PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Teles Pires Hydropower Plant Project Activity.
Version number of the PDD	7.0
Completion date of the PDD	04/10/2012
Project participant(s)	• Companhia Hidrelétrica Teles Pires • Ecopart Assessoria em Negócios Empresariais Ltda.
Host Party(ies)	Brazil.
Sectoral scope and selected methodology(ies)	• Sectoral Scope: 1 – Energy industries (renewable - / non-renewable sources) • ACM0002 - Consolidated methodology for grid-connected electricity generation from renewable sources (version 13.0.0).
Estimated amount of annual average GHG emission reductions	2,499,498 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The primary objective of the Teles Pires Hydropower Plant Project Activity (hereafter referred to as the "**Project**" or UHE[18] Teles Pires) is to help meet Brazil's rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to the environmental, social and economic sustainability by increasing renewable energy's share of the total Brazilian (and the Latin America and the Caribbean region's) electricity consumption.

The Latin America and the Caribbean region countries have expressed their commitment towards achieving a target of at least 10% renewable energy of the total energy use in the region. Through an initiative of the Ministers of the Environment in 2002[1], a preliminary meeting of the *World Summit for Sustainable Development* (WSSD) was held in Johannesburg in 2002. In the WSSD final Plan of Implementation no specific targets or timeframes were stated, however, their importance was recognized for achieving sustainability in accordance with the Millennium Development Goals[2].

The Brazilian electricity sector privatization process initiated in 1995 arrived with an expectation of moderate tariffs and better prices for generators. It drew the attention of investors to possible alternatives not available in the previous centrally planned electricity market. But at the end of the 1990's an over average increase in demand, in contrast with an under-average investment in new power generations, caused the supply crisis/rationing from 2001/2002. One of the solutions the government provided was a more flexible and private initiative friendly legislation. Furthermore, investors were already aware of the potential eligibility under the Clean Development Mechanism of the Kyoto Protocol for hydropower projects.

This indigenous and cleaner source of electricity has an important contribution to environmental sustainability by reducing carbon dioxide emissions that would have occurred otherwise in the absence of the hydropower projects.

The hydropower project reduces emissions of *greenhouse gas* (GHG) by avoiding electricity generation by fossil fuel sources (and CO_2 emissions), which would necessary in the absence of the Project.

The Project will make use of the hydrological resources of the Teles Pires River between the cities of Paranaita and Jacareacanga, Brazil, in order to generate greenhouse gases (GHG) emission free

[1] UNEP (2002). Final Report of the 7th Meeting of the Inter-Sessional Committee of the Forum of Ministers of the Environment of Latin America and the Caribbean (15-17 May 2002, Sao Paulo, Brazil). United Nations Environment Programme, Regional Office for Latina America and the Caribbean.

[2] WSSD Plan of Implementation, Paragraph 20 (e): "Diversify energy supply by developing advanced, cleaner, more efficient, affordable and cost-effective energy technologies, including fossil fuel technologies and renewable energy technologies, hydro included, and their transfer to developing countries on concessional terms as mutually agreed. With a sense of urgency, substantially increase the global share of renewable energy sources with the objective of increasing its contribution to total energy supply, recognizing the role of national and voluntary regional targets as well as initiatives, where they exist, and ensuring that energy policies are supportive to developing countries' efforts to eradicate poverty, and regularly evaluate available data to review progress to this end."

electricity to be dispatched into the *Brazilian National Interconnected System* (**SIN**, from the Portuguese, "Sistema Interligado Nacional"), thereby displacing more carbon-intensive electricity generation, reducing GHG emissions. The baseline scenario is the continuation of the current situation, i.e. to use all power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance. The additional power generated under the project would be generated in existing and new grid-connected power plants in the electricity system.

The Project consists of implementing a new hydropower (greenfield) plant where no renewable power plant was operated prior to the implementation of the Project. The Project total installed capacity is of 1,820 MW[3] and the reservoir area of 134.70 km^2 at the maximum-maximorum reservoir level (220 m)[4] . The Project presents five Francis turbines with 369.70 MW[5] of nominal power each and five three-phase synchronous generators with nominal power 404.45 MVA[5] each and the Project is expected to be fully operational by 2015. The fully technical description of the Project is presented at Section A.3 below.

Prior to the implementation of the project activity no electricity was generated in the place where the project is located. Therefore, the electricity to be generated by the plant which is going to be dispatched into the national grid would be generated by the mix of plants connected to SIN. In addition, according to ACM0002 methodology and Section B.4 below, the baseline scenario is the continuation of the current situation, i.e. to use all power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance. The additional power generated under the project would be generated in existing and new grid-connected power plants in the electricity system. Therefore, the baseline scenario and the scenario prior to the implementation of the Project are the same.

