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Risk management in non-financial companies: An application in a Brazilian wind farm project

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Summary

1. Introduction

In a project analysis or valuation, the financial analyst should take into account the intrinsic risk business to find out how likely the success of this project is, given the chosen assumptions in the analysis. But, if in his analyses the financial analyst often uses a deterministic approach, how secure is he to say that the project results will be successful in the future? Or could he answer what are the assumptions that can most impact the outcome that the investor is expecting? Probably not!

However, if the financial analyst uses a different approach in his analyses, for instance, using stochastic tools to study the intrinsic risk in the business that he is concerned about, perhaps he will be able to answer those questions.

Through the analysis of the cash flow of a given project – in this paper a wind project hypothetically invested will be used – this “different” approach, the Cash Flow At Risk – CfaR method, will allow the investor analyst or a company to evaluate more efficiently the probability distribution of the return (success) established by the deterministic analysis of the project.

Furthermore, this paper will review the main risk management methods established by the market, such as Value at Risk and VaR and CFaR, and analyze the results obtained by the application of the CFaR model to the hypothetical wind project mentioned.

During last years, risk management has assumed significant position as a priority of businesses concerns, especially in the case of financial firms. Moreover, recently, the theme has also become part of the concerns at non-financial sectors. It has happened due to the fact that companies are dealing with more risky environment with volatile economies and indicators, greater regulation by governments in countries and economies. For this reason the practice of managing risks has been developing considerably over the years, which allows companies less accustomed to instruments of risk management, such as non-financial companies, to find tools that identify the risk factors and quantify its impacts in their business.

Furthermore, since the first privatization processes has begun, in the mid '90s, Brazil has adopted systematically the model of public service concession for private and public investments in infrastructure projects, particularly, in power generation.

This kind of concession model is very competitive. Due to this reason, the investor needs to be more careful in their risk analyses. Mainly because the bids proposed by the Brazilian government requires large investments in the short-run and gives a return and payback, quite often, in the long-run. Thus the decision about risk assumptions must be accurate.

Consequently, in order to set the correct and accurate decision in the Brazilian bids, or in any investment, the investor should have, as a concern, addressing his efforts on the triad of factors where lies almost all risks: a) Revenue (in the paper example, energy available to sale); b) Capex (amount and project details) and c) Costs, expenses and taxes (Environmental costs, social costs, OPEX and taxes structure).

Such factors are, routinely, analyzed by studying and modeling a project cash flow. If it is possible to find out for each one of those factors an associated risk, then, that economic and financial equation must present considerable volatility. Therefore, the understanding of such variation or volatility is crucial to the decision making of the investor with respect to the economic and financial feasibility of a given project.

The objective of this paper is to give an example of using a risk analysis tool for risk management in non-financial companies. This tool, the Cash Flow at Risk – CfaR, will be used to evaluate, synthetically, the business risks and, finally, to carry out a simulation on a hypothetical wind energy project to analyze its outcomes.

The paper justification lies in the fact that is unusual, actually, in Brazil, find out non-financial companies using stochastic risk control approaches for measuring their projects or investments risks. Especially in the Brazilian Power Sector, where, as a rule, high-risk investments and capital-intensive are performed, such metrics are seldom used, and due to this fact, to reach an adoption of stochastic risk management tools in these companies and improve the risk management in their investments, the financial analysts must face the challenge to study, understanding and using such tools as CFaR.

Throughout the stochastic approach financial analysts will be able to understand what the inherent risks of the project are and their behavior. Doing this and estimating a safety margin for the project study, the investors can avoid huge mistakes and try to maximize their returns. So, they will have better conditions to decide where and when allocate their investments, optimizing their decisions.

2. Risk and Risk Measurement

Damodaran has defined risk, in a financial approach, thus: **“Risk in finance is defined in terms of variability of actual returns on an investment around an expected return, even when those returns represent positive outcomes”** (Damodaran, 2008)

Every economic activity has a risk versus return itself that can be caused by one or more risk factors. Knowing the risk-return ratio is a condition without which it is not possible to obtain a good performance in a competitive environment. Therefore, it is reasonable that the most competitive agent in such an environment is one that has better knowledge about the risk factors and also the best condition to model them.

Nowadays, achieve success in run a business, is not possible without know and study the risk factors involved in that business. However, it is also impractical to study anything that poses a risk to the business. So, due to this reason, synthetically, risk management is based on knowing what the risks are actually relevant to business and study them enough to be able to model them desirably. It means, in order to quantify what is the risks interference in the return. Finally, we can find an efficient tool to mitigate them.

According to La Rocque and Lowenkron: **"it is possible to classify the corporate risk as a) business risk (demand, marketing, technological risk), b) event risk (legal, reputation, regulatory) and c) financial risks (operational, liquidity, credit, market).** (Lowenkron, 2004)

However, the metrics of VaR and CFaR are associated with the financial risk measurement in financial and non-financial companies, respectively. Historically, we would say that with the evolution the stock markets and investor significant losses in sophisticated operations almost “forced” the financial industry and its participants try to find out, somewhat, which is an asset potential exposure to a certain risk. It happened in both financial and non-financial companies.

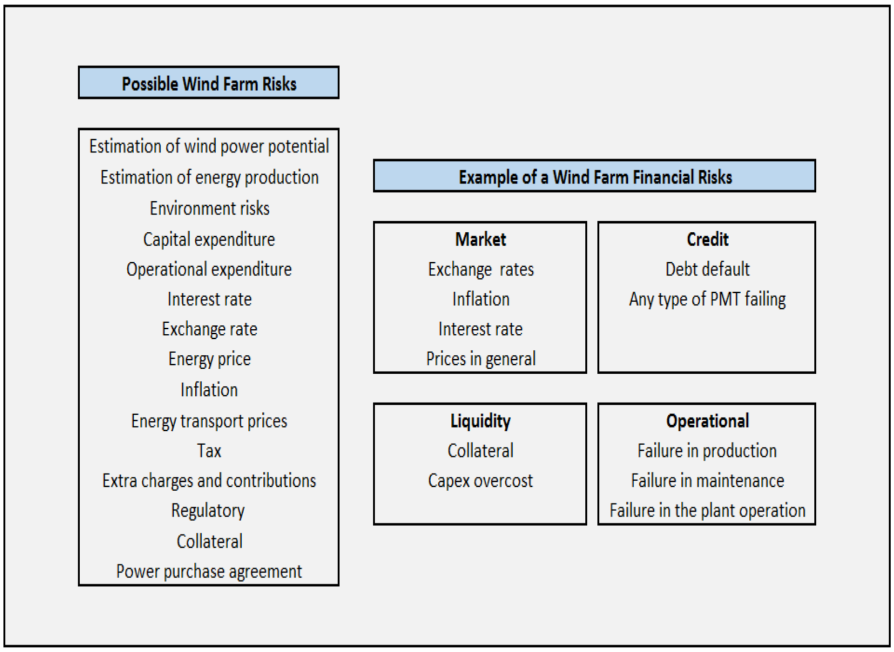
Although the paper does stick only to financial risks, and it is important to introduce them, since they are necessary for the explanation of the concept of

Value at Risk – VaR. Thus,the financial risks faced by financial and non-financial companies are: market risk, credit risk, liquidity risk and operational risk.

Briefly, we would say that the **a) Market risk** is the risk of financial loss on a financial instrument associated with fluctuations in prices and rates prevailing in the market; **b) Credit risk** is the risk of the lender does not receive the principal and interest of any loan made, for instance, when there is a transaction between two parties, there is always a probability that the lender does not receive expected cash flow, this uncertainty is called risk credit; **c) Liquidity risk is**, in practice, the risk of a company or even a person cannot turn into cash assets or money owned to deal with obligations or disbursements required; Finally, **d) Operational risk** is directly related to the risk of errors / failures of the daily operations of the company.

Willing to link these concepts with the risks of a real wind farm project, below is listed, briefly, some risks normally found in this kind of projects:

Figure 1: General Risks in a Wind Farm Project



2.1 Value at Risk

Financial institutions operate their positions betting on the behavior of a variety of economic variables. This whole financial market dynamics greatly motivated several studies on risk that eventually culminated in the creation of value at risk, reported as risk measurement in 1994 by JP Morgan tool.

According to Jorion: "Value at Risk - VaR summarizes the worst expected loss greater or within a certain period of time and confidence". (Jorion, 1997)

The time period used is one that normally would take to dispose of a certain financial position and the confidence interval represents the maximum percentage of events that overcome the value to a risk that correspond to the confidence interval chosen.

To understand how the VaR is estimated, it is necessary to know the process of four steps used in its calculation: i) Determine the time horizon over which it is required to estimate the potential loss; ii) Select the required degree of certainty that is, the confidence interval for the estimate; iii) Create a probability distribution for the desired instrument or portfolio returns under consideration; 4- Finally, to read the solution, the estimated VaR. So that the end of the process the VaR is able to translate the financial risk of any investment in a single language or pattern: The potential loss.

The implementation of VaR is no longer as simple and easy as the concept, as there are some ways to get the expected potential loss of an asset at a certain period of time, given a confidence interval. The three most commonly used methods for calculating VaR are: Historical, Parametric and Monte Carlo simulation. Each has its peculiarity and are more or less indicated according to the assets at risk that are being analyzed.

However, as the aim of this paper is not explore the VaR conceptually, we will not abide to these methods and therefore we will not detail them.

