries, are linked to the evolution of a foreign currency in relation to the functional currency may result in a lower operating margin and, consequently, a lower net profit.

Finally, the credit risk which is the risk derived from the exposure of the financial creditor positions to the credit quality situation of the counterparts of the same, which may eventually result in a breach of their financial obligations and liquidity risk; the risk arising from exposure to adverse situations in debt or capital markets that hinders or prevents coverage of the financial needs that are required for the proper development of activities (Ramón Cidón, 2016).

10.4. Technological risks

In some cases, the production facilities generate an average performance lower than expected, resulting in the need to invest in technologies ahead of time. In the case of technological risks, we refer to the instruments used for the exploitation of the good in question. When the use of a certain instrument affects and prevents the maximum production of the object object of the project, the technological risk is configured. This type of risk is usually handled from the beginning of the project, when the state entity establishes, in terms of conditions, the requirements that must be met by the equipment and instruments to be used in the project operation phase. However, in the absence of foresight in that first phase, the licensee or licensee must report on the most appropriate technology for the execution and exploitation of the good, avoiding controversy and affecting the projected profitability.

The insurance companies do not offer coverage for this type of technological risks, as they are attributed to a lack of diligence on the part of those in charge of executing the project (LC Arias Barrera, 2012).

10.5. Political risks

It is based in the possibilities of damages/losses produced by specific government actions focused against a company, project, social turmoil, etc. Related to administrative sense there are possibilities of increasing the restrictions to foreign companies in a country due to interventions, generally not specific, of the authorities. The sovereign risk is based in a degree of uncertainty that arises when buying financial assets issued by entities of a foreign country or granting loans to residents of it. Being the State the guarantor, it can refuse to the payment by sovereignty reason and transference, that arises when the debtor is a private company and cannot access to the necessary currencies to make the payments (Ramón Cidón, 2016).

10.6. Risk related to revenues, costs, and initial investment

Related to revenues, in any solar energy generation project, the collection of resources depends mainly on the price linked to the sale of electricity. Usually, the uncertainty in revenue lies in volatility that normally has the price of electricity. With regard to the risk of production, in the case of photovoltaic plants, the resources depend on solar energy and if the production is not enough it will affect our forecast. Also conditioned by the demand that it is linked by the price set in the market, so this factors are closely linked.

Construction costs are the largest investment in the project, so the risks associated with these costs are the most feared by creditors. There is a need to increase financial resources in order to manage with an increase in construction costs. Increasing the degree of leverage of the project, which provoke a higher debt and increasing the own capital implies a loss of profitability.

11. METHODS TO MITIGATE DIFFERRENT RISKS

Once the risks have been identified, is important to set actions and strategies to be decided and defined, also is time to follow them and establish a control. Monitoring and risk control of the project is an essential part of the project manager, due to one of the main causes of failure of these projects are the risks, particularly those not identified and not managed.

Technical guarantee	Sufficient documentary support for banks (prepared by independent technicians, if deemed appropriate) will be necessary for plant design, wind analysis, wind turbine technology, etc.
Construction	During the construction period and regardless of the guarantees of the different construction contracts of the park, SET, connection, etc., which will be transferred to the banking syndicate, the shareholders, by means of Bank Guarantee, will guarantee banks jointly the risks of cost overruns, Delay in construction, and abandonment of the project. This guarantee will be in force until the Final Act of Starting the Plant.
Insurance	Necessary usual insurances, satisfactory for the banks, within the limits established and with the first-class insurance companies
Coverage of the principal debt	The Financial Entities will require a base case that reflects a minimum Debt Service annual coverage ratio of 1.05 in the operating period and a project average of at least 1.10.
Guarantee of functioning of the plant	A maintenance contract of the plant must be signed so that it satisfactorily covers this end, in accordance with the Base Case, to the satisfaction of the parties
Working Capital	Provision of an unavailable reserve account of the Debt Service (Reserve Fund), which at all times, from its total endowment, shall cover half of the quota (principal and interest) corresponding to the following annuity.