The full implementation of the project will generate annual estimated emission reductions of 2,499,498 tCO_2 and 24,994,984 tCO_2 during the whole crediting period.

The Project is owned by *Companhia Hidrelétrica Teles Pires*, a *special purpose company* (SPC) composed by the following shareholders structure[6]:

- Neoenergia S.A., 50.1%
- Furnas Centrais Eletricas S.A., 24.5%.
- Eletrosul Centrais Eletricas S.A., 24.5%.
- Odebrecht Participações e Investimentos S.A., 0.9%.

The Project contributes to sustainable development for many reasons, to name but a few:

- Increases short, mid and long-term employment opportunities in the area where it is located during construction and operation;
- Enhances the local investment environment and, therefore, improves the local economy;

[3] ANEEL Ordinance 3,504 dated August 26th, 2011. Available at http://www.aneel.gov.br/cedoc/dsp20113504.pdf.
[4] ANEEL Technical Summary – Feasibility studies and Project Design (July 2011)
[5] UHE Teles Pires. Consolidated Basic Project ("Projeto Básico Consolidado"), August 2011.
[6] ANEEL notice of bidding and auction ratification 04/2010. Available at http://bit.ly/QV053w.

- Diversifies the sources of electricity generation and promote regional integration. This is important for meeting growing energy demands, and transitioning away from fossil-fuel-fired electricity generation in the whole country, but markedly in the region.
- Makes use of renewable hydroelectric resources.

It is also worth mentioning that, taking into account that it is a "prerogative of the host country on the design and implementation of policies to promote or give competitive advantage to low greenhouse gas emitting fuels and technologies[7]," the Brazilian Government already in the first version of its *National Plan on Climate Change*[8], released in 2008, included the goal to increase hydropower generation. In the plan planned hydropower plants are referenced as cumulatively reducing 183 million tCO_2e. The goal was later communicated by the Brazilian Government to the UNFCCC in January 2010[9], as a follow up of the Copenhagen Accord, as follows:

> *Increase in energy supply by hydroelectric power plants (range of estimated reduction: 79 to 99 million tons of CO_2 eq in 2020).*

From the above it is clear that the project not only contributes to sustainable development but is also in line with the planned national climate change mitigation actions.

A.2. Location of project activity

A.2.1. Host Party(ies)

Brazil

A.2.2. Region/State/Province etc.

States of Mato Grosso (MT) and Pará (PA)

A.2.3. City/Town/Community etc.

Paranaíta (MT) and Jacareacanga (PA)

A.2.4. Physical/Geographical location

Teles Pires Hydropower Plant Project Activity is located at the intersection of the following geographic coordinates[3]:

- Latitude: 9°21'04'' S
- Longitude: 56°46'39'' W

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[7] UNFCCC (2009). Decision 5/CMP.5, paragraph 11.
[8] Interministerial Committee on Climate Change (from the Portuguese "Comitê Interministerial sobre Mudança do Clima"), 2008. National Plan on Climate Change ("PNMC" from the Portuguese *Plano Nacional sobre Mudança do Clima)*.
[9] Communication from the Government of Brazil to the UNFCCC indicating the intended nationally appropriate mitigation actions, the use of the CDM not excluded (29 January 2010). Retrieved on 04/10/2011 from <http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5262.php>.