2.2 Cash Flow at Risk

According Nunes (apud Samanez, 2006) cash flow "summarizes inputs and actual outputs of money over time, allowing to know the profitability and economic viability of the project. Thus, the cash flows represent the economic rent generated by the project over its useful life. " (Nunes, 2009)

The measurement of a cash flow can be used for many reasons. Among then, we can evaluate the state or performance of a company or project, also to determine liquidity problems of a company or project, to find out return rates of investment, project or companies, whenever the accounting results cannot represent the economic reality of business, company or project analyzed.

In summary, any cash flow is able to show the operating, investment and financing activities of a company or project. If these activities are not balanced on the point of time from a financial standpoint, there is a risk of investments being postponed, growth of operations being jeopardized and even at risk of bankruptcy. Finally, the cash flow is also used for analysis of liquidity and profitability and is widely used, as will be shown later, to determine the value of investment in a project or a company - Investment Valuation.

Taking all was mentioned above it is possible to understand the significance of cash flow and its applications, then it’s become clear the reasons why cash flow is one of the most important metrics to be analyzed in corporate risk management.

Therefore, to address the company's need to quantify the impact of risk factors on cash flow, Corporate Metrics defines the Following measures of cash flow volatility as the "Cash-Flow-at-Risk (CFaR): The maximum shortfall of net cash generated, relative to the specific target, That could be experienced due to the impact of market risk on a specified set of exposures, for the specified reporting period and confidence level." (Lee, 1999).

In this definition we note that CFaR is defined as a relative risk measure, with risk being measured relatively to a target level of cash flow. A target level for future cash flow can be estimating by first constructing a pro forma statement of cash flows (or a determistic cash flows, a procedure which companies using in their planning process and often for investment valuation). With a cash flow forecast model in place, a target level of cash flow can be calculated by applying budget rates, spot rates, forward rates, or whatever market rates and prices are deemed appropriate by a company, to the anticipated operating, investing, and financing activities for the period.

2.2.1 Risk Exposure Mapping and Scenario Generation

The risk exposure mapping is the next step once the risk measure - CFaR - was chosen. This process of risk exposure mapping can be defined as the process of identifying how fluctuations in costs and prices (i.e. the risk factors or random variables) affect the aftermath of a given project.

The mapping process is unique to each situation analyzed. The relationships between the variables and the financial results can take several forms, for this reason, several models can be applied, from the most basic and linear model to the most and complex econometric models.

When analyzing exposure to multiple risk factors, it is common to combine various mappings into a single. The financial statements, for example, are good ways to create maps of risk exposure that can make clear perception of how different inputs affect the projected outcome. However, with all of this information available, the challenge for the analyst is build a cash flow forecast as precisely as possible. To do that, the analyst need to realize how much this precision can be costly in terms of complexity (regression analysis, econometric models) and time spent (many historical data to be analyzed). Therefore, the analyst also should keep in mind if an extremely reliable and accurate model is his best choice comparing with all of burden generated by the great time spent in analyzing the data and designing the complex model.

After the risk exposure mapping, build scenarios for the random variables mapping is needed. This process is very important because it is what enables the analyst to know the frequency distribution associated with a result considered for the project analyzed.

In order to generate scenarios, is necessary to specify the probability distributions of each of the random variables at different time horizons and, from there, to carry out sampling for each distribution, so that each simulated scenario is a trajectory over the time for one or more random variables, leaving the analyst to choose the one that suits better for the analysis in question.

Nowadays, in the literature there is no consensus on the best method for determining the probability distributions for each of the random variables. The interesting thing is that the analyst himself knows the variable under consideration or he would be supported by some expert in this type of information, which enables the best treatment to the dataset that is available for the determination of the probability distribution of a given random variable.

2.2.1 Risk Measuring and Risk Assessment

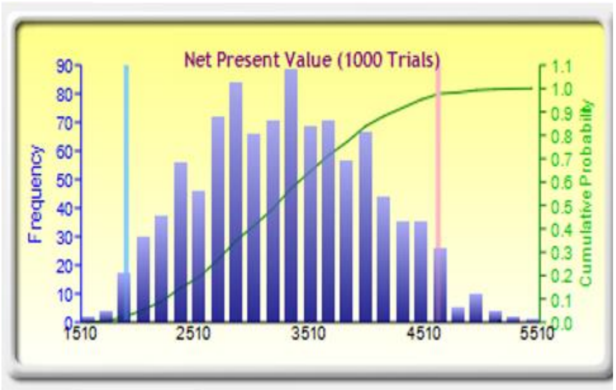
The risk assessment is simply the evaluation of financial tool to create a distribution of financial results from the exposure maps and the various market rates scenarios.

Risk measurement refers to the calculation of risk measures – CFAR in this case - of distributions of financial results, with both related and linked to the processes previously shown.

In the risk assessment process, the idea is to redo the calculation of financial results or any of its components, whether profit or cash flow, as a function of the process of exposure mapping for each of the scenarios designed for the purpose of projecting financial results. Thus through the knowledge of several possible values for the metric (i.e. cash flow) to be analyzed, generated through various scenarios, it is possible to generate a probability distribution of this chosen metric.

Figure 2 below illustrates a hypothetical situation of a distribution of discounted cash flows. From there the analyst will take all the necessary information to do his analysis.

Figure 2: A sample of a discounted cash flows distribution



Source: Software Risk Simulator

3. Investment Valuation

The presentation of some methods of investment evaluation aims to legitimize the choice of the discounted cash flow as the best choice to value an investment. Generally, the construction of wind farms follows the pattern of the current power sector from the country in which a project is built. However, it appears clearly that each country has a specific model for its electricity sector that meets their needs and peculiarities. However, usually, infrastructure projects, including in power sector, has common features such as intensive capital investments, long-term maturity, reasonable level of intrinsic business risk, and at least some level of regulation. (Lee, 1999)

According to Gitman: **"Once the long-term investments represent significant disbursements of equity that require the company to follow a certain course of action, some procedures are needed to analyze and select them properly"** (Gitman, 1997). As selection and decision procedure, Gitman defines the capital budget, as **"the process of evaluating and selecting long-term investments that are consistent with the company's objective of maximizing the wealth of their owners."** (Gitman, 1997). Also according Gitman: **“the evaluation process of the capital budget has five steps: a) Generation of Proposals, b) Evaluation and Analysis, c) Decision Making, d) Implementation e) Monitoring”** (Gitman, 1997). In this paper, only efforts in evaluating and analyzing step will be focused.

Finally, The Gitman understanding on investment evaluation is: "Evaluation is the process that links risk and return to determine the value of an investment / asset. It is a relatively simple process that can be applied to determine the value of an asset at a given moment in time (Gitman, 1997)”. However, other alternatives for determining the value of an asset or investment exist and may be widely used. Its because, the financial analysts have found in their routine a range of options other than the evaluation to try to measure or determine the value of an asset or investment, such as the performance measures of an asset that can be measured by profit margin, return on invested capital the economic value added among others.

Besides these alternatives described above, other basic methodologies that are fairly widespread in the market besides the NPV for asset valuation, which will also be presented here. They are: PB - Payback, PBD - Discounted Payback and IRR - Internal Rate of Return.

3.1 PB – Pay Back

According to Ross et al: "One of the most popular alternatives to the NPV criterion is the payback period." (Ross, 2002). This methodology indicates the number of periods (months and years, for example) that will be needed to recover the investment originally made in a project. Thus, the best project will be the one that have the shorter payback period calculated as:

Payback Period = Cost of Project / Annual Cash Inflows

Also according ROSS et al: "The payback period criterion in making investment decisions on projects is simple" (Ross, 2002). However, we can figure out some problems in this methodology. Among the problems we would say that the major is to ignore the distribution of project cash flows, as noted by GITMAN: "It is an unsophisticated capital budgeting technique, since it does not explicitly consider the value of money over time" (Gitman, 1997).

Table 1: Payback Periods for Projects A, B and C:

Year	Project A	Project B	Project C
0	-35000	-40000	-40000
1	5000	10000	9000
2	10000	10000	9000
3	12000	10000	9000
4	13000	10000	12000
5	13000	13000	12000
PB	3,6	4,0	4,1

Hypothetically, if a company would consider all projects with PB under 5 years as good projects, all three projects listed above would be accepted. However, if that same company rather would consider the smaller PB as the only choice, the best from this point of view will be Project A.

3.2 DPB – Discounted Pay Back

The method of discounted payback is a variation of the previous methodology. According to Ross et al: "... This approach initially discounted the cash flows. Then we wonder how long it takes for that discounted cash flows are equal to the initial investment " (Ross, 2002). Basically, a discounted payback period gives the number of years it takes to break even from undertaking the initial expenditure. Future cash flows are considered are discounted to time "zero." This procedure is similar to a payback period; however, the payback period only measure how long it takes for the initial cash outflow to be paid back, ignoring the time value of money.

At first glance, the focus of the discounted payback period seems to be a good alternative for evaluating projects, however, a more careful examination of the methodology reveals that this alternative has the same basic deficiencies that the previous, as well as the same benefits, except the fact that, the fact that the discounted payback period considers the time value of the money.

