FINANCIAL EVALUATION OF HYDROELECTRIC POWER PLANT

BELO MONTE 11.233 MW

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Thanks

To my family, for the support and understanding in the missing moments, and Eletronorte for give me that oportunity.

ABSTRACT

This paper aims to conduct an economic and financial analysis of project construction and operation of Hydroelectric Belo Monte to be built in Brazil. The hypothesis is that the project is viable and adds value to shareholders, investors and society. This paper will offer an evaluation based on the perspective of the Investor and the Project (full equity). Chapter 1 will explain the theories of investment appraisal. Chapter 2 will address the case of UHE Belo Monte, the assumptions used in financial analysis and the main results found.

CONTENTS

INTRODUCTION

Before starting to conduct an economic and financial analysis of the project of building Hydroelectric Belo Monte in Brazil, it is necessary to analyze why this theme is so important to Brazil.

The expansion of infrastructure investment is a critical condition to accelerating sustainable development in Brazil because, this way, the country can overcome some barriers in the economy and stimulate increased productivity and reduction of regional and social inequalities.

The lack of energy supplied can affect, in a negative way, the economic growth of any country. The desired cycle of sustained development as well as the ongoing recovery of the Brazilian economy can become unviable in the face of a new of energy rationing.

The evolution of the national economy, in the sense of a more developed economy and with a better income distribution, requesting services and commercial segments of increasing sophistication, together with the potential for tourism of the Country, contribute to an accelerated growth of electricity consumption.

According to the information provided by the report of the Agência Nacional de Energia Elétrica (ANEEL) - National Agency of Electrical Energy, up to on 31 December 2012, the installed capacity in Brazil was 121.1 thousand Megawatts (MW) and it came from 2,809 hydroelectric, thermal and nuclear power stations, wind power plants, small hydroelectric centers and hydroelectric generating centers.

And yet, according to the ANEEL Report, the energy that comes from hydroelectric power stations is prevalent and represents 65.96% of the installed capacity of the country, followed by thermal power plants representing 27.15% and the small hydroelectric centers with 3.52%. Nuclear power plants representing 1.66% of the power, wind farms representing 1.51% and generating centers representing 0.20% are still part of the matrix.

In Brazil, the role of the State is to carry out, in accordance to the law, the planning functions, which are *determining* for the public sector and *indicative* to the private sector. In the energy sector, the Conselho Nacional de Política Energética (CNPE) - National Counsel of Energy Policies –is responsible for establishing policies and guidelines that aim for national sustainable development.

By doing so, the Brazilian State, on the fulfillment of its duties, develops Ten-Year Plans for the electric sector. These are, traditionally, one of the main instruments of the planning of the electro energetic expansion of the country that brings an integrated vision of the expansion of the demand and offers a variety of energetics, besides the electric energy.

One of the sources used in this paper is the o Plano Decenal de Expansão de Energia- PDE 2021 (Ten-Year Plan of Energy Expansion – 2012/2021), which presents important signalizations in order to guide the actions and decisions related to the setup between the projections of economic growth of the country and the necessary offer expansion, so that it ensures the energetic supply with proper costs in bases that are technically and environmentally sustainable.

Considering the premises of the Ten-Year Plan of Electric Energy 2021 of the Empresa de Pesquisa Energética- EPE (Company of Energetic Research), Brazil will have a installed capacity of 182.4 GW (Gigawatts), in 2021. In the end of 2011, according to EPE, Brazil had an installed capacity of 116.5 GW. In order to reach this installed capacity in 2021 Brazil will have to expand its capacity in about 6.5 GW annually, on average.

According to the study performed by Associação Brasileira dos Agentes Comercializadores de Energia Elétrica - ABRACEEL (Brazilian Association of the Agents that Commercialize Electric Energy) to reach the objectives of sustainable growth of the Gross Domestic Product (GDP) with rates higher than 4.5% per year and to avoid a deficit between supply and demand of energy in medium or short term, Brazil needs to generate, at least 4.0 GW per year in hydraulic, thermal and other renewable sources generation, so that it expands the installed capacity[1].

Keeping in mind this scenario, big hydric projects, like Madeira and Belo Monte, will meet the expectations of this need for attending the demand. In case these projects are not implemented, the country will have to look for alternative sources to assist the energy demand. However, this alternative would imply a relevant increase in the energy costs, causing the loss of competitiveness of the national industry.

When Brazil faced the rationing of electric power in 2001, it represented significant impacts to the Brazilian economy. The rhythm of the GDP growth diminished from 4.3%, in 2000, to only 1.3% in 2001. Even more intense was the impact in the reduction of the rhythm of growth of the industrial production that decreased from 6.6% to 1.5%, in the same period.[2]

The risk of occurring a new rationing can affect, in a negative way, decisions related to new investments by the companies, and still there are negative reflections that would come due to that. Another potential impact is the increase of costs in the energy supply. In short, rationing would not only represent a stop in the economic growth, but also an increase in the costs of industrial production.

Thanks to this, the fulfillment of the premises of electric energy installed capacity, that are part of the Ten-Year Energy Plan EPE-2021, as well as the need for being prepared, in the supply of electric power point of view, when Brazil starts growing again above 4.5% of the GDP, it is fundamental to ensure the offer expansion that Brazil needs.

1 Source: www.abraceel.com.br/.../a-oferta-de-energia-eletrica-vai-afetar-o-rescimento-economico-brasileiro?-

2 “Electric energy offer will oferta de energia elétrica vai afetar o crescimento econômico brasileiro?” Newton Duarte, Folha de S. Paulo de 04/06/2007.

2021 TEN-YEAR PLAN – GROWTH OF INSTALLED CAPACITY PROJECTION IN A PERIOD OF FIVE YEARS.

Ten-Year Plan of Energy Expansion - PDE 2021	2011	2016	2021	First Five-Year Period		Second Five-Year Period		Decade	
				Increase	*%*	*Increase*	*%*	*Increase*	*%*
Installed Capacity Of Electric Power Generation (GW)	116.5	151.4	182.4	34.9	30%	31.0	20%	65.9	57%
Hydroelectric Power Plant	83.6	98.2	116.8	14.6	17%	18.6	19%	33.2	40%
Nuclear Power Plant	2.0	3.4	3.4	1.4	70%	0.0	0%	1.4	70%
Thermal Power Plant	17.2	25.3	26	8.1	47%	0.7	3%	8.8	51%
Small Hydroelectric Power Centers	4.6	5.4	7.1	0.8	17%	1.7	31%	2.5	54%
Biomass	7.8	9.6	13.4	1.8	23%	3.8	40%	5.6	72%
Wind Farms	1.4	9.4	15.6	8.0	571%	6.2	66%	14.2	1014%
Transmission Of Energy Power									
Transmission Lines (Km)	101,237	135,792	148,969	34,555	34%	13,177	10%	47,732	47%
Electrical Substations (MVA)	232,877	297,358	311,213	64,481	28%	13,855	5%	78,336	34%
Shipping of Natural Gas (Km pipelines)	9,489	9,745	9,745	256	3%	0	0%	256	3%

Source: Empresa de Pesquisa Energética - EPE

In the last decade, without the hydroelectric plants, the offer increase was viable only in thermal stations generated by oil and natural gas, which are more expensive and pollutant. However, from 2009, auctions of large-sized stations of hydraulic energy generation are gradually occurring again in Brazil. Hydroelectric power performs an important role in the integration and development of regions that are localized far away from great urban and industrial centers.

The renewable matrixes of energy have a number of advantages: availability of resources, easy profiting and the fact that they are still available in nature over time. From all these sources, the hydroelectric source represents a significant portion of the world's production, about 16% of all electricity generated in the planet.

The hydroelectric power in Brazil, besides being a historic factor of economic development, performs an important role in the integration and development of distant regions of great urban and industrial centers.