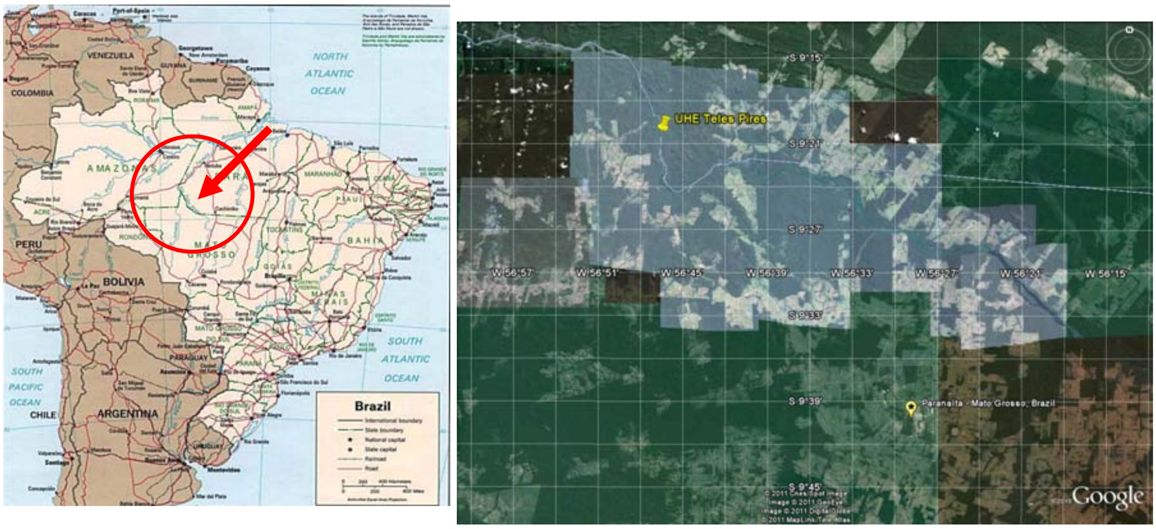

Figure 1 - Political division of Brazil showing the states of Mato Grosso and Pará on the left and a Google Earth image showing the cities involved in the project activity

A.3. Technologies and/or measures

Prior to the implementation of the project activity no electricity was generated in the place where the project is located. Therefore, the electricity to be generated by the plant which is going to be dispatched into the national grid would be generated by the mix of plants connected to SIN. Also, the ACM0002 states that the baseline scenario is the continuation of the current situation. Therefore, the baseline scenario and the scenario prior to the implementation of the Project are the same.

The following technical information is retrieved from the *Final Consolidated Basic Project*[5] (PBC from the Portuguese "Projeto Básico Consolidado"), approved by the *Brazilian Electricity Regulatory Agency* (ANEEL from the Portuguese, "Agência Nacional de Energia Elétrica") on 26 August 2011[3]. Still, it shall be clear that during the construction the project and, consequently, some technical specifications, may suffer small changes.

The facility consists of a power house totalizing 1,820 MW of installed capacity with 5 turbine generator sets. The total firm energy of the plant is 940.6 $MW_{average}$/year[10]. Therefore, the ex-ante estimated plant load factor[11] - defined as the ratio between the assured energy and total installed capacity of the plant - is roughly 0.517[12]. The main characteristics of the Project are, as explicated in the *Final Consolidated Basic Project*, the following:

- Total installed capacity = 1,820 MW

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[10] At the moment of the energy auction and signature of the concession contract, the project activity had a configuration of 6 generation units and firm energy of 915.4 $MW_{average}$. After that, the project was optimized; increasing the firm energy to 940.6 $MW_{average}$ (see the Consolidated Basic Project) and reducing the number of generation units to five (see ANEEL Resolution nr. 3,324, dated January 31[th], 2012). Consequently, the assured energy was revised and the approval was requested to the ANEEL. Although the information was not available at the project starting date, it is used in the investment analysis for conservative reasons.

[11] Following the requirements of the "*Guidelines for the reporting and validation of plant load factors*" (version 1, EB48), the load factor of the UHE Teles Pires was defined *ex-ante* considering the value that was approved by a third party, namely, the Brazilian Electricity Regulatory Agency.

[12] PLF = 940.6 ÷ 1,820 = 0.5168

- Total firm energy[10] = 940.6 MW_{avg}
- Generator type = Three-phase synchronous
- Nominal generator power = 404.45 MVA
- Generator average lifetime[13] = 30 years
- Nominal generator power factor = 0.9
- Turbine type = Francis
- Nominal Power of each unit (turbine) = 369.70 MW
- Turbine average lifetime[13] = 40 years
- Number of generation units = 5
- Reference net head = 52.2 m
- Weighted average efficiency of the turbine = 93.68%
- Weighted average efficiency (turbine+generator) = 92.10%
- Nominal flow per unit = 764 m^3/s
- Maximum-maximorum reservoir level[4] = 220 m
- Reservoir area at maximum level (220 m)[4] = 134.70 km^2
- River bed area[14] = 40.6 km^2

The figure below represents the project boundary.

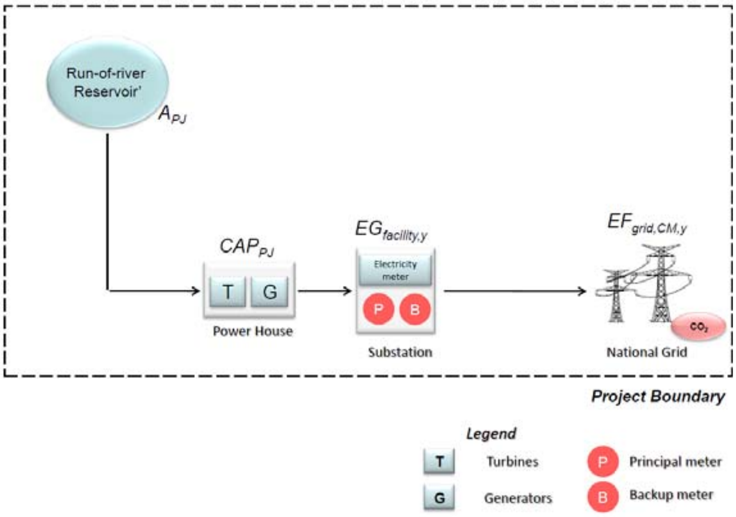

Figure 2 - Schematic project boundary

[13] ANEEL Resolution 044, dated March, 17th 1999. Available at http://bit.ly/NYM570.
[14] ANEEL Technical Summary – Feasibility studies and Project Design (April 2008).