Below is an example of applying the methodology of "DPB" in the evaluation of projects with the same three projects (A, B and C):

Table 2: Discounted Payback Periods for Projects A, B and C:

Year	Project A	Project B	Project C
0	-35000	-40000	-40000
1	5000	10000	9000
2	10000	10000	9000
3	12000	10000	9000
4	13000	10000	12000
5	13000	13000	12000

DR	11%	9%	7,0%
PB	4,65	4,90	4,84

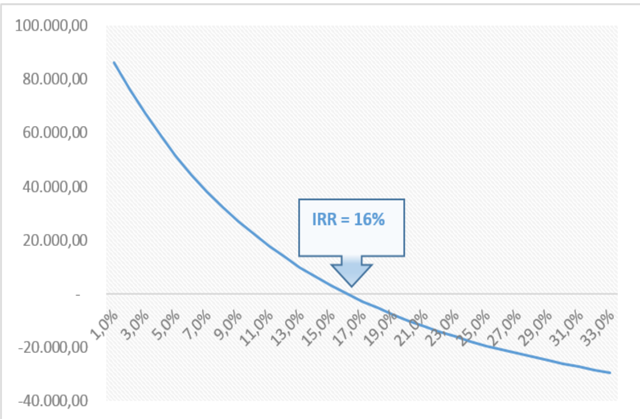
Once again, hypothetically, if the same company quoted above, consider all projects with attractive PBD under 5, all three projects listed above would also be accepted. However, if that same company rather would consider again the smaller DPB as the only choice, the best from this point of view is still the Project A.

3.3 IRR – Internal Rate of Return

The methodology of the IRR is a very widespread technique in the market for investment appraisal. It is an indicator widely accepted and one of the most used as decision parameter.

Gitman defines the IRR as: "... the discount rate that equates the present value of cash flows to the initial investment value referring to a project. The IRR, in other words, is the discount rate that makes the NPV of an investment into zero" (Gitman, 1997). Below a figure that represents the statement about the concept of IRR:

Figure 3: Internal Rate of Return:



ROSS et al also note that: "the basic rationale behind the IRR is that it seeks a single figure to synthesize the merits of a project. This figure is independent of what happens in the capital market. That is why it is called internal rate of return; the figure is internal or intrinsic to the project, depending only on its cash flows " (Ross, 2002).

Thus, based on which was presented, the application of IRR in the evaluation of projects or investment opportunities becomes simple. If a company come across an investment opportunity where its IRR is equal to 15%, the company should accept or reject (it means that in this situation the project or the investment will be indifferent for the investor) the project if the hurdle rate or the risk that firm for the project is equal or below to the IRR, i.e., 15%. On the other hand, if the hurdle rate is greater than the IRR, for example 20%, it will be rejected, and finally, if the hurdle rate is less than the IRR, e.g. 10%, it will be accepted.

Finally, it must be said that there are some problems in the application of the IRR approach to project or investment evaluation. For example, when a cash flow is not standard, have more than one signal inversion, there may be more than one or multiple IRR, for example, IRRs 10% and 20%. As can be found in Ross et al: "In a case like this, use the IRR does not make sense. Which IRR must be used, 10% or 20%? Since there is no good reason to choose one or another, the IRR simply cannot be used" (Ross, 2002). Furthermore, the application of the IRR approach for two mutually exclusive projects together has some nuances that must be observed. Well, not always the project with the highest IRR has the higher value or higher NPV. For instance, when there are two mutually exclusive investment opportunities, once again according to Ross et al: "opportunity 1 - You receive $ 10 now and returns is $ 11 an hour later and opportunity 2 - You receive $ 1 and returns up $ 1.5 one hours later, in which one would be most appropriate to invest?" (Ross, 2002).

Based on the value of IRR any investor would choose the opportunity 2 since its value IRR (50%) is higher than the RIR opportunity 2 (10%). However, when one observes the generation of wealth or opportunity NPV of one ($ 1), it appears that the same is greater than the wealth creation opportunity of 2 ($ 0.5), making this choice is the best between the two opportunities.

To explain the previous paragraph we must say that the problem of IRR is lied on its inability to take in consideration the differences in scale. Although the opportunity 1 has higher IRR, the total investment is much lower. In other words, the high percentage of profitability in first opportunity is more than offset by the ability to, at least, get a reasonable return on a much larger investment opportunity in the second.

3.4 NPV – Net Present Value

As shown by Gitman: "Considering the time value of money, net present value is considered a sophisticated analysis technique of capital budgeting. This type of technique in one way or another, discounts the cash flows of a project (business or investment) at a specified rate. This rate, often called the discount rate, opportunity cost or cost of capital, refers to the minimum return that must be achieved by a project, business or investment ... " (Gitman, 1997).

The NPV can be obtained by separating the initial investment from the present value of the project cash flows, discounted at a rate equal to the capital cost of the project / company, as exemplified in the following equation:

$$NPV = \sum_{t=1}^{n} \frac{CFt}{(1+i)^t} - Initial\ Investment$$

Where:

CF = is the net cash flow expected to be generated each period;

t = is the tie of the cash flow;

I = is the required rate of return per period or hurdle rate or cost of capital;

n = are the number of periods during which the project is expected to operate and generate cash flows.

About the advantages that the NPV method relative to other methods, in ROSS et al we can see that the advantages make the method of higher NPV rely on three attributes: “1-The NPV uses cash flows (the cash flows represent wealth generation by the company or project, as opposed to accounting profits), 2- the NPV uses all the cash flows from the project (other approaches ignore flows beyond a certain date) and 3- the NPV discounts the cash flows correctly (since it considers the time value of money)" (Ross, 2002).

For this paper, it is believed that the NPV method is the best method for evaluating projects / investment, for this reason it will be the dependent variable being sought in the CFaR exercise. However, we tried to show above some alternative methods, which are still widely used, to prove that the NPV is really the most appropriate method to be used in our project analyses.

4. Brazilian Power Sector and Wind plants Bid

This chapter is written in order to give an idea of the Brazilian Power Sector – BPS - structure and how most wind plants are inserted in this structure by government bids. Other business models for wind plants may also exist (e.g. merchant plants) but they are much less common at least for the time being.

4.1 Structure of Brazilian Power Sector

The BPS is characterized as a system composed primarily of four segments, Generation, Transmission, Distribution and Energy Marketing. They act in a complementary manner by providing conditions for the operation of the entire system. Another relevant feature of the BPS is the coexistence of two systems of marketing – Ambiente de Contratação Livre (ACL) or Free Market and Ambiente de Contratação Regulada (ACR) or regulated market. The free market led to new agents who work in the industry actually: energy marketers, special and free consumers (who can freely negotiate the price and terms of the supply contract).

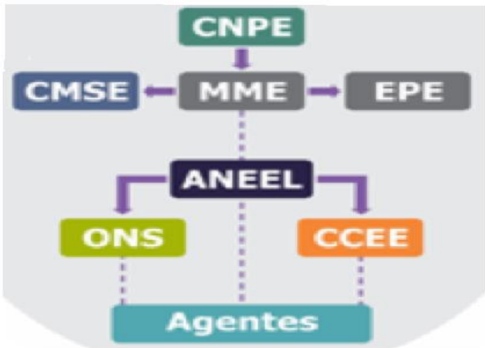
The BPS presents as major entities that operate and regulate the sector itself the institutions below:

- CNPE - Conselho Nacional de Política Energética: responsible for approval of energy policy, in conjunction with other public policies;
- MME – Responsible for formulating and implementing policies for the energy sector, according to the guidelines of CNPE;
- EPE – Responsible for the execution of studies to define the energy matrix and planning of the electric power sector (G and T only);
- CMSE – Comitê de Monitoramento do Setor Elétrico – Responsible for monitoring the conditions of service and recommending preventive measures to ensure security of energy supply;
- ANEEL – Agência Nacional de Energia Elétrica – Responsible for the regulation and supervision of all agents, ensuring the quality of services,

and the establishment of tariffs for all consumers, also works to preserving the economic and financial feasibility of the agents;

- ONS – Operador Nacional do Sistema: Responsible for the coordination and control of the operation of power generation and transmission in the interconnected power system;
- CCEE – Câmara de Comercialização de Energia Elétrica: Responsible for the administration and accounting of contracts, settlement of short-term market, in addition to energy auctions.

Figure 4: Brazilian Power Sector Organization Chart:



Source: Operador Nacional do Sistema – ONS

4.2 Recent History and Changes

The BPS began to be restructured from the mid-1990s and even today continues to evolve, a fact that is evident by the series of reforms that followed from the initial milestone with the publication of Law No. 8,631 / 93, to the present year 2014 with the enactment of Provisional Measure 579/2012 which later became Law 12783/2013. All these reforms aim to establish and consolidate the model began to be proposed in 1993.

The current model was developed with the goal of promoting affordable tariffs, reliable and secure energy supply, and the search for regulatory stability and promotion social inclusion through universal provision. These goals were intended to create the necessary conditions for attracting private capital for expansion of the sector, in contrast to the previous model, underpinned almost exclusively on public investment. It is noteworthy that there were two major regulatory milestones, the first in 1995 and second in 2004.

The former model, that was establish from the 1950s until 1995, was based on federal funding, which captured its resources externally via external debt in the financial market, with multilateral funding external bodies, besides self-funding through tariff adjustment. In this model all segments were government-owned, state-level the distribution companies and generation companies at the federal level, being the holding of the system, the Eletrobrás S.A. In that model, Eletrobrás was responsible for planning, financing and operation of the electrical system. The restructuring of the current model at the time was pressing, given the budget constraints of governments at state and federal levels that restrict their ability to invest.

Economic conditions of the mid-1990s were an urgent need for investment in the sector: due to heating of the economy caused by the Real Plan and the consequent increase in demand for energy in this period. Coupled with the depletion of generation capacity of existing plants and especially the needed capacity expansion and investments to maintain the system and ensure its reliability.