The technical potential of efficient use of Brazil's hydraulic energy is among the world's five biggest. The country has 12% of the superficial fresh water of the planet and adequate conditions for exploitation. The hydroelectric potential is estimated in about 260 GW, from which 40.5% are placed in the Amazonas Hydrological Basin. In order to compare, the Paraná Basin is responsible for 23%, the Tocantins Basin, for 10.6% and the São Francisco Basin, for 10%. Yet, only 63% of the potential was inventoried.[3]

Some of the stations that are in a bid process or under construction in the Amazon region will be in the list of the ten biggest in Brazil: Belo Monte (that will have installed power of 11,233 megawatts), São Luiz do Tapajós (8.381 MW), Jirau (3.750 MW) e Santo Antonio (3.150MW). Among the biggest ones that are functioning are: Itaipu (14 thousand MW, or 16.4% of the whole energy consumed in all Brazil), Tucuruí (8,730 MW), Ilha Solteira (3,444 MW), Xingó (3,162 MW) e Paulo Afonso IV (2,462 MW).[4]

3 http://www.brasil.gov.br/infraestrutura/2011/12/potencial-hidreletrico-brasileiro-esta-entre-os-cinco-maiores-do-mundo

4 Manual de Inventario Hidroeléctrico de Bacias Hidrográficas / Ministerio de Minas e Energia, CEPEL. – Rio de Janeiro: E-papers, 2007.

The North Region of Brazil has a great potential yet to be exploited. Nevertheless, these new stations from North region face a logistic challenge: the transmission to big centers that are thousands of miles away. This problem will be solved by the Sistema Integrado Nacional – SIN (National Integrated System) a network composed by lines of transmission and plants that operate in most parts of the country territory.

The National Agency of Electrical Energy (ANEEL) auctioned, on February 2014, 2.1 thousand kilometers of transmission lines that will connect the Hydroelectric Plant of Belo Monte to the Southeast Region. The facilities, located in the states of Pará, Minas Gerais, Tocantins and Goiás, must became operational in 44 to 46 months. The forecast is that 15 thousand direct jobs will be created and that the investments will be of 5 billion Reais (Brazilian currency). According to Aneel, it will be the first time that the country will build a transmission line of 800 kV with direct current.

The approach of the referred theme will be made in two chapters. In chapter 1, the theoretical framework about the investment's evaluation will be discussed. At this point, matters like the cost of capital in the electric power sector, the expected returns for the stockholders and the perspectives of analysis and methodologies of discounted cash flow analysis will be evaluated.

Chapter 2 is composed of two sections. In the first section, the Belo Monte case will be presented and it will be discussed questions related to the social, economic and environmental aspects associated with the project. In the second section, an economic and financial evaluation will be made and the results of the study will be will be presented. These results will confirm the hypothesis defined in this paper, that is: the Belo Monte Hydroelectric Power Plant is viable, adds value to the investors and presents positive externalities to the society.

The last part of this paper has some considerations about the positive impacts of Belo Monte Power Plant project regarding the social economic development of the region close to the Construction of the Plant.

CHAPTER 1

THEORETICAL FRAMEWORK OF INVESTMENTS EVALUATION

The environment of the Setor Elétrico Brasileiro - SEB (Brazilian Electric Sector) demands that the investment decisions of a determined project have to be based on an analysis of the economic and financial viability. Among other reasons, due to the fact that it contributes as an instrument of support to the system planning, as well as in the managing and establishment of priorities.

When participating in a specific project involves the formation of a consortium of companies (public or private), it is extremely relevant the determination of the profitability inherent to each of the participants of the structure of the financing of the project.

In this context, Brazil's government is signalizing the intention of stimulating the participation of the private capital in the infrastructure sector. Therefore, in association with the change of the managing model, transmitting to the society the additional costs related to inefficient decisions will not be possible anymore. Consequently, the companies of the sector will have to accurately analyze the resulting impacts of their decisions based on the quantification of the risks, in the capacity of absorbing eventual losses, in the desired rate of attractiveness to the enterprises and in the competitiveness of the projects.

In order to analyze the viability and the financial risk of building projects of generation power plants, it is indispensable to precisely identify which are the main parameters that influence its viability so that they can measure the impacts in the financial return.

The financial analysis of power generation projects is also necessary due to many other factors, such as the characteristic of strong mobilization of capital: *"sunk costs"*. That is, the implementation costs will not have another destination different from the one that was initially planned.

The investment analysis is a process that evaluates a diversity of alternatives and that decides which the best option is. In order to manage the financing of enough creditors that assures the creation of a project, in a way that they will be convinced of investing, it is necessary to prove the economic-financial viability of the enterprise and its ability for ensuring the credit for the payment of the financing debt. Besides, the investors need to be familiar with the economic and technical characteristic of the project and with the risks involved in it, so that the financial return is enough to compensate the risks taken.

The economic viability of an enterprise can be verified when the expected Net Present Value (NPV) of future net worth cash flows are higher than the expected costs of the investment, that is, when the NPV of the projects is positive (FINNERTY, 1999).

When studying the participation in a determined business venture of hydraulic generation it is essential to analyze the amount of the necessary investment to the implementation of the project, the curve of the disbursement of the work (that represents the physic and financial schedule), the need for fund raising, the technical characteristics of the power plant, loss indexes, hiring conditions, taxes incentives, among others.

According to ROSS:

> *"In the analysis of the economic-financial viability, the entrepreneur needs to be concerned about three important aspects. The first is about the capital budget decision, which indicates how the planning and management of the long term investment expenses of the project. The second is about the financing decision, that is, which will be the resources used to finance the enterprise's investments. Finally, the third aspect calls the attention for how and which short-term finances will be made in order to pay the expenses." (ROSS et al., 1995)*

The investment's evaluation process of a project follows five steps (FINNERTY, 1999):

> *"Step 1. Estimate the expected future cash flows to the project.*
>
> *Step 2. Evaluate the risk and determine the discount rate (capital opportunity cost) to discount the expected future cash flows.*
>
> *Step 3. Calculate the financial indicators, mainly the NPV of the expected future cash flows.*
>
> *Step 4. Decide whether to invest or not in the project. Therefore, in order to determine the expected profitability of a project and its attractiveness, it is essential to make the analysis of the discounted cash flow."*

The profitability of a project depends on its future cash flow. Considering that R$1.00 received today is more valuable than the same R$1.00 that will be received in a year, it is clear that in the analysis of a project it is essential that the value of the money is considered according to the time.

There are several methods for analyzing projects. The more popular ones, that take into consideration the value of the money according to the time, are the Net Present Value Method and the Internal Rate of Return Method.

1.1 NET PRESENT VALUE METHOD - NPV

The net present value method, or NPV method, compares all the cash inflows and outflows in the initial date of the project, deducting all the future values of cash flow by the interest rate that measures the cost of capital. The general formula of the NPV is the following:

$$VPL = \sum_{t=0}^{n} \frac{F_t}{(1+i)^t},$$

Where,

Ft: Net Cash Flow;

n: Analysis deadline, also called studying period;

i: Capital cost or opportunity cost, that is, the minimum remuneration acceptable by the investor.

If the NPV is positive, that is, NVP > 0, the sum of all income represented in the cash flow is higher than the sum of all expenses at time 0, including the value of the investment. In this case, it can be affirmed that the capital put up by the investor will be totally recovered based on its capital cost.

Besides that, you might say that at time 0, the project will generate an extra profit that is equal the to the NPV itself, assuring to the investor a profitability superior to the opportunity cost of its capital and adding value to its patrimony.

Then, the NPV criteria establishes that while the present value of the cash inflows are higher than the present value of the cash outflows of the project, calculated with the rate that measures the capital cost of the investor, the project might be accepted.

The decision criterion can be summed up based on the NPV as follows:

- ✓ NPV > 0, the project should be accepted;
- ✓ NPV = 0, accepting or not is indifferent;
- ✓ NPV < 0, the project should not be accepted.

The NPV method is usually appointed for projects evaluation because it recognizes the value of money in time, reflects the increase of richness to the investor and depends only on the cash flow and on the capital cost.

1.2 INTERNAL RATE OF RETURN (IRR) METHOD

The Internal Rate of Return, or IRR, is the discount that makes the NPV becomes zero. The IRR is the highest opportunity cost of the capital that the project can hold. The criteria of the Internal Rate of Return establishes that while the value of the IRR is higher than the value of the capital cost, the project must be accepted, that is:

- ✓ IRR > i, the project must be accepted;
- ✓ IRR = i, accepting or not is indifferent;
- ✓ IRR < i, the project should not be accepted.

A characteristic of the IRR is that, most of the times, it brings the same results that the NPV brings, but these can be conflicting in some cases. This method is largely used in practice, but some measurements need to be taken in order to use it in the right way:

- ✓ Among a set of projects, the one that has the highest IRR, does not necessarily have the higher NPV. That is why we need to be careful when using the IRR in an indiscriminate way when choosing projects that are mutually exclusive;
- ✓ In projects that the cash flow changes the down payment more than once, there can be multiple values of the IRR, or there may not be any IRR;
- ✓ In long projects, there can be many opportunity costs. Since the IRR is only one to the whole project, it is not clear to which opportunity cost it must be compared. It is

questionable that a fixed rate to all the periods represents a cash flow evaluated by different opportunity costs.