A.4. Parties and project participants

Table 1 - Party(ies) and private/public entities involved in the project activity

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Companhia Hidrelétrica Teles Pires (private entity)	No
	Ecopart Assessoria em Negócios Empresariais Ltda. (private entity)	

Detailed contact information on party(ies) and private/public entities involved in the project activity is listed in Annex 1.

A.5. Public funding of project activity

No official development assistance or related public funding was or will be used in *Teles Pires Hydropower Plant Project Activity*.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology[15]

1. ACM0002 - Consolidated methodology for grid-connected electricity generation from renewable sources, version 13.0.0;
2. Tool for demonstration and assessment of additionality, version 06.0.0;
3. Tool to calculate the emission factor for an electricity system, version 2.2.1.

B.2. Applicability of methodology

The applicability conditions of ACM0002 are all fulfilled by the proposed project activity as further detailed below.

- *The methodology is applicable to grid-connected renewable power generation project activities that: (a) install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant); (b) involve a capacity addition;*

[15] Approved methodologies and tools available at http://cdm.unfccc.int/methodologies/PAmethodologies/approved.

(c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).

The proposed project activity comprises the installation of a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant).[16]

- *The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;*

The proposed project activity is the installation of a new run-of-river hydro power plant[5].

- *In the case of capacity additions, retrofits or replacements (except for wind, solar, wave or tidal power capacity addition projects which use Option 2: on page 10 to calculate the parameter EGPJ,y): the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity;*

Not applicable. The proposed project activity does not correspond to a capacity addition, retrofit or replacement.[16]

In case of hydro power plants, one of the following conditions must apply:

- *The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of reservoirs; or*
- *The project activity is implemented in an existing single or multiple reservoirs, where the volume of any of reservoirs is increased and the power density of each reservoir, as per definitions given in the project emissions section, is greater than 4 W/m^2; or*
- *The project activity results in new single or multiple reservoirs and the power density of each reservoir, as per the definitions given in the project emissions section, is greater than 4 W/m^2.*

The implementation of the proposed project activity will result in a new reservoir and the power density is greater than 4 W/m^2 (refer to section B.6.1 for calculation and references).

In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4 W/m^2 all the following conditions must apply:

- *The power density calculated for the entire project activity using equation 5 is greater than 4 W/m^2;*
- *Multiple reservoirs and hydro power plants located at the same river and where are designed together to function as an integrated project that collectively constitute the generation capacity of the combined power plant;*

[16] ANEEL Decree, dated June, 1st 2011. Available at: http://www.aneel.gov.br/cedoc/dec2011sn105.pdf.

- *Water flow between multiple reservoirs is not used by any other hydropower unit which is not a part of the project activity;*
- *Total installed capacity of the power units, which are driven using water from the reservoirs with power density lower than 4 W/m^2, is lower than 15 MW;*
- *Total installed capacity of the power units, which are driven using water from reservoirs with power density lower than 4 W/m^2, is less than 10% of the total installed capacity of the project activity from multiple reservoirs.*

Not applicable. The implementation of the proposed project activity will result in a new single reservoir.[3]

Finally, the methodology has the following restrictions – *i.e.* project activities may not be applicable in the following cases:

- *Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;*
- *Biomass fired power plants;*
- *Hydro power plants that result in the creation of a new single reservoir or in the increase in existing single reservoir where the power density of the power plant is less than 4 W/m^2.*

The project is still applicable for the use of ACM0002 since it does not correspond to any of the restrictions listed above. In addition to the applicability conditions of the ACM0002 methodology, the applicability conditions of the tools used must also be assessed.

In order to estimate the baseline emissions occurring after the implementation of the proposed project activity the "*Tool to calculate the emission factor for an electricity system*" is used. This tool provides the steps required to estimate the CO_2 emission factor, which consists of a "*combined margin*", for the displacement of electricity generated by plants connected to an electric grid.

As further described below in section B.6.1, off-grid power plants are not considered. Hence, the requirements of Annex 2 of the tool, referring to the applicability conditions that shall be met when this kind of plants are considered, is not applicable. Besides, the Brazilian Electric System is neither partially nor totally located in any Annex-I country.