Limits on the dividend	In order to carry out the distribution of dividends, each and every one of the following conditions must be met: -DSCR annual greater than 1.05 -FRSD fully endowed -The first installment of credit has been amortized - That there has been no breach of obligations in any of the contracts related to the project.

1.16. Table: Mitigation of risk, resume for the project. Source: Adapted from María José García López.

11.1. Mitigation in the operation stage

Previously we have talked about the risks linked to the operating stage of the project, related to them there are several ways or methods to mitigate them. In case of the risk are involved with the inefficiency or with interruptions during the operating, It is important to establish a performance and maintenance guarantees and initial operating support from partners.
Relating with shortage it is important to set supply contract with guarantees and closet prices, and in case of extra charges, to establish O&M contracts with reviewable prices.
Also market risks, insolvency risk and force majeure risks are linked with risk that can affect income flow and operating cost. For the market risks, it is essential to set in advance signature of contractual agreements of demand guarantee, both in volume and in prices. Moreover, "take or pay" and other clauses. For insolvency risks a risk analysis by funders in necessary and caution policies and for force majeure risk to consider insurance policies.

11.2. Mitigation in the construction stage

In case of the construction, for instance if the main risk were the calendar days, there are penalties scheme and renegotiation clauses. The cost excesses can be mitigated with "turn-key" and "closet price" contract. A "turn-key" contract is based in those engineering works where engineers and builders are the same entity, leaving in only two the number of agents, the promoter and agent being involved in the work. It is usually when the developer receives the infrastructure already in operation without having to perform bureaucracy or other formalities, often already has up to the assigned maintenance.

11.3. Mitigation in the financial risk

In case of mitigating interest rate risk, as we have used in this project it is necessary the used o Swaps, Floors or Collars. A swap is a contract whereby two parties agree to exchange a number of amounts of money at future dates. Usually future money exchanges are referenced to interest rates, called the Interest Rate Swap (IRS). Related to currency rate, and depending on currency there are financial hedge with derivatives. If the risk is linked to default risk, there is a need to contract an insurance and to set ratings.

11.4. Mitigation in technological risks

In case of technological problems, the most logical solution to avoid this risk is to hire technical qualificated builder and supplementary guarantees. Sufficient documentary support for banks (prepared by independent technicians, if deemed appropriate) will be necessary for plant design, wind analysis, wind turbine technology, etc... (Ramón Cidón, 2016).

11.5. Mitigation of political risks

In case of country risk, there are rating agencies and insurance called ECAs. Export Credit Agencies, are public agencies and entities that offer government-backed loans, insurances and guarantees to companies of their own country that are searching to focus their business in developing countries and emerging markets. Currently, ECAs are the biggest type of public finance institutions that operates internationally. Jointly they have exceeded the dimension of the WBG. Here in Spain, we have CESCE as ECA. In relation with legislation, there are commitments of the authorities and multilateral institutions as BEI or BERD. And finally, in case of expropriation, there is necessary an insurance (BBVA, 2016).

12. CONCLUSIONS

Firstly, the first variable to take into account when financing a photovoltaic plant is the location and how the power plant it is connected to the grid. In this case, we have chosen an ideal location for producing solar energy, in the south of Spain, in Malaga and that it is really close to the grid.

In relation with o the economic model, it includes cash flow forecasts for the 20 years of useful life of the plant and it has been modelled, Capex and Opex cost, variation of the electricity price and forecast of the hours of production

The results of the model allow to calculate the net present value and the debt coverage ratio to establish the solvency level. The results have been very favourable for the base case, which the final conclusion is based on the fact that the Project is profitable, generates income and is financially solvent. Personally I would like to give importance to the fact that subsidies for this type of renewable energy is scarce.

In the sensitivity analysis it has been observed that, as a general rule, the Project has been profitable except in the case of a strong reduction of the electricity price directly affects revenues, causing a significant reduction in cash flows that is finally reflected in the IRR and in the NPV.