- ✓ The great advantage of Internal Rate of Return lies in the fact that it can be calculated on the basis of project data alone. In particular, its calculation does not require data on opportunity cost of capital which is critical to the Present Value Technique and can often be exceedingly difficult to estimate.[5]

1.3 PERSPECTIVES OF CASH FLOW ANALYSIS

As shown previously, the basic element to the financial evaluation of a project is the analysis of your cash flow. Normally, the cash flow can be obtained and discounted under three perspectives: 1) perspective of the Total Investment (full equity), 2) perspective of the Investor and 3) perspective of the Dividends.

1.4 PERSPECTIVE OF THE TOTAL INVESTMENT

Under the perspective of the **Total Investment**, it is wished that the project is analyzed as a whole, measuring its profitability without distinguishing the sources used in the project financing framework, that is, it is important to know the return to all rights' owners of the shareholding project and the financial backers.

Thanks to this, the cash flow does not take into consideration the loans that were made as well as debt service associated to the financings. However, the financial effect of the financing framework can be verified, in an indirect way, in the discount rate used to calculate the NPV of the project, which is given by the Weighted Average Cost of Capital - WACC. Later, the concept of the WACC will be better analyzed.

Therefore, the aim of this analysis is to verify if the project can remunerate the several agents that are allocating capital in it, considering an average discount rate that represents the capital cost of each the sources mentioned before.

The viability analyses that took place under the perspective of the Total Investment are also called Analysis de of the Economic Viability of the project. A project is considered economically viable if its profitability is equal or higher than the weighted average cost of capital that is invested in the enterprise.

1.5 PERSPECTIVE OF THE INVESTOR

As mentioned in the previous section, the perspective of the Total Investment verifies the economic viability of a project as a whole. Nevertheless, it is known that this condition is necessary, but it is not enough to ensure that the profitability obtained by each agent that participates in the project is superior to its capital cost individually. This analysis is made under the perspective of the Investor, when the project is verified according to a specific financing framework and is capable of remunerating the capital of the stockholders in the intended value.

5 Advantages and defect of the internal rate of return, Chapter 2, pg 27. Project Evaluation, collected Papers, Arnold C. Harberger.

In this case, the cash flow is calculated considering the effects of the loans and of the debt service, resulting in cash flow associated to the equity capital. The NPV of the project is obtained through the discount of the cash flow by the cost of the equity capital.

The analyses of viability made under the perspective of the Investor are called Analysis of the Economical-Financial Viability of the free cash flow to the stockholder. The premise is that the cash flow is available to the stockholders, regardless the distribution of dividends. A project is considered economically and financially viable if its profitability is equal or higher than the equity capital cost to be is invested in the enterprise.

1.6 PERSPECTIVE OF THE DIVIDENDS

As seen previously, the analysis of the project by the Perspective of the Investor determines if it can pay satisfactorily its stockholders' capital, when supposing a given financing condition. An alternative approach in the determination of the attractiveness of a project would be considering that the earning that comes from the investment that was made occurs as a way of receiving dividends, in the form of interest over the equity capital distributed by the project, and of eventual reductions of the capital that can happen.

In this approach, it is considered that the Investor holds a share of the project, being remunerated according to this logic. Thus, in the viability analyses performed under the perspective of the stockholder, the project is considered doable when its profitability is equal or superior to the cost of the equity capital invested, considering that the investment made will be remunerated exclusively through the receiving of dividends, interest over the equity capital, and of any capital reduction that may happen.

1.7 COST OF CAPITAL

One of the differences between the perspectives of the cash flow analysis is the utilized capital cost. Consequently, it is important to define the capital costs of the project. The components of the capital cost framework of a project are:

- ✓ Equity Capital Cost (Ke);
- ✓ Average Cost of Debt (Kd)

A project could be financed only with equity capital. In this case, your capital cost would be the remuneration demanded by the investors, that is, the cost of equity capital. Most of the projects, however, are financed with a great amount of debt. The reasons why it happens are diverse, but one of the main facts is that the debt cost is normally lower than the cost of equity capital. The investors take a higher risk than the creditors, since their capital is invested during a longer term and without the guarantees of the payment of loans. Thus, it is reasonable to suppose that the investors are paid with a rate higher than the creditors', to compensate the higher risk that was taken.

1.8 EQUITY CAPITAL COST (Ke); [6]

6 Part of the approach to explain the Cost of Equity was obtained from the Texts for Discussion of the Electricity Sector - TDSE: Cost of capital for investment appraisal activity for generation, distribution and transmission, and Luiz Roberto Brandão Ozório. Coordination: Teacher Nivalde J. Castro Study Group of the Electricity Sector (GESEL IE-UFRJ). Rio de Janeiro, July 2009.

The equity capital cost is calculated based on the opportunity cost of the capital that was invested. Taking into consideration that the project must remunerate the investors at the minimum of its capital cost so that they accept to participate in the project, it is essential to determine this parameter in order to fulfill the investment analysis.

With the aim of determining the equity capital cost in an appropriate way, a great number of models were developed through time, being the two main models the Dividend Discount Model (DDM), known as Gordon Growth Model and the Capital Asset Pricing Model (CAPM).

The methodology that is used most by the market to calculate the stockholders capital cost is the CAPM model (Capital Asset Pricing Model). The CAPM Model relates the capital cost of an asset to the current level of the interest rates and the premium risk that the market attributes by investments in variable income, weighing the last one by the beta index. The estimative of the Stockholders' Capital Cost (Ke) can be found in the formula below:

$$Ke = Rf + \beta i * (E(Rm) - Rf)$$

Where:

Rf = Expected Return of an out of risk asset;

βi = Beta Index of the Asset (i) Related to the Market (m);

E(Rm) – Rf) = Premium Risk of the Market Portfolio.

Based on the supposition that the typical investor has diversified investments, the CAPM model believes that the main premise that the volatility of the returns is the appropriate measure to the risk and that only part of this volatility is systematic (does not diversify) should be awarded. This systematic risk is incorporated in the beta index, which measures the sensitiveness of the returns of the asset in relation to the market returns. In order to find the beta index of the asset, a linear regression of the weekly returns of an asset priced in the stock exchange with market returns is usually made, in a period of two years or through the following formula:

$$\beta i = \frac{COV(i,m)}{VAR(m)}$$

Where:

βi = Beta Index of the Asset i

COV(i,m) = Covariance of the Asset (i) and Market (m)

VAR(m) = Variance of the Market (m)

A beta 1 means that the asset has a risk similar to the markets. A beta lower than 1 means that the assets' returns are less sensitive to the economic fluctuations than the market average. A beta higher than 1 means that the assets' returns are more sensitive to the economic fluctuations than the market average.

An alternative to the calculation of the beta index obtained through the historic returns of the asset and of the market is the use of the sectorial beta. This can be done when it is believed that the risk of the sector in which the evaluated company or project is part of, is a better parameter of sensitivity of the investment risk than the regression beta made from the quotation of the company's share in the stock exchange. The sectorial beta is also an interesting alternative to the implementation of the CAPM in companies that do not have shares in the stock exchange, to which it is not possible to estimate the beta through regression.

The other parameters that are used by the model CAPM, are the Risk Free Rates (Rf) and the Premium Risk of the Market Portfolio (Rm – Rf).

The Risk Free Rate represents the minimum return expected by any investor and to any investment. The Risk Free Rate is usually estimated according to the returns over sovereign debt securities (governments' bonds) of mature economies. Because of the defined redemption value (pre-determined) and the low risk of default of its issuers, these assets, in a normal economic situation, pay their investors real annual rates (above inflation) of 2% to 4%. These rates are also known as premium "for the wait" or premium for the postponement of the consumption.

The Premium Risk of the Market Portfolio (Rm – Rf) is the premium that the investor waits to receive for applying in assets of variable income (shares), riskier than the fixed income bonds. The greatest demand of return for investments in shares is due to the aversion that investors have to risks. Typically, analysts use the historic averages of the premiums (difference between market returns and risk free assets), to estimate the market premium risk.

1.9 AVERAGE COST OF DEBT

In Brazil, the interest paid in loans is deductible in order to determine the taxation of the project. Consequently, the real cost of the loan is lower than the apparent cost, because the government pays the loan as a way of reducing the income tax and social contribution. For a loan with a rate of 20% and tax aliquot (income tax + social contribution) of 33%, the real cost of the loan is: (1 - 0.33) x 0.20 = 0.134 or 13.4%.