In this sense, it can be concluded that there are no applicability conditions preventing the use of this tool to estimate the CO_2 emission factor of the Brazilian Electricity System in the context of the proposed project activity.

B.3. Project boundary

The project boundary is defined by the emissions targeted or directly affected by the project activity, construction and operation. It encompasses the physical, geographical site of the hydropower generation source, which is represented by the respective river basin of the project close to the power

plant facility, as well as the interconnected grid (Figure 3). On May 26th, 2008, the Brazilian Designated Authority published Resolution number 8 defining the Brazilian Interconnected Grid as a single system comprising the fifth regions of the country[17].

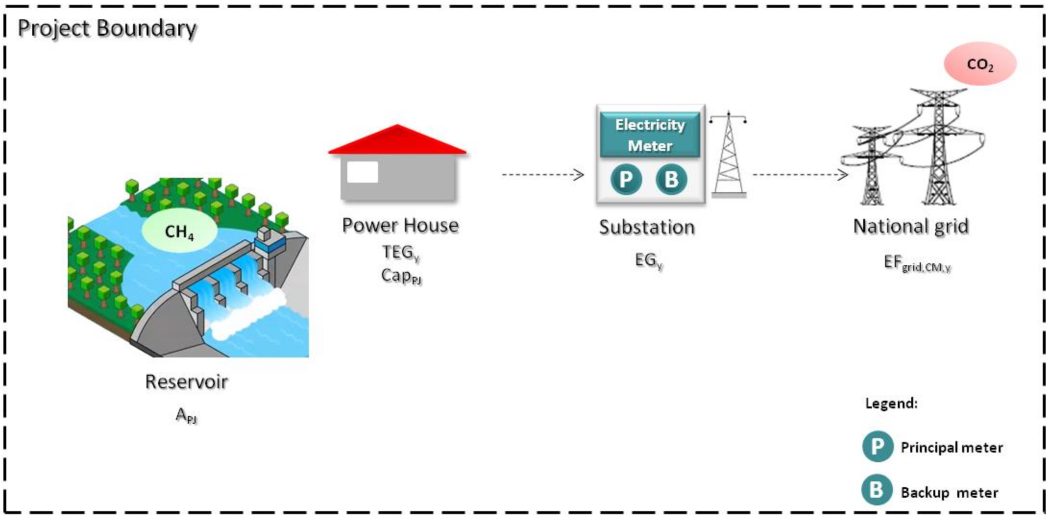

Figure 3 - Project Boundary of the project activity.

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in the below table.

Table 2 - Emission sources and gases related to the project activity

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project scenario	Emission of CH_4 from the reservoir	CO_2	No	Minor emission source
		CH_4	No	There are no emission from the project reservoir considering its power density of 13.51 W/m^2 *i.e.*, greater than 10 W/m^2. However, project sponsor will monitor the reservoir area following ACM0002.
		N_2O	No	Minor emission source

B.4. Establishment and description of baseline scenario

The project activity is the installation of a new grid-connected renewable power plant. Hence, accordingly to ACM0002 the baseline scenario is the following:

"Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as

[17] Brazilian DNA's Resolution nr 8 from May 26th, 2008 available at: <http://www.mct.gov.br/upd_blob/0024/24719.pdf>.

reflected in the combined margin (CM) calculations as described in the "Tool to calculate the emission factor for an electricity system".

B.5. Demonstration of additionality

The identified starting date of the proposed project activity is 19 August 2011, which is the date of the EPC contract. For details, please refer to section C.1.1.

In accordance with the "CDM Project Cycle Procedure" (Annex 64, EB 66), for projects activities with a starting date on or after 02 August 2008, the Project Participants must notify the host country DNA the UNFCCC secretariat of their intention to seek CDM status within 180 days of the start date of the project activity.

In December 2010, the Project Participants have forwarded the Prior Consideration of the CDM Form (F-CDM-Prior consideration) both for the Brazilian Designated National Authority and to UNFCCC secretariat. Copies of the forms as well as the confirmation of receipt by the Brazilian DNA and UNFCCC were presented to the DOE validating the project. Therefore, the proposed project activity follows the "CDM Project Cycle Procedure".

For the purpose of assessing the additionality of the project activity, ACM0002 methodology requires the use of the latest version of the *"Tool for the demonstration and assessment of additionality"* agreed by the CDM Executive Board.

Following are the necessary steps for the demonstration and assessment of the *Teles Pires Hydropower Plant Project Activity* additionality.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulation

Sub-step 1a. Define alternatives to the project activity

Companhia Hidrelétrica Teles Pires is a SPC set up specifically to construct and operate the UHE[18] Teles Pires.