In 2004 the Law 10.848 and Decree 5.163, provided the legal framework for the implementation of the so new framework, which from the foregoing principles, sought to attract investment for expansion in order to reduce the risk of supply and system reliability without sacrificing low tariffs and resuming the strategic long-term planning. Both mentioned law and decree also created the EPE - Empresa de Pesquisa Energética and CMSE – Comitê de Monitoramento do Setor Elétrico, and these institutions would help the MME – Ministério de Minas e Energia to exercise its function of sectorial planner.

The 2004 legal framework would be operationalized through long-term contracts through public auction/bid, providing the market with stable long-term earnings that would mitigate the risk of market entrepreneurs. Another factor of stability auction was made possible by the ability to raise financing in the form of Project Finance, consequently the predictability of positive cash flows in a long-term horizon. Public banks as Banco Nacional do Desenvolvimento Econômico e Social - BNDES would provide credit lines that could be used in this type of funding.

Moreover, the return of long-term planning was critical to the success of the new model, this role recovered by MME to resume the function of planning the expansion of energy supply, adjusting it to the demand. Distribution companies should design their demand based on such projection, buy energy in the auctions/bids 100% based the total informed. And on the supply side, generation companies should present their respective amounts of assured energy to supply the quantity sold at auction/bids. This model is meant to reduce the risk of oversupply or undersupply. The total demand from distribution companies should be operated in ACR - Regulated Contracting Environment, based on reverse auctions lowest price. ACL - Free Market would be responsible for the care of traders and free consumers and special consumers.

4.3 Wind Farm Auctions in Brazil

As mentioned above, there are two environments in the BPS to buy and sell energy, the so-called ACR and the so-called ACL. In the ACR the expansion of the generation is done through competitive bidding for lowest tariff, passed through the distributor’s tariffs and, based on their demand forecasts. This Power Purchase Agreement - PPA is named CCEAR (Contrato de Comercialização de Energia no Ambiente Regulado).

Regarding the ACR, we must say that the Decree 5.163, established in 2004, also set forth that the source of the energy necessary to meet the supply needs should come from auctions, and in these auctions are allowed to participated brown and green field projects. It is also appropriated to mention that the new energy auctions are designed to meet the demands of distributors are previously declared, and generally, those projects have not started their construction phase yet (in the green field projects cases).

Then, those auctions are called "A-5" and "A-3", it means that the projects bid in A-3 or A-5 auctions must be ready to operate and delivery energy up to three or five years, respectively, from the date of the closing date of the deal or, hypothetically, from the date of the auction. Still according to the Decree 5.163, the (CCEAR) may have the following forms: quantity of energy and availability of electricity.

In the ACR, the PPA can also be made directly with the CCEE, made with the purpose of providing security to the system through the auction reserve energy, in this case, the PPA is called CER (Contrato de Energia de Reserva);

In the ACL the expansion of the generation is done simply through bilateral contracts freely negotiated by the counterparts.

With regard to the auctions of wind farms in Brazil, following we will make a brief historical summary and explanation of existing bidding models.

The first wind power project constructed, in order to be connected to the grid in 2004, was contracted by PROINFA[1]. It was a government program that offered fixed prices (a kind of feed-in-tariff) for all energy generated and no penalty in terms of deviations occurred between the contracted amount and the real generation.

After the wind farms contracted by PROINFA, some unsuccessful attempts by the government to bid wind farms together with other projects based on different renewable sources (based on lower prices) in the same auction, the

[1] The **Programa de Incentivo às Fontes Alternativas de Energia Elétrica (Proinfa)** as described in Decree No. 5025, 2004 was established with the objective of increasing the share of electric power produced by projects based on renewable sources like wind, biomass and small hydro in the National Interconnected System (SIN). Source: http://www.mme.gov.br/programas/proinfa

Government itself did revise its strategy for wind projects. At that time the wind source was unable, due to high prices, to compete with the projects from biomass and small hydropower, for instance. Therefore no wind farm was commissioned in Alternative Sources Auction in June 2007 and Reserve Energy Auction August 2008.

From this period on, the MME chose to conduct a specific auction for the wind industry in 2009 in the Reserve Energy Auction (2nd LER – Leilão de Energia de Reserva) and since then the format of the auctions for wind power has been successful following the model of LER, LFA (Leilão de Fontes Alternativas) and LEN (Leilão de Energia Nova) Auctions. Below is a table showing all auctions made in Brazil for wind projects from 2009 to 2014 and some data about it:

Table 3: Brazilian Auctions for Wind Farm Projects – 2009 / 2014

Auctions Type	Date Year	PPA Units	Ceiling price BRL/MWh	Average Price BRL/MWh	Average discount %
2 LER	2009	71	189	148,329	21,5%
2 LFA	2010	50	167	134,456	19,5%
3 LER	2010	20	167	122,872	40,5%
12 LEN	2011	44	139	99,379	11,6%
4 LER	2011	34	146	98,920	32,2%
13 LEN	2011	39	112	105,526	5,8%
15 LEN	2012	10	112	87,977	21,4%
5 LER	2013	66	117	110,417	5,6%
17 LEN	2013	39	126	124,455	1,2%
18 LEN	2013	97	122	119,083	2,4%
19 LEN	2014	21	133	130,046	2,2%

Source: CCEE

5. ABC Wind Farm Project

In this chapter a case study of a wind farm – The ABC Wind Farm - project will be presented. Beyond that, an analysis of its deterministic cash flow will take place, and its results.

The location for ABC Wind Farm will be northeastern region in Brazil, in Rio Grande do Norte State, one of the best wind regions in Brazil and where we gathered some wind data from auction and plants already in operation from this location.

Figure 5: Wind Farm ABC Location:

Source: CEPEL\CRESESB

Due to the reason that in this paper we are not interested in technical issues, the project will be presented synthetically, it means, just presenting the group of information that we need to analyze the project from a financial perspective.

This project will be invested as a project finance structure. As defined by Borges: "Project finance is a form of engineering / financial collaboration contractually sustained by the cash flow of a project, serving as collateral to that all assets and receivables values over time for that project. " (Borges, 2002)

In the case of transactions within the modality of project finance (like in this study) the focus of the borrower credit area analysis is not only the guarantor, but also the enterprise itself. It happens because during the implementation period of the wind farm (pre-operational phase), the great responsible of the warranty is the corporate guarantee of special purpose company (SPC) - SPC sponsors, which, normally in Brazilian financing rules – basically designed by BNDES - can be supplemented or replaced by bank guarantee contracted by the SPE sponsors, as well as a possible equity support agreement signed by the sponsors too.

However, when the project proves to be able to carry on your duties by itself, it means that the project can guarantee payment of its debt service, the financing bank attests to completion of the project and the bail is cancelled. Thus, in the Wind Farm ABC, we will assume, for simplicity that the SPE sponsors are the solid companies A, B and C. All of them with maximum investment grade rating. Due to this fact the guarantee structure built seems good enough to the financing bank - BNDES.

The key data about the ABC Wind Farm project can be found on the table below and is detailed item-by-item immediately after the table:

Table 4: Wind Farm ABC Project Data

DATA	VALUE	UNIT
Investment	**180.000**	BRL x 1000
Equity	**54.000**	30%
Debt	**126.000**	70%
Loan		
Grace Period	**2,5**	years
Period	**20**	years
Rate	**2,4%**	% Per year (Real)
Concession period	**20**	**Years**
Pre-operational	*2*	Years
Operational	*18*	Years
Power Purchase Agreement		
Period	*18*	years
Price	*153,07*	BRL/MWh
Energy per year	*173.724,58*	MWh
Installed Capacity	**45**	MW
Capacity Factor	**0,47**	%
Taxes		
Pis	0,65	%
Cofins	3,00	%
IR	25,00	%
CSLL	9,00	%
Power sector fees		
ONS fee	18,45	BRL/Year x 1000
TUSd	1,5	BRL/Year x 1000
TFSEE	69,43	BRL/Year x 1000
CCEE	0,07	BRL/MWh
O&M		
3-20 years	3.150,00	BRL/Year x 1000

5.1 Project data

For the ABC Wind Farm the necessary investments for its implementation are below on the table that is summarizing the value of CAPEX:

Table 5: Wind Farm ABC Project CAPEX

Capital Expenditure	180.000	100%
Wind Turbine	126.000	70%
Civil Works	27.000	15%
Transmission conts	10.800	6%
Engeharia do proprietário	5.400	3%
Insurrance	5.400	3%
Others	5.400	3%

BRL x 1000

Loan: In much of the analysis of financing for wind farms, the Engineering, Procurement and Construction - EPC Company that will be responsible for implementing the project is already defined. So its EPC contract is generally signed before financing is approved. Thus, the project investments have already been negotiated with the EPC contractor and because of that the prediction of project spending is already relatively reliable, especially in cases where the hiring was done in the form of a fixed price contract – Lump Sum Turnkey Contract

Additionally, the standard of Project Finance also provides that the Operation and Maintenance contract for a project is supposed to be already signed, so the OPEX also already pre-defined, allowed a financial projection closer than it will be held in reality.