Thus, the Average Cost of Debt (*Kd*) can be defined as:

$$Kd = K\,(1 - T)$$

Where *K* is the average interest of the loans and *T* is the applicable aliquot of taxation.

1.10 WEIGHTED AVERAGE COST OF CAPITAL

The Weighted Average Cost of Capital (WACC) of a project is the weighted average of the costs of all kinds of financing, that is, the WACC can be obtained from the average cost of debt and from the equity capital cost, weighted by the participation of each one of them in the investment associated to the project. For example, the following financing framework of a project is:

- ✓ Participation of Equity Capital Pp = 30%;
- ✓ Participation of Debt = 70%;

- ✓ Equity Capital Cost (Kp) = 15%;
- ✓ Average Cost of Debt (Kd) = 8%

The Weighted Average Cost of Capital of this project will be:

$$WACC = Pp\ Kp + Pt\ Kd = 0.3 \text{ x } 0.15 + 0.7 \text{ x } 0.08 = 0.101 \text{ or } 10.1\%.$$

1.11 EVALUTION MODEL FOR THE BELO MONTE POWER PLANT

The economic and financial evaluation of the Belo Monte project (11,233 MW) will be tested in the financial model in the platform Excel, for this to happen, during this chapter there will be a brief description of the functionalities of this.

This tool in Excel allows the evaluation of the financial competitiveness of investment of the project before many scenarios as the investment costs, technical characteristic of the power plant, costs of fixed and variable O&M, installation schedule, structure and financial conditions, and other parameters.

The problem of the economic and financial analysis is associated with the determination of indexes that reflect the profitability that can be obtained by a determined project. The recommended methods for projects' evaluation are based on the analysis of the projections of cash flows generated by the project throughout their life time.

In the analysis of viability and financial risk were considered uncertainties associated to the project through three basic methods: analysis of sensitivity, analysis of scenarios and analysis of risk.

1.12 SENSITIVITY ANALYSIS

The sensitivity analysis is a procedure that verifies the impact in the financial indicators, like the Net Present Value (NPV) and the Internal Rate of Return (IRR), when varies a determined parameter relevant to the investment. Thus, this analysis allows detecting to which of the estimates of the project the financial indicators are more sensible and relevant, and consequently, which should be estimated more precisely.

After this, it is possible to determine the value of each estimate of the parameter that zeroes the NPV of the project, that is, the reversal point, allowing separating the interval of acceptance or rejection of the project (LAPPONI, 2000).

The sensitivity analysis of the financial model deals with each variable separately when, in practice, all the variables involved in the project tend to be associated, besides the fact that some variables can be foreseen more easily than others, however it does not invalidate the evaluation.

1.13 ANALYSIS OF SCENARIOS

Due to the fact that the sensitivity analysis checks the effects of only one variable of interest in the project in the results of the financial indicators, the scenario analysis consists in varying more than one parameter simultaneously, creating a set of alternative scenarios and embodying the probable gap of variations of the parameters of the project. This technique of risk analysis reviews many possible scenarios about the enterprise, where each one of them considers a given combination of factors.

The procedure of the scenario analysis considers three kinds of scenarios for the analysis of the risk of the project: More Probable, Optimistic e Pessimistic. The first scenario is considered the most probable by the specialists in the business field of the project, where it is used the expected value (average) or the most "representative" of each estimate of the project. In the optimistic scenario, determined parameters of interest of the scenario are increased in value, while in the pessimistic scenario occurs the opposite, the values diminish in relation to the basis scenario.

1.14 RISK ANALYSIS [7]

The main advantage of the previous methods reside in the simplicity and easiness of their use, besides providing the identification of the most important and impacting to the modeling of the risk. Despite the importance and great use of these methods, the uncertainties associated to the estimates of the parameters were considered in a subjective way.

A more efficient way consists in the construction of random, but probable, scenarios from the distributions of probabilities of the interest variables. In this case, the uncertainties in the parameters are considered in an explicit way, through the use of probabilistic techniques (KLEIJNEN, 1974).

Many statistics can be used as a way of measuring the risks in the projects, as the expected value of the financial indicators, its variances, semi variances, etc. For example, the expected value of a financial indicator I, E(I), can be given by:

$$E(I) = \sum_{x \in X} I(X) P(X)$$

Where:

x, vector representing a scenario that is going to be analyzed; each component in x represents the state of a random variable.

X, space of states, i.e., the set of all the possible x scenarios x, that result from the combinations of the random variables that are considered.

P(x), probability of the x scenario.

I(x), obtained result to the financial indicator I in the analyzed x scenario.

The calculation of statistics can be done through analytical techniques or by using the Monte Carlo Simulation method. The analytical methods present very attractive characteristics: they are precise, efficient for computation and allow a better understanding of the relationship between the inflow and outflow in the adopted probabilistic. However, many times, in order

7 This section is from the Methodology of the Program Manual ANAFIN (2002).

to turn the problem into something that can be treated analytically, it is used simplifying and strong hypotheses. In these cases, there is a need of applying statistics simulation techniques.

1.15 BASIC CHARACTERISTICS OF THE FINANCIAL ANALYSIS [8]

The main data for the financial evaluation of a project of electric power generation will be presented below:

- ✓ Physical and financial schedule of the investment expenses;
- ✓ Financing Framework - participation of equity and composition of debt, as, for example, the set of bonds of the company to finance the investment of the project, proportions related to the debts of short and long term deadlines and equity capital;
- ✓ Financing conditions - sources of fund raising in national or foreign currency, interest rates, grace periods and amortization deadlines;
- ✓ Technical characteristics of the electric project - installed total power, availability factor, useful life, energy fee, installation timetable of the generating units, among others;
- ✓ Taxes and other costs - land, net cost, O&M, Contributions, ICMS (Brazilian tax - state added-value sales tax) and COFINS (Contribution to Social Security Financing), Income tax, Social Contribution, ANEEL (National Agency of Electrical Energy) Supervision, etc.

1.16 INDICATORS OF THE DETERMINISTIC ANALYSIS

- ✓ Net Present Value (NPV) of the project - present value of the future receipts discounted the interest rates, minus the present value of the investment costs;
- ✓ Internal Rate of Return (IRR) of the project - discount rate that equals the NPV of the investment to zero;
- ✓ Balance Investment - corresponds to the minimum value of investment that remunerates the capital of the agents that participate in the project in the percentages that were previously defined.

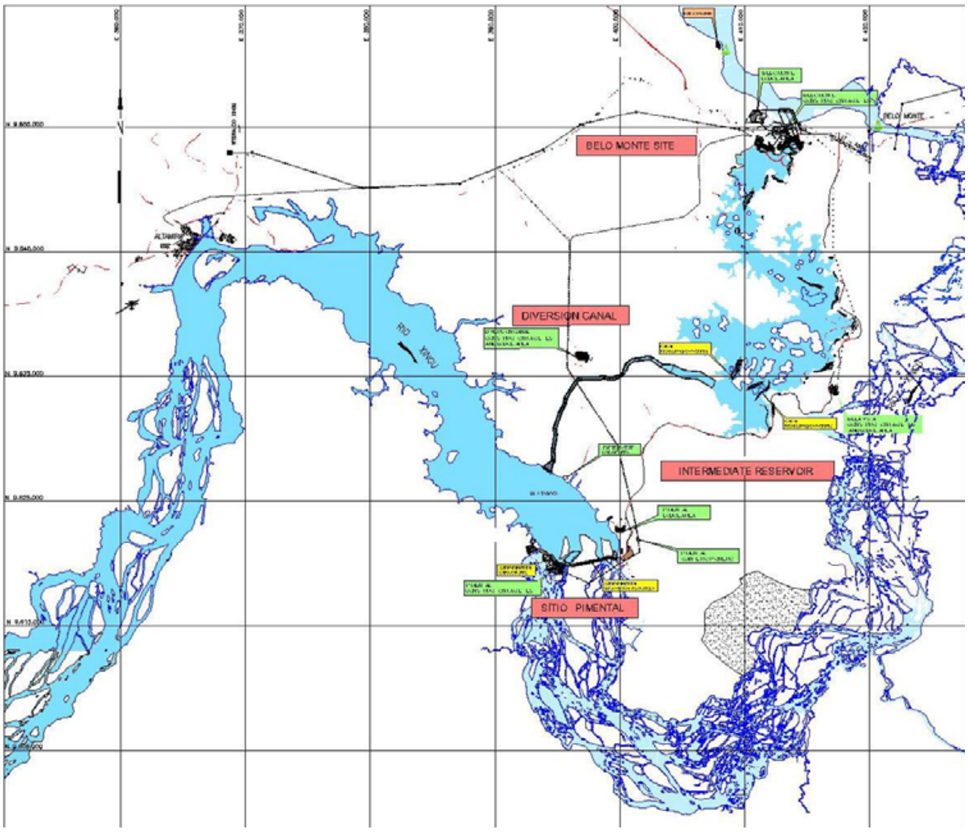
8 These characteristics were from ANAFIN Mothodology Manual Program - ANAFIN (2002).