Ecopart Assessoria em Negócios Empresariais Ltda. is the CDM project developer.

Hence, based on the nature of these companies, namely the project participants, the only realistic and credible alternatives to the project activity identified are:

(a) Alternative 1: The proposed Project activity undertaken without being registered as a CDM project activity;

(b) Alternative 2: Continuation of the current situation, i.e. electricity will continue to be generated by the existing generation mix operating in the grid.

Sub-step 1b. Consistency with mandatory laws and regulations

[18] UHE stands for "Usina Hidro Elétrica" (Hydro Power Plant).

Both the project activity and the alternatives scenarios are in compliance with all laws and regulations according the electricity sector and environmental relevant entities, namely, *National Electric System Operator* (ONS from the Portuguese "Operador Nacional do Sistema Elétrico", the national dispatch center), *Brazilian Electricity Regulator* (ANEEL from the Portuguese "Agência Nacional de Energia Elétrica") and, the *Brazilian Institute of Environmental and Renewable Natural Resources* (the federal environmental agency, IBAMA from the Portuguese "Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis").

In order to obtain detailed information about the regulations that the project activity and the proposed scenarios are in compliance with Brazilian Regulations in electrical and environmental sectors, refer to Section B.7 – Monitoring Plan – and Section D – Environmental impacts – below, which describe the procedures established by ONS applied by the project activity and the applicable environmental norms and laws.

Additionally in the next paragraphs a short historic of the power generation sector is given to demonstrate that Brazil is promoting hydropower as a low greenhouse gas emitting technology for power generation.

During 2003 and 2004, the Federal Government announced the new model for the Brazilian Electricity Market sustained by Laws n°10.847 and 10.848 of March 15th, 2004 and Decree n°5.163 of July 30th, 2004. According to OECD[19], "central to the new model [and a novelty in the Brazilian electricity sector] is the creation of the 'Pool' ("Ambiente de Contratação Regulado", ACR), matching electricity demand and supply capacity through long-term contracts, which will replace on a competitive bases the "initial contracts" inherited from the 1990s. These contracts were designed as a bridge between the 1980s and the new environment after the privatization of most distribution companies and schedule to gradually expire after 2002. The new framework is inspired by the "single-buyer" model, where an entity - typically the government - buys all electricity from producers and sells it to distributors. However, although establishing a common mechanism for the purchase of energy, the model allows market risk to be shared among participants instead of being borne exclusively by the government, which acts rather like an auctioneer than a buyer. With long-term contracts set through the Pool, price uncertainty will be broadly restricted to electricity traded in the free, short-term market and bilateral contracts between generators and large consumers."

Coming back to the initial results of the new regulatory environment, the new generation contracted in the first 10 tenders under the new model (from 2004 to 2007), actually the first in the Brazilian electricity sector history, was predominantly fossil-fuel based, namely, 3.6% biomass-fired, 35% hydropower and 61.4% fossil-fuel-fired[20].

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[19] Regulation of the Eletricity Sector IN OECD Economic Survey of Brazil 2005.

[20] Esparta, A.R.J. (2008). *Greenhouse gases emission reductions in the Brazilian power sector – Kyoto Protocol's CDM experience and a future pathway.* PhD Thesis. Energy Graduation Program, University of Sao Paulo, p. 42-43 (retrieved from http://www.teses.usp.br/teses/disponiveis/86/86131/tde-29042008-160752/pt-br.php on 09-Jul-2012).

Aware of the global impacts caused by the increased fossil-fuel based electricity generation and corresponding GHG emissions the Brazilian Government in the *Ten-Year Plan for Electric Energy Expansion 2006-2010*[21] recognized the GHG emission reduction potential of hydropower projects.

Such results lead the Brazilian government to adopt regulatory actions to integrate climate change mitigation activities into its electricity expansion policies, for example, with auctions for renewable energy project only, clearly an E- policy.

Repeating the text from the introduction, it is also worth mentioning that the Brazilian Government already in the first version of its *National Plan on Climate Change* included the goal to keep a high share of renewables in the primary energy sources and to increase hydropower generation. In the plan hydropower plants are referenced as cumulatively reducing 183 million tCO_2e. The goal was later communicated by the Brazilian Government to the UNFCCC in January 2010, as a follow up of the Copenhagen Accord, as follows:

> *Increase in energy supply by hydroelectric power plants (range of estimated reduction: 79 to 99 million tons of CO2eq in 2020).*

Therefore, it seems clear to the PPs that in addition to the assessment and demonstration of additionality in the PDD, hydropower generation is being promoted at least since 2008 as a low greenhouse gas emitting technology, unequivocally an E- policy.