Furthermore, the loan assumptions for the ABC Wind Farm will be taken directly by BNDES. So, it means that the project will be exclusively financed by BNDES. In the case of direct operations like this operation concerns, the total interest rate of financing is composed of 3 parts, namely: a) Financial cost (Taxa de Juros de Longo Prazo - TJLP (TJLP, established by the National Monetary Council - CMN; b) BNDES commission (1.0% per annum); c) Credit risk (up to 4.18% per annum, as the credit risk of the customer), calculated by the credit department of BNDES.

As mentioned, the Wind Farm ABC SPE sponsors are the companies A, B and C, all of them BBB- investment grade rating (medium risk) and it means that BNDES, hypothetically, will charge a 3,5% risk spread. So, as the current TJLP is 5% per annum, the total loan cost for the project will be 5% + 1% + 3,5%% = 9,5% per annum in nominal terms and 4,785% per annum in real terms, as the inflation target that the Brazilian Central Bank pursue is 4,5%.

Concerning the repayment period, BNDES gives a maximum 16 years term. The interest may be capitalized during the grace period, and it will be up to six months after the entry of the project into commercial operation. The Constant Amortization System (SAC) will be adopted, and the maximum participation of BNDES loan in the capital structure of the ABC Wind Farm, will be 70% or BRL 126.000.000.

Project Schedule and Concession Period: The concession period in Brazil for wind energy plants is usually about 240 months or 20 years maturity, starting about 24 months later than the PPA closing date. The deadline for the implementation of a wind farm depends on its size. It can take, normally, between 12 and 24 months. Nevertheless, for the ABC Wind Farm the schedule will have a 24 months period.

It is important to say that there are many factors that can delay the project schedule, among these factors can be highlighted: the land issue and the relationship with local communities; weather conditions during deployment; and the quality and availability of civil works contractors and suppliers of wind turbines.

Finally, the SPE responsible for the project should be aware of all the variables that can affect the project and try to check whether there is a significant likelihood of delays in the implementation of the wind farm. If there is, this probability must be measured, as expected for calculating the potential penalty arising from a possible postponement of the start of commercial operation of the wind farm, especially in the case of electricity sold under the Power Purchased Agreement delay, where, in addition to fines, revisions may occur in the amount of energy delivered and therefore to be sold in the long term of the contract.

Power Purchase Agreement: To calculate the amount of energy to be generated by the project, it is important to require the winds study from the wind farm to be analyzed. Therefore, in this study we supposed to analyze or require winds study from Rio Grande do Norte State, because it is the chosen location for ABC wind farm. However, to guarantee credibility in the analysis, it is important that the winds study had been certified by an organization of international reputation. It will not happen in this study. However, despite this issue not to be part of the study scope, for reasons of simplification we will assume public wind energy generation data, published by the Câmara de Comercialização do Setor Elétrico - CCEE.

Nevertheless, in the studies mentioned in the previous paragraph, winds likely to provide minimum power generation, among which we highlight the P90 (90% probability of generating at least the estimated energy) and P50 likely (50% probability of generating at minimum estimated energy).

It is very important mentioning that because as the capacity factor is the most critical variable in the estimation of the revenue line in de financial model, in parallel to the contracted price of energy. Then, now the investor or the financial analyst have one more risk variable to deal with, that, in the case of this study will be used a non-conservative (from public source as mentioned) data parameter P50, instead of P90 that would be better or less risky. The reason to this is that we are using data from old bid, and from 2009 until 2012 the Brazilian government used to accept P50 in the agents analyses for wind farm bids, and it was accepted by BNDES in loan requirements. As far as the plants were not able to produce as the agents planned, the government and BNDES begun to require P90 in 2013.

Then, the capacity factor for ABC Wind Farm will be 47.33% that represents an average from those capacity factors values found in all wind farm project auctioned between 2009 and 2012 in Brazil.

Concerning the installed capacity for the ABC Wind Farm, it will be 45 MW, which is powered by 30 wind turbines of 1.5 MW of power.

For the Price we will different approach. To be optimistic the price for ABC Wind Farm will be BRL 153.07 MWh that represents the maximum price found in all wind farm project auctioned between 2009 and 2012. Concerning the PPA period, the contract will cover all the concession period, it means 20 years term.

Regarding the structure of the PPA, we are assuming that this case will be a CER contract that was practiced until 2012. Then, in our assumptions we are simulating a sort of a LER auction project.

By this reason we must say that the characteristics of this PPA are as following:

The CER is celebrated with the CCEE in the modality of "quantity of energy", whose calculation is through the Energy Account, which is the accumulated balance annually, every 12 months, resulting from the difference between the power generated and the energy contracted, obeying a range of tolerance of 10% below and 30% above the contracted energy. The detail of this contract and its rules is explained as follows:

- Use any surplus energy to be sold under the ACL is prohibited.

- There are revisions every four years for the quantity of energy:

  i) When power generation is below the amount of energy contracted during the first four years, there will be a single requalification for the contracted energy. From that point on the energy contracted will be at the verified lower level.
  ii) When power generation is above the contracted amount of energy, there will be no requalification up and contracted energy will remain at the same level originally established.

iii) Regarding the quadrennial review of energy generation, positive or negative quadrennial balance must be: a) paid at the contract price, b) or passed on to the next quadrennial.

- There are also annual reviews for the quantity of energy:

i) If generation of energy in a year is between 90% and 130% of the quantity contracted, the surplus or shortfall will be reassigned for the coming year.
ii) The negative balance or deficit will be penalized 115% of the contract price, and the entrepreneur must pay the energy due within 12 months.
iii) The positive balance or surplus will be settled at 70% of contracted price and the seller will have extra revenue, however this extra revenue will be received within 12 months.

- If there is early entry into commercial operation, the energy sold before the original deadline for entry into commercial operation will be paid at the contract price.

The reason to apply this sort of mechanism of bands for the generation deviations is to soften the intrinsic volatility of the winds behavior and consequently heding the volatility of the revenues. Thus, any generation shortfalls in a given year are not settled immediately and can be offset against any excess in the coming years.

Another benefit in this PPA is the plan to purchase energy for those who anticipate the delivery of energy at the price of 100% of the contract value and not at the spot price, which varies depending on the supply and demand of energy in the spot market.

Taxes: For the ABC Wind Farm will be used a tax regime that has the tax and tax rates listed below:

a) Prog. de Integração Social - PIS: 0.65%;
b) Contribuição Fin. da Seg. Social - COFINS: 3.00%;
c) Imposto de Renda - IR: 25%
d) Contrib. Social Sobre Lucro Líquido - CSLL: 9%

The taxes above have a different tax basis calculation. For PIS and COFINS, the basis of calculation is Operational Revenue. Regarding the IR and CSLL, the rates are considered 25.00% and 9.00%, respectively. But in the case of accounting based on estimated profits (a special tax regime in Brazil), we will assume for ABC Wind Farm study, we have to calculate de basis that is given, respectively, by. 8.00% X Operational Revenue and 12.00% X Operational Revenue.

Grid System Operation Fee: The charge of transmission called taxa Operador Nacional do Sistema refers to the reimbursement of part of the costs of administration and operation of the ONS (entity responsible for the operation and coordination of the national grid in Brazil) by all companies for generation, transmission and distribution as well as the large consumers (free consumers) connected to the national grid system.

TUSD: The "Tarifa para Uso do Sistema de Distribuição" or The Distribution Facilities User Fee is the price paid by those who use the electric network of dealerships owned distribution companies. The price is regulated by ANEEL through Tarifa de Uso dos Sistemas Elétricos de Distribuição - TUSD. In this case study, we considered a value, as of TUSD, the rate of BRL 2.781 per kW.month as settled by ANEEL for 2013-2014 term.

TFSEE: Taxa de Fiscalização de Serviços de Energia Elétrica - TFSEE or Power services supervision fee was established by Law number 9.427/1996 in order to constitute the revenue of the National Electric Energy Agency - ANEEL to cover its administrative and operating expenses. Nowadays, TFSEE is settled in 0.4% of economic value added by the entrepreneur, permission or authorization, including in the case of production independent and self-production, the operation of services and facilities of electricity.

CCEE fee: This is the fee that a entrepreneur should pay for the broker administration costs. CCEE – Câmara de Comercialização de Energia Elétrica, the broker, receives 0.07 BRL/MWh dealed.

O&M: Regarding the negotiated value often figures include staggered contracts to be paid for this service. This occurs because the vast majority of wind farm projects present their limited leverage in terms of coverage ratio of debt service – DSCR, which is often critical (minimum) in the first year of commercial operation of the plant, the time which the outstanding balance was not significantly amortized. Thus, in seeking to maximize share of debt in the capital structure of the company, thereby maximizing SPE IRR, in the specific case of the ABC wind farm analyzed, the O & M cost assumptions were given on table 4.

Cost of Capital: According to the principles of financial management, the cost of capital weighed average between the cost of equity and the cost of debt. Thus, it is possible to calculate the Weighted Average Cost of Capital to be used as the hurdle/discount rate for the project cash flows. However, as this paper we will analyze the free cash flow to equity, we suppose to calculate the cost of equity. Nevertheless as the objective of this paper is not to calculate the WACC or the cost of equity, since this cost is used as an assumption to the model, this variable will be chosen from the market. Then, as a proxy for this variable we will use the real interest rate of the Brazilian bonds market. It means, a risk free real interest rate, specifically the National Treasury Notes series B for 10 years - NTN-B 10 years tenor.

Accordingly with information found on the Brazilian Treasury (Secretaria do Tesouro Nacional do Ministério da Fazenda – STN/MF) the average for this rate from the 2008 to 2012 is equal to 6,31%. As assumed in several papers on financial management, this cost is the best parameter to discount the cash flows of a project in order to calculate its NPV.