CHAPTER 2

THE BELO MONTE POWER PLANT PROJECT

2.1 GENERAL ASPECTS OF THE PROJECT

The enterprise understands the great hydrologic development of the Xingu River, in the State of Para, with the installation of the Belo Monte Power Plant in the territory of the municipality of Vitoria do Xingu, which reference coordinates are 03°26'13"S and 51°56'49"W.



The Belo Monte Hydroelectric Power Plant project is old, but the current efforts with investment in development in order to optimize the project, in the environmental and social point of view allowed its viability, with a modified proposal that includes a smaller waterlogged area, construction of water transmission channels, two machine rooms and numerous dams, besides a social and economic project in the city of Altamira-PA, which will be covered more deeply further.

Over the inventory and viability stages, the engineering project of the Belo Monte Power Plant was adjusted because of the social and environmental demands. Some modifications are mentioned below:

a. Flooding area reduction from 1,225 km^2 to 516 km^2
b. Indian lands will not be flooded (in the engineering studies of the 80s, part of the Indian territories of Paquicamba, Arara da Volta Grande do Xingu e Trincheira Bacaja would be flooded).

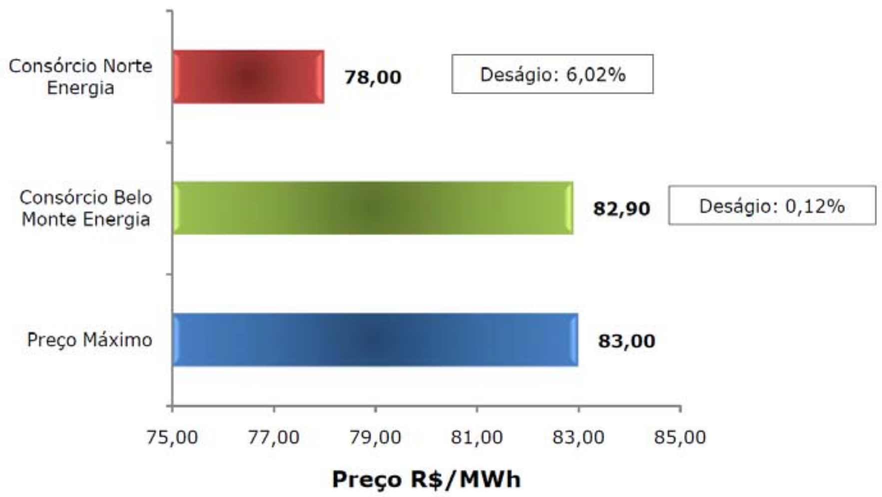
c. Reviews in the engineering project and in the Inventory Studies of the Xingu River basin, approved by Aneel, setting the construction of only one large size power plant in the Xingu River – the Belo Monte Power Plant. The inventory studies of the 80s preconized the construction of other kinds of exploitation in the Xingu River.

The approval process of the public bidding documents for the construction and sale of the energy that comes from the Belo Monte Power Plant involved a lot of demands related to the adjustment of the enterprise to the social and environmental impacts resulting from the installation of the hydroelectric complex, besides the viability studies of the project and the preparation of the bidding documents.

Besides these many demands prior to the auction, on April 20th 2010, through the Auction/Aneel # 006/2009 and according to the context of public Brazilian concessions, especially in the electric sector, it was given an entrepreneur qualification to build and operate, in a period of 35 years, the Belo Monte Hydroelectric Power Plant ("UHE Belo Monte"), in the Xingu River, state of Para.

The qualification was given to the proponent that offered the lowest energy price to sell it to the registered distributors in the Auction, integrated to the Sistema Interligado Nacional [National Interconnected System] - SIN. The proponent that won the bid was the **Consorcio Norte Energia [North Energy Consortium] that offered a bid of R $** 78.00/MWh.

MAXIMUM PRICE AND RESULTING PRICE OF THE ANEEL AUCTION 006/2009.



The Belo Monte Power Plant will have an installed capacity of 11,233 MW, operating with a physical warrant of 4.571 MW. For the implementation of the Belo Monte Power Plant project, it was constituted a Special Purpose Company – SPC, denominated **Norte Energia S.A** (North Energy Corporation) with the following shareholding formation, which is showed below in details[9]:

9 Along the years the SPE had some changes in stockholder`sequiy, but nothing that has relevance in the anaysis in reference.

Business Partner	Share Ownership
Eletrobras Group	**49.98%**
Pension Funds	**12.50%**
Investments Funds	**5.00%**
Special Purpose Company - SPC	**10.00%**
Builders	**12.27%**
Others Entities	**0.25%**
Self- Producers	**10.00%**

Source: Norte Energia S.A

2.2 BASIC DATA OF THE POWER PLANT

The forecast for the beginning of the construction of the Belo Monte hydroelectric power plant is due to February, 2015. The total estimated investment is of de R$ 25.8 billion, base date April/2010 (US$ 14.962 billion). From the day of the signature of the contract of concession, August 26th 2010, the construction might last 4 years and 6 months until the first turbine begins operating commercially in February, 2015. The initial premises used in the viability test of the Belo Monte Power Plant are in the following table.

Basic Data		
Commercial Operation	Feb-15	-
Study Period	35	years
Installed power	11.233	MW
Investment in Brazilian Reais (R $)	25.885	Billions
Investment in U.S. Dollars (U.S. $)	14.962	Billions
Investment	2.304	R$/kW
Exchange rate	1.73	R$/US$

Source: Norte Energia S.A (Adapted). Date Base: April/2010.

2.3 TECHNICAL DATA

The Belo Monte Power Plant will have an Installed Power of 11,233.1 MW and a Physical Warrant of 4,571 MW (average), divided in:

a. 10,998 MW in the *Main Power House* composed of 18 Francis turbines of 611 MW, with 619,2 meters of length and 90 meters of gross head, corresponding to a Physical warrant of 4,418.9 MW (average).
b. 232.9 MW in the *Supplemental Main Power House* composed of 6 generating units (Bulbo type) of 38.8 MW of 94.80 meters of length and 11.4 meters of gross head, corresponding to a Physical Warrant of 152.1 (average).

The table below presents the schedule for the machine operations' beginning with more details:

Turbines	Start of Operation	Installed Power (MW)
1 Turbine	Feb-15	38.8
2 Turbine	Apr-15	38.8
3 Turbine	Jun-15	38.8
4 Turbine	Aug-15	38.8
5 Turbine	Oct-15	38.8
6 Turbine	Dec-15	38.8
7 Turbine	Mar-16	611.1
8 Turbine	May-16	611.1
9 Turbine	Jul-16	611.1
10 Turbine	Sep-16	611.1
11 Turbine	Nov-16	611.1
12 Turbine	Jan-17	611.1
13 Turbine	Mar-17	611.1
14 Turbine	May-17	611.1
15 Turbine	Jul-17	611.1
16 Turbine	Sep-17	611.1
17 Turbine	Nov-17	611.1
18 Turbine	Jan-18	611.1
19 Turbine	Mar-18	611.1
20 Turbine	May-18	611.1
21 Turbine	Jul-18	611.1
22 Turbine	Sep-18	611.1
23 Turbine	Nov-18	611.1
24 Turbine	Jan-19	611.1
Total		**11,233**

Source: Norte Energia S.A

The Belo Monte Power Plant will have, basically, three types of energy contracting: in the Regulated Contracting Environment - RCE related to the sale in the Auction # 006/2009-ANEEL; in the Unregulated Contracting Environment - UCE (*spot* market or bilateral contracts); and in the scope of self-production (when a partner of the power plant buys part of its production to his own use).