Outcome of step 1b: Both identified realistic and credible alternative scenarios to the project activity that are in compliance with mandatory legislation and regulations, taking into account the enforcement in the region or country and EB decisions on national and/or sectoral policies and regulations.

Proceed to Step 2 (Investment analysis) or Step 3 (Barrier analysis)

PPs will apply step 2, investment analysis.

Step 2. Investment analysis

Determine whether the proposed project activity is not:

(a) The most economically or financially attractive; or

(b) Economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs).

Sub-step 2a. Determine appropriate analysis method

According to the "Tool for the demonstration and assessment of additionality", three options can be applied to conduct the investment analysis. These are "Simple Cost Analysis" (Option I), "Investment Comparison Analysis" (Option II), and "Benchmark Analysis" (Option III). The additionality of the Project is assessed and demonstrated by means of an investment benchmark analysis; option III.

Options I and II are not applicable to the proposed project activity since:

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[21] MME:EPE (2006). *Plano Decenal de Expansão de Energia Elétrica 2006-2015.* Ministério das Minas e Energia; colaboração Empresa de Pesquisa Energética, pages 121, 271 and 294.

- Option I – both the CDM project activity and the alternatives identified generate financial and economic benefits other than CDM related income.
- Option II – the implementation of other project types of renewable energy generation – e.g. cogeneration or small hydro power plant projects - are not potential alternatives in the site where the project is planned.

In addition, in accordance with paragraph 19, Annex 5, EB 62, the benchmark analysis is the most appropriate method to demonstrate the additionality of the proposed CDM Project Activity once the alternative to the implementation of the UHE *Teles Pires* is the supply of electricity to the grid.

Sub-step 2b: Option III – Apply benchmark analysis

The most suitable and widely used financial indicator for the benchmark analysis is the Internal Rate of Return (IRR). The IRR is the annualized effective compounded return rate which can be earned on the invested capital, i.e., the yield on the investment. In other words, it is the precise discount rate that makes the present value of the future cash returns from a capital investment exactly equal to the initial amount of capital invested. If IRR is higher than the benchmark, the investment is an attractive opportunity; if less, the investment is substandard from the cost-of capital point of view.

Naturally, investors are typically looking for a constant and secure return on their investment, consequently when investing in a different activity (sector) such as renewable energy generation; a higher return rate is expected because of all involved risks.

The World Bank published a report in 2008[22] stating that *"The combination of regulatory uncertainties arising from the environmental legal framework and (to a lesser extent) from the legal framework governing the energy sector, represents substantial risks for potential investors. Investors are obliged to put a price on this risk and pass on the costs to consumers. The Brazilian Electricity Regulator (ANEEL) estimates that investors are prepared to invest in electricity generation only when rates of return are approximately 15%".*

Furthermore, ANEEL also calculated an adequate return on capital investments in the Brazilian electricity distribution sector as described in their technical report in 2008[23] through which evaluated that the cost of equity for investing in the energy distribution sector should be 13.75% in real terms. According to IPEA[24], the current methodology adopted by ANEEL to estimate the rate of return (cost of capital) should be modified by adding the country risk, exchange rate risk and regulatory risk in order to estimate a more proper return. Based on that, the expected return on equity in real terms should range between 13.4 and 15.4%[25] in the Host Countries energy sector.

[22] Environmental Licensing for Hydroelectric Projects in Brazil: A Contribution to the Debate, Volume I, Summary Report, 2008. Available at: <http://siteresources.worldbank.org/EXTWAT/Resources/4602122-1214578930250/Summary_Report.pdf>.

[23] ANEEL technical note 68/2007, §108. Available at http://bit.ly/QV3bV1.

[24] Governmental Institute for Economic Research ("IPEA" from the Portuguese I*nstituto de Pesquisa Econômica Aplicada*) is a public foundation associated to the Secretariat for Strategic Affairs of the Presidency and is responsible for providing technical and institutional support to the government.

[25] Capital cost of power utilities of electric energy distribution in the tariff revision process (in a free translation from the Portuguese *Custo de capital das concessionárias de distribuição de energia elétrica no processo de revisão tarifária*). April 2006. Available at: <http://desafios.ipea.gov.br/pub/td/2006/td_1174.pdf>.

Another suitable Benchmark is calculated applying the *Weighted Average Cost of Capital* (WACC) for the power generation sector in Brazil.

The *Weighted Average Cost of Capital* (WACC) is a rate used to discount business cash flows and takes into consideration the cost of debt and the cost of equity of a typical investor in the sector of the project activity. The benchmark can be applied to the cash flow of the project as a discount rate when calculating the net present value (NPV) of the same, or simply by comparing its value to the Internal Rate of Return (IRR) of the project (in accordance with paragraph 12, Annex 5, EB 62). The WACC considers that the shareholders expect compensation for the projected risk of investing resources in a specific sector or industry in a particular country.