Table 6: NTN-B 2008 - 2012

NTN-B 10 yrs tenor	
2008	8,04%
2009	6,69%
2010	6,30%
2011	6,11%
2012	4,41%
Average	**6,31%**

Source: STN/MF

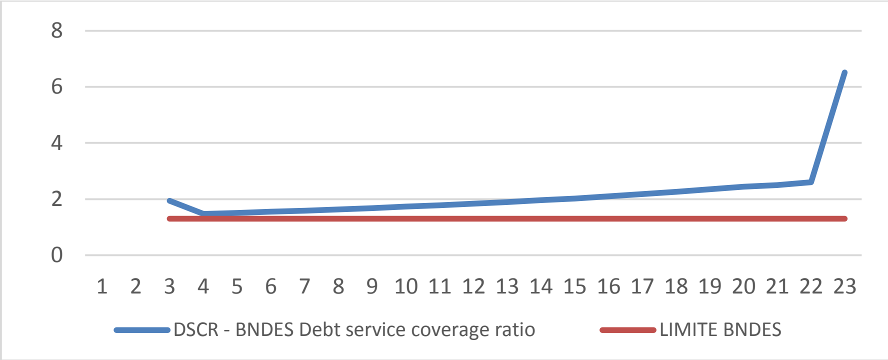
5.2 Results

In this session we show following the table with the Free Cash to Equity calculated for Wind Farm ABC, based on deterministic assumptions listed above.

The flows were projected in real terms. For this case, the deterministic assessment, it was considered that all available energy was sold at auction at the time and there were no deviations in the generation, which consequently did not result in penalties or revisions of the contracted energy.

Additionally, from the figure 6, we can observe the evolution of the DSCR, which demonstrates the financial soundness of the project during entire concession period. The results of the projections show that the project is sustainable, with positive cash balances throughout the period analyzed, and sufficient to honor with amortization and interest on borrowed funds from the BNDES.

Figure 6: DSCR – LOAN BNDES



Finally, the break even price for the project is BRL 132,09 MWh, it means that any price below this price will lead the project for a negative NPV, and discounting the cash flows from year to year, at the cost of capital of 6.31%, we obtained net present value of the BRL36.615 (x1000).

Table 7: Wind Farm ABC Results

Parameter	Result	Unit
NPV for FCFE @ 6,31%	**36.615**	**BRL Mil**
Acumulated Cash Flow	**141.384**	**BRL Mil**
Cost of equity	**6,31%**	**aa**
IRR	**11,88%**	**aa**
Discounted pay back	**12,66**	**years**

Figure 7: Wind Farm ABC Statement and Free Cash Flow to Equity – Deterministic Case

Years	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
TOTAL REVENUE	-	-	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**	**26.785**
PPA - Energy sold in ACR	-	-	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785	26.785
Balance (90%-130%) from year t-1				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penalties	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Extra Revenue				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TAXES ON REVENUE	-	-	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**	**(978)**
COFINS	-	-	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)	(804)
PIS	-	-	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)
TOTAL NET REVENUE	**-**	**-**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**	**25.808**
SECTORIAL CHARGES AND	-	-	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(851)**	**(1.207)**	**(1.207)**	**(1.207)**
TFSEE	-	-	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)	(69)
CCEE FEE	-	-	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)
ONS/GRID FEE	-	-	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)	(18)
TUSD	-	-	(751)	(751)	(751)	(751)	(751)	(751)	(751)	(751)	(751)	(751)	(751)	(751)	(751)	(751)	(751)	(751)	(751)	(751)	(1.107)	(1.107)	(1.107)
COSTS	**-**	**-**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(5.832)**	**(4.257)**
Pre-operational	-	-																					
Management and Admistratives	-	-	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)	(480)
O&M	-	-	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(3.150)	(1.575)
Rent	-	-	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)	(402)
Insurrace	-	-	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)	(1.800)
EBITDA	**-**	**-**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**19.125**	**18.769**	**18.769**	**20.344**
Depreciation	-	-	(9.000)	(8.612)	(8.242)	(7.887)	(7.547)	(7.222)	(6.911)	(6.613)	(6.329)	(6.056)	(5.795)	(5.546)	(5.307)	(5.078)	(4.860)	(4.650)	(4.450)	(4.259)	(4.075)	(3.900)	(3.732)
Financial revenue		-	50	305	511	502	494	486	477	469	461	453	444	436	428	419	411	402	394	386	377	369	296
Interest paid	-	-	(6.188)	(5.906)	(5.596)	(5.286)	(4.990)	(4.665)	(4.355)	(4.045)	(3.745)	(3.425)	(3.115)	(2.804)	(2.501)	(2.184)	(1.874)	(1.564)	(1.257)	(943)	(633)	(323)	(45)
Loan fees	(1.890)																						
EBT	**(1.890)**	**-**	**3.987**	**4.912**	**5.798**	**6.455**	**7.083**	**7.723**	**8.336**	**8.935**	**9.512**	**10.097**	**10.659**	**11.211**	**11.744**	**12.282**	**12.802**	**13.313**	**13.812**	**14.309**	**14.438**	**14.915**	**16.862**
IR	-	-	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)	(536)
CSLL	-	-	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)	(289)
NPAT	**(1.890)**	**-**	**3.162**	**4.087**	**4.973**	**5.630**	**6.258**	**6.898**	**7.511**	**8.110**	**8.687**	**9.272**	**9.834**	**10.386**	**10.919**	**11.457**	**11.977**	**12.488**	**12.987**	**13.484**	**13.613**	**14.090**	**16.037**
FREE CASH FLOW																							
EBIT	**-**	**-**	**10.125**	**10.513**	**10.883**	**11.238**	**11.578**	**11.903**	**12.214**	**12.511**	**12.796**	**13.069**	**13.330**	**13.579**	**13.818**	**14.047**	**14.265**	**14.474**	**14.675**	**14.866**	**14.693**	**14.869**	**16.612**
(+) Depreciation	-	-	9.000	8.612	8.242	7.887	7.547	7.222	6.911	6.613	6.329	6.056	5.795	5.546	5.307	5.078	4.860	4.650	4.450	4.259	4.075	3.900	3.732
(+) Financial revenue	-	-	50	305	511	502	494	486	477	469	461	453	444	436	428	419	411	402	394	386	377	369	296
(-) Capital expenditure	(54.000)	(126.000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(-) IR / CSSL	-	-	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)	(825)
FCFF	**(54.000)**	**(126.000)**	**18.350**	**18.605**	**18.811**	**18.802**	**18.794**	**18.786**	**18.777**	**18.769**	**18.761**	**18.753**	**18.744**	**18.736**	**18.727**	**18.719**	**18.711**	**18.702**	**18.694**	**18.686**	**18.321**	**18.313**	**19.815**
(+) Cash			893	4.790	4.713	4.635	4.561	4.480	4.402	4.325	4.250	4.170	4.092	4.015	3.939	3.860	3.782	3.704	3.628	3.549	3.472	3.394	2.115
(+) Loan	37.800	88.200	-	-	-																		
(-) Amortization	-	-	(3.266)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(6.533)	(3.266)
(-) Interest paid	(1.890)	-	(6.188)	(5.906)	(5.596)	(5.286)	(4.990)	(4.665)	(4.355)	(4.045)	(3.745)	(3.425)	(3.115)	(2.804)	(2.501)	(2.184)	(1.874)	(1.564)	(1.257)	(943)	(633)	(323)	(45)
(-) Minimum cash		(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	(893)	
(-) Reserv account	-	-	(3.897)	(3.820)	(3.742)	(3.668)	(3.587)	(3.510)	(3.432)	(3.357)	(3.277)	(3.199)	(3.122)	(3.046)	(2.967)	(2.889)	(2.812)	(2.735)	(2.657)	(2.579)	(2.501)	(1.222)	0
(+/-) Variação do Capital de Giro	-	(1.901)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(131)	2.032
FCFE	**(18.090)**	**(40.594)**	**4.998**	**6.244**	**6.759**	**7.058**	**7.353**	**7.665**	**7.967**	**8.266**	**8.563**	**8.872**	**9.174**	**9.474**	**9.773**	**10.080**	**10.382**	**10.682**	**10.983**	**11.287**	**11.233**	**12.605**	**20.649**

6. Analyzing by CfaR the Wind Farm ABC Cash Flow

In this chapter another cash flow analysis will take place instead. However, at this time, we will use a relative risk measure – CfaR and as instrumental support in the processing and analysis of data, software risk simulator will be used.

As we already mentioned in chapter 2, the CFaR is defined as a relative risk measure, it means that the risk is being measured relatively to a target level of a cash flow. Our cash flow target level was given by the deterministic cash flow analysis. It means that the results shown in chapter 5 will be our target and the results of CFaR analysis will be compared with it.

The deterministic cash flow model will serve as a basis for this analysis, however, this time the data collected will be submitted to the CFaR metric. Thus, variations in cash flow will then be designed using the technique of Monte Carlo simulation. The goal of this process is to extract the variations in cash flows from the project analyzed according to established scenarios.

As mentioned in chapter two, for this process to be executed, we must follow a few steps. Such steps are organized synthetically as follow: a) First step is try to identify the variables that have more influence on the project cash flow; b) Second step is estimate the future values expected for each individual variables identified in the last step, for the same time horizon used for the project cash flow study; c) Third, establish different scenarios for the variables identified using the technique of Monte Carlo simulation; and d) Fourth, insert in the model the risk factors, which are independent variables adopted in step 1, and obtain the probability distribution for the dependent variable (i.e. IRR and NPV) and finally calculate CFaR under some confidence level (i.e. 99%).