The positions considered for energy sale produced by the Belo Monte Power can be summarized this way:

a. The price of the RCE comes from the results of the Auction # 006/2009 and faces all the implications that come from the bidding documents that ruled the dispute mentioned before. 70% of all the produced energy will be commercialized in this environment with the price of 78 R$/MWh.
b. The UCE price comes from a clause of the Norte Energia S.A. Stockholders Agreement, concession owner of the Belo Monte Power Plant, according to which Eletrobras (Brazilian Electricity Company), or companies that belong to its group, have the option of buying the energy that comes from the Belo Monte Power Plant for R$ 130.00/MWh, representing 20% of all the commercialized energy.
c. The price of R$ 100.00/MWh to Self-Producer comes from the negotiations with the self-producers partners, equally established in the Stockholders Agreement, and represents 10% of the commercialized energy.

Based on the information above, the average sale's price of the energy that comes from the Belo Monte Power Plant will be R$ 90.6 MWh that corresponds to the weighted average of the sale's price in the regulated, unregulated environments and to the self-producer.

2.4 EXPENSES

For the ***Operational Costs and Expenses*** it was considered, for the Belo Monte Power Plant, the following premises:

Operational Cost and Expenses			
Description		**Value**	**Frequency**
Administrative Expenses	R$	20,000,000	per year
Connection Charges	R$	3,500,000	per year
Energy Trading Chamber - CCEE	R$	300,000	per year
Insurance	R$	12,500,000	per year
Xingu Sustainable Regional Development Program	R$	250,000,000	during the concession

Source: Norte Energia S.A e Edital leilão # 006/2009-Aneel. Data Base Abril/2010

Amongst the operational expenses and costs, the expenses of the *Programa de Desenvolvimento Regional Sustentável do Xingu* - PDRS (Xingu Sustainable Regional Development Program) stands out. The PDRS of Xingu is a program that intends to promote the development of the region, and its guidelines are the social and environmental requirements involved in the process. The Plan was established through the signature of the Decree # 7,340 of 10/21/10. Afterwards, the Decree # 7,373, of 11/26/10, created the Plan Managing Counsel, responsible for the definition of the investments insured to the implementation of the PDRS. The *Conselho Gestor do Plano do Xingu* (Managing Council of the Xingu Plan) is formed by the federal government representatives, state and municipal, and by other institutions.

In this program, it will be spent a total of R$500 million, with R$ 250 million in the building phase and the rest in the operational phase, according to the table above. Through this Xingu Sustainable Regional Development Program and through the implementation of actions foreseen in the *Estudos de Impacto Ambiental* [Environmental Impact Studies] EIA, the following projects will take place: streets' paving and drainage, water supply and distribution, improvement in the garbage collection, construction and operation of sanitary landfill and sewer system construction.

Additionally, the costs of the *Tarifa de Uso do Sistema de Transmissão* (Transmission System Usage Tariff). This is a legal encumbrance of the electric Brazilian sector that incurs over the consumers connected to the electric systems of transmission concessionaires. This is one of the more relevant expenses during the operational phase of the Belo Monte Power Plant. As determined in the **Bidding Documents,** the values of the Usage Tariffs of this sectorial encumbrance are defined in the following table:

Transmission System Usage Tariff		
Description	**Value**	**Unit**
2015	-	R$/kW Mês
2016	4.923	R$/kW Mês
2017	4.736	R$/kW Mês
2018 until the end	4.549	R$/kW Mês

Source: Edital leilão n. 006/2009-Aneel. Data Base jun/2009

This encumbrance of the Transmission Grid Usage will cost about R$ 640 million per year to the Norte Energia S.A, when all the turbines are in commercial operation, that is, from 2019.

The other operational expenses are related to the following table.

Other Regulatory Charges			
Description		**Value**	**Unit**
Contribution ONS	R$	567,000	per year
Use of Public Property	R$	16,617,413	per year
ANEEL Inspection Fee	R$	20,421,594	per year
Compensation for use Water Resources	R$	174,846,221	per year
Research & Development - R & D		1.0%	Net income

Source: Edital leilão n. 006/2009-Aneel. Data Base jun/2009

The financial compensation for the Hydric Resources Usage of R$ 174.8 million per year refers to the total physical warrant of the power plant of 4,571 MW (reached in 2019), being recognized proportionally to the beginning of the turbines operation. This tariff was defined in the Aneel Ratifying Resolution # 917/2009.

Operation and Maintenance of the Belo Monte Power Plant 11,233 MW will be performed by Eletronorte – Eletrobras subsidiary and holder of 19.98% of the shares of company Norte Energia S.A. The values are in the table below and will be readjusted through IPCA (Extended National Consumer Price Index).

Operation & Maintenance					
Year	**R$ Millon**	**Year**	**R$ Millon**	**Year**	**R$ Millon**
2015	35.1	**2025**	68.6	**2035**	72.4
2016	40.7	**2026**	69.0	**2036**	7.6
2017	52.5	**2027**	69.4	**2037**	73.2
2018	63.4	**2028**	69.7	**2038**	73.5
2019	66.7	**2029**	70.1	**2039**	73.9
2020	66.7	**2030**	70.5	**2040...**	74.3
2021	67.1	**2031**	70.9		
2022	67.5	**2032**	71.3		
2023	67.8	**2033**	716.0		
2024	68.2	**2034**	72.0		

Source: Edital leilão n. 006/2009-Aneel. Data Base jun/2009

2.5 TAX PREMISES

The Belo Monte Power Plant is part of the tax regimen of Taxable Income, because its annual turnover exceeds the limit of R$ 78 million established in the tax legislation for the Presumed Profit assessment regimen option.

Since the enterprise is localized in the Legal Amazon region, it was considered a reduced tax benefit of 75% of the related Income Tax. It was an incentive of the *Superintendência do Desenvolvimento da Amazônia* - SUDAM (Superintendence for the Development of the Amazon) which development begins in 2016 and ends in 2025.

The project is also part of important programs of governmental incentives, in which, the Regime Especial de Incentivos para o Desenvolvimento de Infraestrutura [Special Incentive Regime for the Development of the Infrastructure - REIDI, instituted by the Law 11.488/2007, that consists of one of the measures of tax incentives in the Programa de Aceleração do Crescimento [Program of the Acceleration of the Growth] (PAC) of the Federal Government.[10]

The Norte Energia S.A SPE [Special Purpose Entity] also integrates the Programa de Aceleração do Crescimento [Program of Growth Acceleration] (PAC). The PAC comprehends the set of economical politics that has the objective of accelerating Brazil's economic growth. In four years, the program forecasts a total of investments in the infrastructure of R$ 503.9 billion, in the transportation areas, energy, sanitation, habitation and hydric resources.

2.6 DISBURSEMENT INVESTMENT AND SCHEDULE

As described previously, the date for the beginning of the commercial operation of the first generating unit is in February 2015, from this period on, the new units will begin their operations in each two months, to the auxiliary power house. In March 2016, the phase of the installation of the main power house will begin, and in each two months a new turbine will be added, and in January 2019, the last generating unit will be installed.

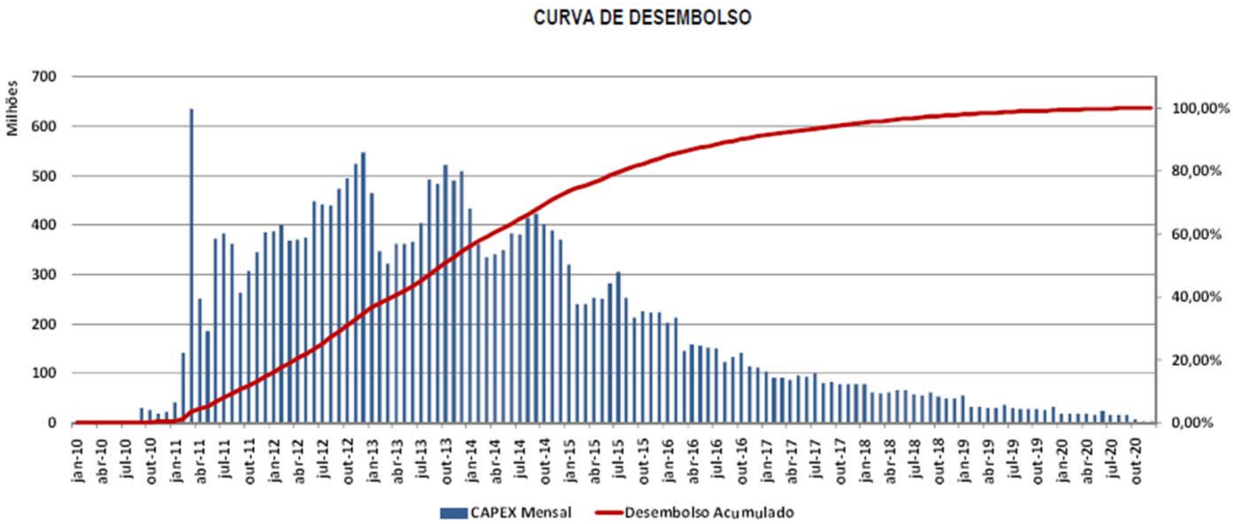
The total investment is of R$ 25.8 billion. The table below details the investment, taking into consideration the financeable and not financeable quota.