After the financial economic analysis, we have identified the risk related to the project, and set actions and strategies to mitigate the negative effect of these ones. Monitoring and risk control of the project is an essential part of the project

I would like to emphasize that PV projects have economic advantages, as it has been proved with the financial and environmental model, so I believe it is an energy that should receive more support from public institutions. If it is important to note that perhaps other energies such as hydraulics or biomass have more support but many times, the construction of these is much more expensive given the materials and connections you need.

13. REFERENCES

13.1. Books and articles

- Brealey, R.A.,Myers, S. *Principles of corporate finance, 7th edition.* 2003.
- Casanovas Martínez, Tomás. *Project Finance Internacional: Una manera ganadora, inteligente y eficaz de financiar un proyecto de inversión.* 2016.
- Cidón, Martínez Ramón. *Project Finance.* ,2016.
- Del Carpio G, Javier F. *Financiamiento de proyectos (Project Finance)*. 2014.
- Delmon, J. *Project finance, BOT projects and risk*. 2005.
- Espejo Martín, Cayetano. *La energía solar fotovoltaica en España.* 2004.
- Fight, Andrew*. Introduction to Project Finance.* 2005.
- García López, María José. Serrano Serrano, Samuel. *Project Finance*. 2005.
- Gatti, Stefano. *Project Finance in Theory and Practice: Designing, Structuring, and Financing private and public projects.* 2013.
- González Torrijos, Jesús. *La financiación de la colaboración público - privada: El «Project Finance».* 2006.
- Méndez Muñiz, Javier María. Cuervo García, Rafael. *Energía solar fotovoltaica*. 2006.
- Morrison, Rod. *The principles of Project Finance*. 2016.
- Pérez de Herrasti y de Goyeneche, Ignacio. *Project finance: inversión en proyectos autofinanciados.* 1997.
- Yescombe, E. R. *Principles of Project Finance.* 2002.

13.2. Links

- Agencía Andaluza de la Energía, Revision date in 2017. Consulted date in May, 2017. Available in: https://www.agenciaandaluzadelaenergia.es/.
- Bankinter. *Previsión del IPC en España para 2017 y 2018.* Revision date in 2017. Consulted date in April, 2017.
- BBVA. Revision date in 2017. Consulted date in June, 2017. Available in: https://www.bbva.com/es/que-es-el-hedging-o-cobertura/.
- Deutsche Bundesbank. Revision date in 2017. Consulted date in April, 2017. Available in:https://www.bundesbank.de/Redaktion/EN/Glossareintraege/S/special_purpose_vehicle.html
- EOI. Revision date in 2017. Consulted date in June, 2017. Available in: https://www.eoi.es/es/file/17379/download?token=bsMvy6UA.
- European Comission. Revision date in 2017. Consulted date in May, 2017. Available in: http://re.jrc.ec.europa.eu/pvgis/apps4/PVcalc.php.
- European Commission. Revision date in 2017. Consulted date in May, 2017. Available in: https://ec.europa.eu/clima/policies/strategies/2030_es.
- Global and Planetary Change Journal. Revision date in 2016. Consulted date in April, 2017. Available in: https://www.journals.elsevier.com/global-and-planetary-change/.
- Global Negotiator. Revision date in 2017. Consulted date in April, 2017. Available in: http://www.globalnegotiator.com/international-trade/dictionary/country-risk/.
- IDAE. Instituto para la Diversificación y Ahorro de la Energía. Revision date in 2017. Consulted date in April, 2017. Available in: http://www.idae.es/.
- International Energy Agency. Revision date in 2017. Consulted date in May, 2017. Available in: https://www.iea.org/.
- Market Business News. Revision date in 2017. Consulted date in April, 2017. Available in: http://marketbusinessnews.com/financial-glossary/market-risk/.

- OMIP. The Iberian Energy Derivatives exchange. Revision date in 2017. Consulted date in June, 2017. Available in: http://www.omip.pt/.
- REN21. Renewables 2016 Global Status Report. Revision date in 2017. Consulted date in May, 2017. Available in: http://www.ren21.net/status-of-renewables/global-status-report/.
- UNEF. Revision date in 2017. Consulted date in April, 2017. Available in: http://unef.es/legislacion-fotovoltaica/.