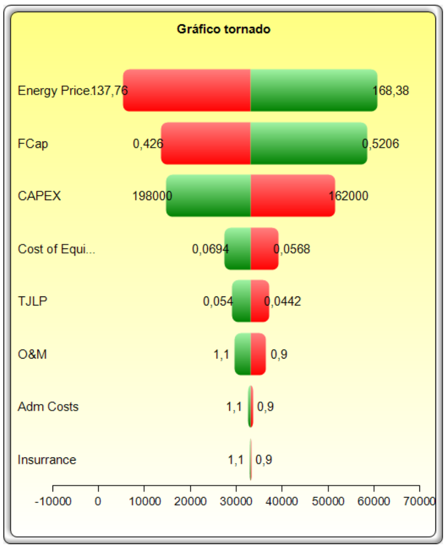
The key tool to the process and analyze was the Microsoft Excel and Risk Simulator.

6.1 Variables that most influence the Project cash flow

To achieve this step, will be used the Tornado analysis tool. This type of tool captures the static impacts of each variable on the outcome of the project cash flow. It is a kind of sensitivity analysis since the tool automatically perturbs each variable in the project cash flow model by a default value (in this case + 10% and -10% for each of the variables used in the cash flow project) that captures the fluctuation in the final result and list the resulting disruption ranked in order of relevance.

After using the Tornado analysis tool in the cash flow model for the ABC Wind Farm Project, the aftermath is shown as follow:

Figure 8: Wind Farm ABC Tornado Results



Thus the Tornado chart above list all entries that most impact the project cash flow in of return (NPV), from the variable that exerts the greatest effect on the project return – Energy price – till the variable that exerts the lowest effect on the project return – Insurance.

From this perspective one can clearly see that the first three variables – Energy price / Capacity factor / Capex – are the most important in terms of impact on the project outcome, followed by other three variables that cause less impact to the same outcome, but still a considerable and important impact – Cost of equity / Interest rate / O&M – and finally the last two variables that in term of impacts are unimportant (it means no material effect) as all others variables that are not included in the chart – Adm. costs / Insurance.

6.2 Estimating future values and different scenarios for variables

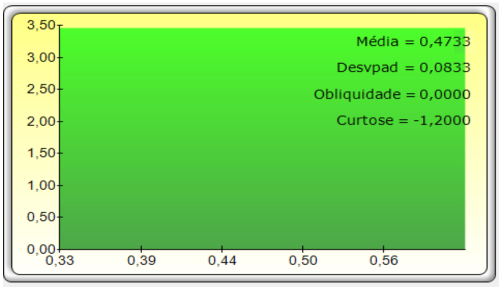
Based on the first step, we need estimate or forecast values for each of those variables that are able to impact materially the outcome or the return of the Wind Farm ABC project and establish some scenarios. As we just find out in the last step, these variables are: Energy price, Capacity factor, Capex, Cost of equity, Interest rate and O&M.

As we do not have a desirable level of historical information about each of these variables to work on its forecast and the objective of this paper is not find those information out, we need to assume some reasonable randes for each variable to make our study possible. Then, in the next paragraphs it will be explained for each of those six variables the treatment and the assumptions took in order to have a forecast or estimation for expected values for the same time horizon used for the project cash flow study.

> **Energy price:** Despite this variable is the most important in terms of impact, as we assume that the Wind Farm ABC is a project that was auctioned, we will assume also that its price (BRL 153,07 / MWh) will be fixed during the concession time period. Then, for our study it will not be a variable that needs to be estimated and its scenario is a fixed price during the concession period.
>
> **Capacity factor:** For this variable, in the deterministic case we assumed that the capacity factor for ABC Wind Farm is 47.33% that represents an

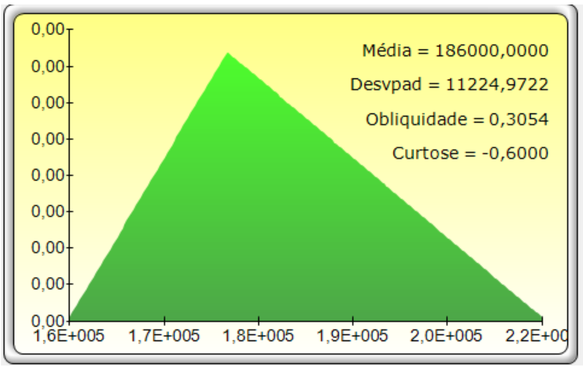
average from those capacity factors values found in all wind farm project auctioned between 2009 and 2012 in Brazil. Taking out the same historical data we have also de minimum and maximum values – 0.3282 and 0.6166 respectively. As these values are values found through out wind behavior studies in the region where the project is hypothetically located and we do not have sure in what is the likelihood to happen for each of the values of the historical data, we decided to use a uniform distribution with 0.3282, 0.4733 and 0.6166 as minimum, average and maximum input values respectively. The scenario for each year will be a value within this range.

Figure 9: Capacity Factor input distribution



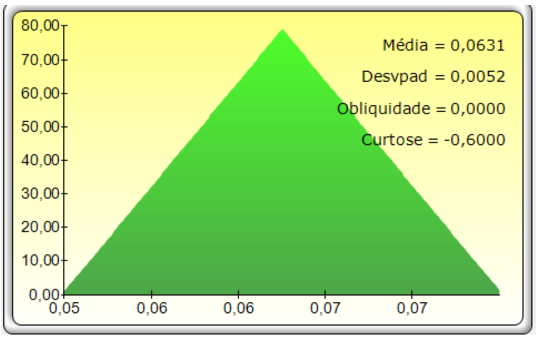
Capex: In the case of the capital expenditure we do not have any track records. Due to this fact we are intend to establish a range with the minimum value below the expected value (indicating possibility to have an effective Capex smaller than the expected Capex) and with the maximum value above the expected value (indicating possibility to have an effective Capex greater than the expected Capex). As a discretionary decision, we will use a range like: Min → 90% of deterministic Capex (BRL 162.000); Expected → 100% of deterministic Capex (180.000); Max: 120% of deterministic Capex (216.000). For this case, as our expectations about the final or real Capex value are always around the number used in the deterministic case, we will use a triangular distribution, which is the distribution where once defined the minimum, expected and maximum values, the values around the expected value are more likely to occur.

Figure 10: Capex input distribution



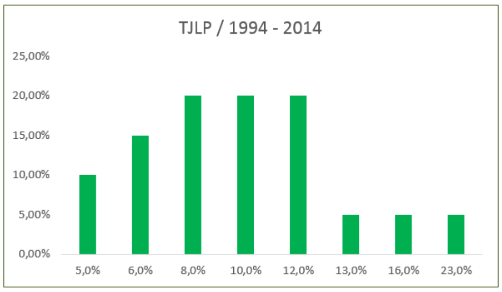
Cost of equity: For this variable, the approach will be almost the same that was used for the Capex. But this time the range will have the same amplitude from the expect value (6,31% or the value used in the deterministic case) to both negative and positive sides. Then, again lead by a discretionary decision, we will have the minimum value 20% less than expected value, (5,06%) and the maximum value 20% more than the expected value (7,57%). For this case, also like the CAPEX, as the expectations about the real for this variable value are always around the expected value, we will use a triangular distribution, which is the distribution where once defined the minimum, expected and maximum values, the values around the expected value are more likely to occur.

Figure 11: Cost of equity input distribution



Interest rate: For the interest rate, it is possible to have a more reliable approach to estimate it. However, as the TJLP is not a market interest rate but instead a very discretionary interest rate, our approach will be use the historical data into a discrete distribution as the input. Below the distribution and the likelihood for each value.

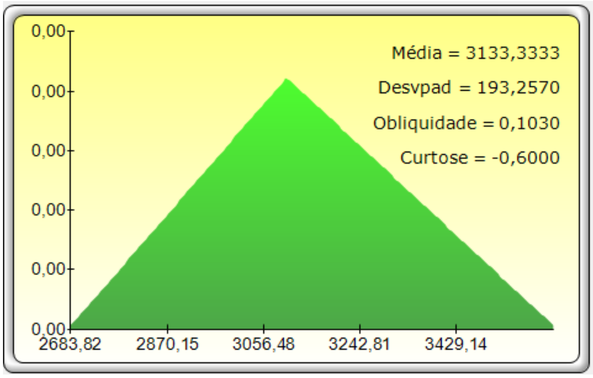
Figure 12: TJLP input distribution



TJLP	Freq.	% cumul.	Likelihood
5,0%	2	10,00%	10,00%
6,0%	3	25,00%	15,00%
8,0%	4	45,00%	20,00%
10,0%	4	65,00%	20,00%
12,0%	4	85,00%	20,00%
13,0%	1	90,00%	5,00%
16,0%	1	95,00%	5,00%
23,0%	1	100,00%	5,00%

O&M: For this variable, the approach again will be almost the same that was used for the Capex and exactly the same used for the cost of equity. The range will have the same amplitude from the expect value to both negative and positive sides. Then, again lead by a discretionary decision, we will have the minimum value 20% less than expected value, (2678) and the maximum value 20% more than the expected value (3623). For this case also as the expectations about the real for this variable value are always around the expected value, we will use a triangular distribution.