10 O REIDI consiste na instituição de alíquota zero para PIS e COFINS incidentes sobre a receita decorrente da venda de máquinas, aparelhos, instrumentos e equipamentos, novos, e de materiais de construção quando adquiridos por pessoa jurídica habilitada ao regime, para incorporação em obras de infraestrutura destinadas ao seu ativo imobilizado.

	R$ Millon
Investiment - Belo Monte Power Plant	
Eligible investments	**24,186**
General items	**2,212**
Construction - Plant, Dam and Reservoir	**19,390**
Construction - Transmission Systems	**90**
socioenvironmental	**2,494**
PDRS do Xingu	*250*
Social Investiments	*1,976*
Others	*268*
Not Eligible investiments	**1,699**
Land	*278*
Environmental	*714*
Others	*707*
Total	**25,885**

Source: Norte Energia S.A. Data base: abr/2010

The investment will take place in many years, as describe in the table below. Great part of the investment is concentrated in the years that precede the beginning of the commercial operation of the last turbine of the auxiliary power house, February 2015.



2.7 FUND RAISING

The investment of R$ 25.8 billion, necessary for the construction of the Belo Monte Power Plant, will be financed with the stockholders' capital (Equity), with the amount of R$ 5.5 billion and with the financing of the Banco Nacional de Desenvolvimento Econômico e Social [Brazilian Social and Economic Development Bank] - BNDES with the amount of R$ 20.3 billion, resulted in a capital structure of 21.4% of equity capital and 78.6% of debt (debt).

	R$ Millon
Sources Of Capital	
Equity	**5,550**
Debt	**20,335**
BNDES Direto	14,958
BNDES Indireto [1]	5,377
Total	**25,885**

Source: Norte Energia S.A

1: BNDES as a mediator

In relation to the debt, the premise is that 100% of the debt will be incurred to the BNDES, 73% will be in a direct way and 27% through transference of other national financial institutions, in the conditions described below:

Costs and Financing Terms	
BNDES Direto	
Financial Cost	TJLP
Spread Basic	0,5% per year
Spread Risk	0,9% per year
Term	30 years
BNDES Indireto	
Financial Cost	TJLP
Spread Basic	0,5% per year
Spread Risk	0,5% per year
Intermediation Spread	1,7% per year
Term	30 years

Source: Norte Energia S.A

The premise is that, first, the stockholders will allocate the amounts that correspond to 25% of the total investment and then, the banks will release the resources necessary to the continuity of the construction, the other 75% of the amount. This is a conservative premise, because the banks usually take about a year to release the financing.

Thus, the amounts predicted amounts of debt will start to be released from July of 2012, that is, one year after the beginning of the construction. During this period, the stockholders should manage the work with their own resources.

2.8 CAPITAL COST

As mentioned before on Chapter 1 of this paper, there are several methodologies that can be used in the evaluation of electric energy generation projects and enterprises, however, one of the methods that are used by the market more often is the Discounted Cash Flow Method.

The Discounted Cash Flow Method relates the current asset value directly to the expectations of the future cash flow and inversely to the investment risk value. This model allows an understanding of the sources that value an asset, because it considers: the perspectives of the growth of the income of the company, the operational expenses, the financial expenses/income, the risk of the appropriate investment in the estimate of the discount, among other factors.

Thus, for an appropriate evaluation of the cash flow and for the correct determination of its Net Present Value - NPV, the definition of the it is fundamental to define the Equity Capital cost, to discount the stockholder cash flow, and the definition of the Weighted Average Cost of Capital (CPMC or WACC) to discount the project cash flow, that considers the total investment (*full equity*).[11]

Then, the value of the equity capital cost was adopted accordingly to methodologies that are spread in the market and adopted by the Eletrobrás Group. The method that was utilized was the CAPM – Capital Asset Pricing Model, which corresponds to the following equation:

$$Ke = Rf + RP + \beta i\ (E(Rm) - Rf)$$

Where:

- Rf = risk free rate;
- RP = Country Premium Risk;
- ßi = Sectorial Beta;
- (E (Rm) – Rf) = Market Premium – Risk Free Rate

The Risk Free Rate (Rf) used corresponds to T-Bond 30 years to calculate the equity capital cost, because it is adherent to the investments' maturation deadlines of infrastructure, the percentage is 4.19% per year.

The EMBI+BR (Emerging Markets Bond Index Plus BR) was the index used as the indicator of country risk. This methodology considered the sovereign spread - that is the differential of the yield of the domestic bond of the desired country in relation to the North American bond of equivalent deadline, the percentage is 2.43% per year.

The unlevered Betas were also used to the generation activities. Such value was calculated based on the quotations variations of companies' shares of the segments mentioned in the Bovespa. The effect of the indebtedness level (leverage) of the companies of the sample was removed to reach the unlevered Beta. After the leverage is made using the capital structure of each company, an average of the segment is calculated with each of one of the companies' unlevered betas and after that, the betas that reflect the averages of each segment are levered again by the consolidated capital structure of Eletrobras, resulting in a Beta of 0.44.

When these three values are defined, it is reached a real capital cost of 7.94% a year. However, the methodology used by the Eletrobrás group defines that the new projects, must be considered an added risk during the construction phase. This added risk implicates in higher equity capital costs in about 0.5% a year for generation enterprises. Doing so, the percentage of 8.44% a year is reached to the Equity Capital Cost.

11 O Fluxo de caixa do projeto (Full Equity) analisa o investimento total como se não tivesse dívida, ou seja, com 100% de capital próprio.

Once the Equity Capital Cost is defined, from this rate should the stockholder cash flow be discounted, discounting the contributions of capital that were made, the NPV to the stockholder is found, if the capital is positive, it is being properly remunerated.

To calculate the Debt cost, the financial model takes into consideration the debts amounts presented in the premises that consider it to an average cost of 3.24% yearly in real terms. When considering the tax benefits of the debt interest (that in this project is of 15.25% of the Taxable Profit) the real debt cost is reduced to 2.75% per year.

Thus, when applying the formula presented in chapter 1, section 1.10, the Weighted Average Cost of Capital to this specific project is of 3.97% yearly. What represents the weighted average between the Equity Capital Cost (8.44%) e and the Debt Cost after the taxes (2.75%), emphasizing that the capital structure is of 21.4% and 78.6% of Equity Capital and Debt, respectively.

2.9 RESULTS

In this section, it will be presented the main results of the financial viability analysis of the Belo Monte Power Plant project 11,233 MW. The results will be presented under two perspectives: the **Investor's** and the **Project's** or total investment.

2.10 RESULTS FROM THE INVESTOR'S PERSPECTIVE

This analysis, made from the perspective of the Investor, when the project is verified according to a specific financing framework, is capable of remunerating the capital of the stockholders in the intended value. It intends to ensure that the profitability given by each agent that participates in the project is superior to its capital cost individually.

In this case, the cash flow is calculated considering the effects of the loans and of the debt service, resulting in cash flow associated to the equity capital. The NPV of the project is obtained through the discount of the cash flow by the cost of the equity capital.

Results From the Investor's Perspective	
Internal Rate of Return - IRR	**11.49%**
Net Present Value - NPV (R$ Mil)	1,380,544

Ke = 8,44% per year, real terms

As shown in the Table above, this enterprise properly remunerates the ***Investor***, once the Internal Rate of Return - IRR is 11.49% a year, while the return demanded by the capital is 8.44% yearly. Consequently, the discount do cash flow value to the investor is positive in R$ 1.380 billion.

The result under the Investor's perspective is found under a level above balance. Actions as optimizations of financial schedule, investment reduction and expenses can make this result even more attractive to the investor. But, if there are occurrences that increase the building costs or the operational expenses and the return rate to the investor, it can be compromised. The investment value that balances the result, that is, the investment value that gives exactly the minimum return (8.44% per year) to the stockholders is R$ 27.969 billion, with base date in April 2010. Therefore, this enterprise can endure an increase of 8.1% in the total of the investment, remain attractive to the investors.