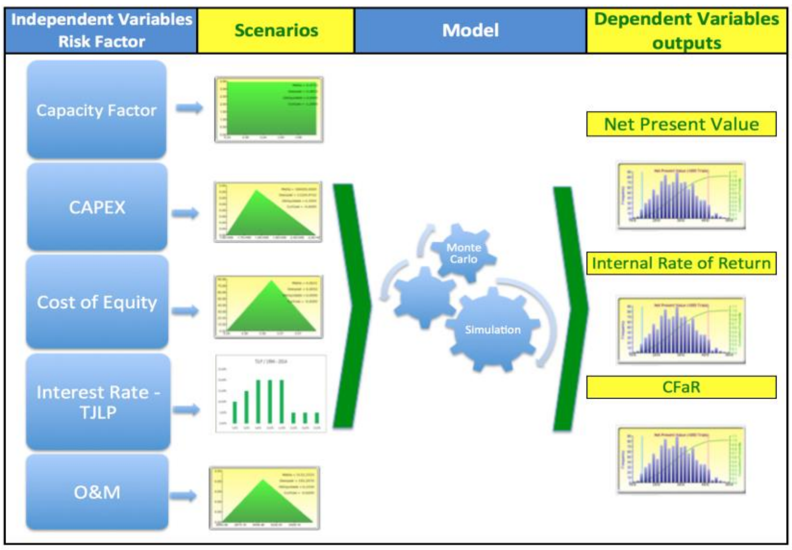
Figure 13: O&M input distribution



6.3 Monte Carlo simulation and results

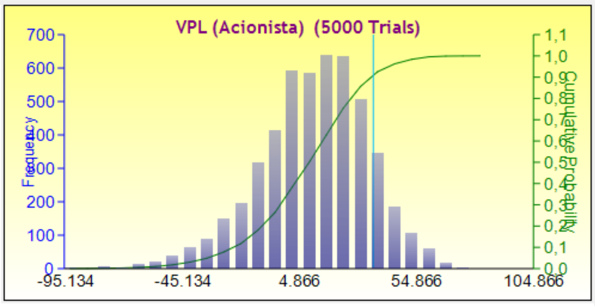
In this section will be combine the independent variables shown in the previous section to determine the cash flow model. Those are the same variable used in the deterministic study. However, at this time the independents variables will be submitted to the Monte Carlo simulation process (5000 iterations; 95% confidence level) resulting in the distribution of results for each of the dependent variables. In the figure below we can find a synthetic demonstration of the modeling process:

Figure 13: O&M input distribution



The distribution of results for each of the dependent variables (NPV, IRR and CFaR) will be now presented, after simulations have been performed.

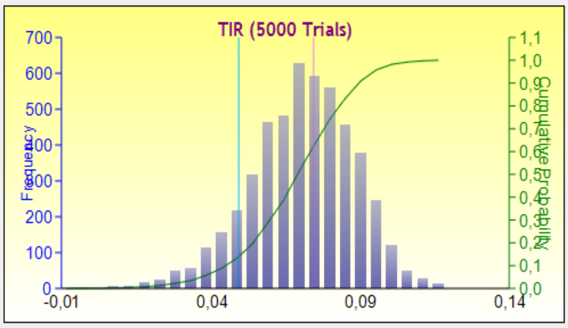
Net Present Value:



Statistics	Result
Number of Trials	5000
Mean	7.459,0465
Median	9.241,6940
Standard Deviation	23.352,6059
Variance	545.344.200,0533
Coefficient of Variation	3,1308
Maximum	82.090,0983
Minimum	-99.864,3787
Range	181.954,4771
Skewness	-0,4850
Kurtosis	0,5963
25% Percentile	-6.711,1079
75% Percentile	23.534,2798
Percentage Error Precision at 95% Confidence	8,6779%

By analyzing the distribution of NPV, one realizes that it appears a normal distribution where the likelihood, with 95% confidence level, that the project Wind Farm ABC have positive or greater than zero NPV is 65.18%. However the likelihood of the NPV being greater than or equal to the deterministic NPV (BRL 36.615 million) is only 8.9%, with 95% confidence. The average NPV of BRL7.459 MM.

Internal Rate of Return:



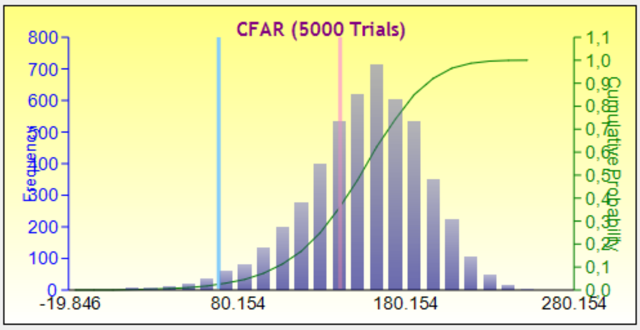
Statistics	Result
Number of Trials	5000
Mean	0,0693
Median	0,0704
Standard Deviation	0,0176
Variance	0,0003
Coefficient of Variation	0,2542
Maximum	0,1174
Minimum	-0,0122
Range	0,1295
Skewness	-0,4383
Kurtosis	0,4149
25% Percentile	0,0585
75% Percentile	0,0815
Percentage Error Precision at 95% C...	0,7047%

Analyzing the distribution of IRR, one can also realizes that it appears also a normal distribution where the likelihood, with 95% confidence, that the project Wind Farm ABC have positive or greater than zero IRR is 99%. However the probability of the IRR being greater than or equal to the deterministic IRR value

(11,88%) is 0%. The reason for it is because the maximum value in this distribution is 11.74%, with a 95% confidence level.

Comparing the IRR with the cost of equity, we can say that the likelihood of IRR be in the range of values taken as input for the fluctuation in the cost of equity (5.06% - 7.57%) is 48.59%. Additionally, the likelihood of the IRR being greater than or equal to the cost of equity for the deterministic case (6.31%) is 65.88%, with 95% confidence.

Cash Flow at Risk: The estimated CFaR obtained through the Monte Carlo simulations gives us the perception of the worst estimated cash flow loss for the Wind Farm project ABC, for a given level of confidence.



Statistics	Result
Number of Trials	5000
Mean	150.206,2800
Median	153.484,8957
Standard Deviation	35.546,7055
Variance	1.263.568.273,68...
Coefficient of Variation	0,2367
Maximum	252.422,4080
Minimum	-27.114,3439
Range	279.536,7520
Skewness	-0,5861
Kurtosis	0,8033
25% Percentile	129.690,4078
75% Percentile	174.850,6161
Percentage Error Precision at 95% C...	0,6560%

The CFaR for the Wind Farm ABC project, during the period of concession and with 95% of confidence is BRL 69.231 million. It means that the project accumulated cash flow variation during the period of concession will be greater than the mentioned value at 95% of likelihood.

If we compare the CFaR at 95% of likelihood (BRL 69.231 million) and the accumulated cash flow in the bas case or deterministic case (BRL 141.384 million), we can se that the likelihood of the accumulated cash flow being within this range is 33.88%.

8. Conclusion and recommendations

The objective of this paper was to give an example of using a risk analysis tool for risk management in non-financial companies by analyzing a wind project developed in the power sector in Brazil.

In many cases in a project evaluation, people use several criteria, such as payback (discounted or not) and NPV, but given the pros and cons of each, as presented in this paper, it is believed that the NPV method is the best method for evaluating projects / investment, for this reason it was the main dependent variable being sought in the CFaR exercise.

However, the analysis of a wind project is not a deterministic exercise. There are many risk factor that need to be considered. The pure NPV does not take into account those risk factors. At best, we can do some sensitivity analysis, which does not fully capture the role that each variable may play, in particular when they are combined.

Generally, People knows as a fact that wind projects, especially in Brazil, have many risks and uncertainties. Some of them are typical to any investment project, such as cost of capital. However, others are very specific to wind projects, for which a reliable historical track record does not exist. Those include, inter alia, variations in production, O&M cost, tariffs, etc.

The natura of the contractual relations for reserve auctions tries to mitigate some of those risks, but some residual (and important) risk may still exist and they need to be studied and mitigated, if it's possible. Moreover, other projects to be developed in the future (e.g. merchant plants) may have different contractual arrangements, and therefore little hedge will be offered to the project intrinsic risks.

For this reason, we decided to give a stochastic treatment to those risks, by looking at each one of the key independent variables that may have a larger impact and create more volatility to the cash flow and, consequently, for the project financial return. Then we estimated the most likely probability distribution to those variables and processes, all of them using a Monte Carlo simulation, supported by Microsoft Excel and Risk Simulator software.

The result of this Monte Carlo simulation were very enlightening. By analyzing it, we proved that in spite of the distribution of probability for the outcome (either NPV or IRR) is generally a normal curve, the standard deviation is very high. Therefore, the outcome of the project may result in IRRs below the hurdle rate and negative NPVs – in other words, some combinations may result in the project being unfeasible. This kind of approach shows a completely different – opposite - results if we compare the deterministic case results that shows a feasible and very profitable project.

Therefore, we strongly suggest analysis to use this stochastic model to have a better sense on the combines risks face by the project. The value of risk may be significant based on a probabilistic the analysis as we carried out, and a simple deterministic analysis is not able to capture this combined effect.

Finally, we understand that this probabilistic model provides a much more valuable tool for managers to make informed judgments and make the correct decision instead a deterministic model.

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