2.11 RESULTS UNDER THE PROJECT'S PERSPECTIVE

Under the perspective of the Project, knowing the return to all holders of the enterprise rights is a concern, the stockholders and financial backers, that is, the project is analyzed as a whole, measuring its profitability without distinguishing the sources used in the project financing framework.

Thanks to this, the cash flow does not take into consideration the loans that were made as well as the service rendered by the debt associated to the financings. However, the financial effect of the financing framework can be verified, in an indirect way, in the discount rate used to calculate the NPV of the project, which is given by the Weighted Average Cost of Capital - WACC.

Results Under the Project's Perspective	
Internal Rate of Return - IRR	**4.71%**
Net Present Value - NPV (R$ Mil)	2,192,686

WACC = 3,97% per year, real terms

The Table above illustrates that this enterprise, under the perspective of the project, has an appropriate remuneration, since the Internal Rate of Return - IRR is 4.71% yearly, while the average return demanded by the capital of the rights' owner is of 3.97% per year. Therefore, the cash flow Net Present Value the project is positive in R$ 2.193 billion.

This result reveals that, given the premises of the established income and expenses, this enterprise is enough to remunerate all of the rights' owners (investors and funders), once the demanded return is not attached anymore to the equity capital (8.44%), but to the Weighted Average Cost of Capital – WACC of 3.97% per year.

Thus, it is the result under the perspective of the project value to the right's owners of the company.

2.12 GLOBAL RESULT

The viability test of the Belo Monte Power Plant was confirmed as the Internal Rate of Return was calculated and the Net Present Value of the future cash flows of the Norte Energy S.A (company), not only under the investors' point of view, but also the viability of the project as a whole. An analysis under the perspective of the dividends was not made, because it was not possible to have access to information related to the company dividends' distribution politics.

Although the results found in the evaluation confirm the financial viability of the enterprise, the Hydroelectric Development of Belo Monte will also cause considerable impacts on the Xingu Region, bringing relevant consequences not only in relation to the environment, that is directly affected by enterprise, but also to what is related to the local population. There will be positive externalities related to the region development, as well as to the way the significant direct and indirect employment generation, and the meaningful tax collection during the concession period of the Hydroelectric Belo Monte Plant.

Direct and Indirect Jobs Created	
Direct during construction	18,700
Indirect during construction	23,000
Direct during operation	60
Indirect during operation	100

Source: Norte Energia S.A

Another important point is in relation to the taxes that will be collected throughout the Belo Monte Power Plant concession. It is predicted a total collection of R$ 76.8 billion, between federal taxes and charges that are destined to the states and municipalities, as shown in the table below.

Taxes and Charges Generated		
Taxes/Charges	**R$ Mil**	**Addressee**
PIS/COFINS (over revenue)	24,675,561	Federal
Imposto de Renda - IR (over Profit)	26,962,369	Federal
Contribuicao Social - CSLL (over Profit)	10,537,543	Federal
Uso do Bem Publico (fixed)	1,306,379	Federal
CFURH (over energy generated)	13,393,912	Federal, States and Local

Source: Norte Energia S.A (data in nominal terms)

One of the more relevant charges to the states and municipalities is the Financial Compensation for the Use of Hydric Resources – CFURH[12]. It is estimated that during the concession of the Norte Energia S.A it will be destined around R$ 13.4 billion to the financial compensation. With these resources, the states and municipalities affected by the Belo Monte Power Plant will be able to enhance its development program of the region in infrastructure, education and health.

It is estimated, however, a mobilization of about 96,000 people due to the implementation of the project, as previously shown, 18,700 people employed in direct functions in the construction Belo Monte Power Plant, 23,000 people employed in activities related to the work, besides 54,300 family members and other people that will be attracted in search for jobs. In order to serve properly this new population, it was proposed, in the Environmental Impact Studies- EIA, measures that involve guidance for the region newcomers, as well as the preparation of the city halls, in order to control the occupation in the cities and the improvement of living conditions and sanitation in the places where most of the population will be affected.

There are, however, several concerns related to the negative externalities resulting from this and others processes, that are mitigated through the **Xingu Sustainable Regional**

12 Criada pela Lei nº 7.990/1998, a Compensação Financeira pela Utilização de Recursos Hídricos (CFURH) é o valor que os titulares de concessão ou autorização de usinas pagam para exploração de potencial hidráulico aos Estados, ao Distrito Federal e aos Municípios, em cujos territórios se localizarem instalações destinadas à produção de energia elétrica, ou que tenham áreas invadidas por águas dos respectivos reservatórios, e a órgãos da administração direta da União.

Development Plan and the adoption of measurements predicted in the **Environmental Impact Studies - EIA**. These are:

a. Paving and streets' drainage;
b. Water supply and distribution;
c. Improvement in garbage collection, aiming to reach all the affected area;
d. Sanitary landfill building and operation;
e. Sewer system construction.

Likewise, there are programs guided to the promotion of the proper indemnity, reallocation or resettlement of all the people influenced by Belo Monte Power Plant enterprise, as well as the concretization of alterations in the engineering project to reach the requirements of the EIA. They are:

a. Construction of 500 houses spread in the City of Altamira;
b. Construction of 2,500 houses in the City of Vitória do Xingu;
c. Construction of a channel near the main dam for the transposition of fish;
d. Construction of a mechanism for the transposition of boats in the main dam;

CONCLUSIONS

According to the information in the Ten-Year Plan of Energy Expansion – PDE 2021 (2012-2021), for the next years, an expansion of the Brazilian generator complex will take place almost exclusively with renewable energy. In this sense, the Belo Monte Power Plant project contributes in a significant way to the increase of the national energetic matrix through a clean, renewable and trustable source of energy.

The hydroelectric projects' development has assets with high demand of capital and long period maturation. In Belo Monte Power Plant's case, the forecasted amount of the total investment is of R$ 25,885 billion, corresponding to an installed capacity of 11,233 MW, operating with a physical warrant of 4,571 MW. From this, it is still considered transmission losses of 3%, being available the amount of 4.432.96 MW (average) or 38,832,693 MWh/year, being put in the National Interconnected System (SIN).

Because of the energy volume generated by the Belo Monte Power Plant and the nature of its energetic source, it is considered, however, that this energy is indispensable to the Brazilian economic development model.

On chapter 2, it was performed a viability test of the Belo Monte Power Plant, in which it was confirmed the financial viability hypothesis, because of the Internal Rate of Return and Net Present Value that remunerate properly the investors and all the right's owners of the concession.

The future cash flow of Norte Energia S.A are generated through the energy sale, with an average price of R$ 90.6 MWh, corresponding to the weighted average of the sale price in unregulated environments, regulated and to the self-producer, are enough to remunerate the investors and the financial agents involved in the enterprise.

The Eletrobras group, the biggest Belo Monte Power Plant stockholder with 49.98% and participation, is a leader in the electric energy generation and transmission in Brazil, has a wide knowledge in the construction and operation of big hydroelectric power plants, what reduces the construction and operation risk. This differential reduces the engineering risk evaluation and helps in the economic viability of the project.

Notwithstanding the financial viability verification of the Belo Monte Power Plant project, it also offers economic adjacent benefits. There will be positive externalities related to the power plant region development, as well as to the significant direct and indirect employment generation, and the meaningful tax collection during the concession period of the Hydroelectric Belo Monte Plant.

To accomplish the construction of this project, it was necessary that, allied to Environmental Impact Studies, it was developed a Xingu Sustainable Regional Development Plan. The PDRS of Xingu is a program that intends to promote the development of the region, and its guidelines are the social and environmental requirements involved in the process. The plan was made through the Presidential Decree # 7,340 of October 21, 2010.

Then, the Decree # 7,373 of 11/26/10, created the Plan Managing Counsel, responsible for the definition of the investments insured to the implementation of the PDRS. This Counsel is formed by representatives of the federal, state, municipal governments and other institutions.

The resources of R$ 500 million to the implementation of the Plan and R$ 1.5 billion for investments during the construction will prepare the region for deep demographic, economic, and social transformations forecasted for the next 20 years, with the execution of great infrastructure projects, with the Hydroelectric Belo Monte Plant and paving of important roads in the region, such as Rodovias Transamazônica (Amazon Highway - BR-230) and Cuiabá-Santarém Highway (BR-163).

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