According to paragraph 6 of the Guidelines on the assessment of investment analysis, "*the input values used in the investment analysis should be valid and applicable at the time of the investment decision by project participants*". As per Section C.1.1 below, the first expenditure commitment related to the Project and therefore, the decision in implement UHE Teles Pires, took place when the EPC Contract was signed. It occurred on August, 19th 2011, then, the WACC of the sector was calculated applying data from the year of 2011. The WACC calculation is based on parameters that are standard in the market, considers the specific characteristics of the project type, and is not linked to the subjective profitability expectation or risk profile of this particular project developer, is equal to 7.27% and was calculated through the formula below:

$$WACC = Wd \times Kd + We \times Ke$$

We and ***Wd*** are, respectively, the weights of equity and debt typically observed at the sector. Applied ***We*** is of 50.00%, and ***Wd*** of 50.00%, in accordance with paragraph 18 of the "Guidelines on the assessment of investment analysis", version 5 (EB 62 Annex 5).

Kd is the cost of debt, which is observed in the market related to the project activity, and which already accounts for the tax benefits of contracting debts. In the ***Kd*** calculation, the marginal tax rate (**t**) is multiplied by the Cost of debt and then by the debt to total cost of capital ratio to ascertain the debt proportion of the WACC formula. In the case of Brazil, and specifically for energy projects, this tax factor could either be 34% or 0%. This is decided by the specific type of project and tax regime under which it sits. In the case of the proposed project activity, the 34% tax factor applies. This method for calculating the corporate income tax and social contribution is called Real Profit.

The Cost of Debt is determined through the sum of the Financial Cost, the BNDES Spread and the Credit Risk Rate. The Financial Cost corresponds to a five-year average of the Long Term Interest Rate (in a free translation from the Portuguese "Taxa de Juros de Longo Prazo") given by BNDES. The five-year average adopted to calculate the TJLP aims to reflect a conservative average of the long term interest rate, considering that it presents a large range of variation through the years. The BNDES Spread is considering the cost of the TJLP for the BNDES and is estimated to be 0.9% for projects that generate electricity[27]. The Credit Risk Rate is determined by BNDES according to the credit risk that the project sponsor presents at the time of the request for financing. The Credit Risk rate is 2.09%.

In addition, the nominal rate achieved for debt is used to calculate nominal WACC, which is used to discount nominal cash flow projections. In order to achieve the real cash flow rate, the inflation targeting figure (d) for Brazil is reduced from the nominal figure achieved. The (d) is obtained from the Brazilian Central Bank (www.bcb.gov.br) and has experienced very little variance in the past 5 years.

This parameter is calculated through the following equation:

$$Kd = [1 + (a+b+c) \times (1-t)] / [(1+d) - 1].$$

Values used in the cost of debt calculation are presented in the table below:

Table 3: Cost of debt (Kd) calculation

Cost of Debt (Kd)	
(a) Financial cost[26]	6.27%
(b) BNDES fee[27]	0.90%
(c) Credit risk rate[27]	2.09%
(d) Financial Intermediation Rate[27]	0.5%
(a+b+c+d) Pre-tax cost of debt	9.76%
(t) Marginal tax rate[28]	34.00%
(d) Inflation forecast[29]	4.50%
After tax Cost of Debt (p.a.)	1.86%

According to the table above, *Kd* is of 1.86%.

Ke is the cost of equity and represents the rate of return for equity investments and is estimated through the equation:

$$Ke = ((1+(Rfr + \beta * Rm + Rc))/(1+\pi'))-1$$

The cost of equity (*Ke*) was determined considering publicly available data from the USA in order to determine the Risk-free rate (*Rf*), the US expected inflation (*I*) and the Equity Risk Premium (*Rm*) at the time of the project investment decision. Taking into account that the proposed project activity is located in Brazil and will generate electricity, project participants customized these parameters applying the estimated country risk premium (*Rc*) and the Sectoral Risk (β) from the power sector.

Risk free rate (*Rf*)

Rf stands for the risk free rate. The risk-free rate used for *Ke* calculation is a long term bond rate. This bond was based on the US Treasury bond, which are long term titles of a mature market.

The risk free rate is the default rate available in the market which represents the standard investment rate available to all investors. This risk-free rate acts as an opportunity cost figure, allowing investors to compare and gauge the value to them from pursuing alternative risk and reward opportunities versus simply purchasing and holding the risk-free instrument freely available for purchase in the market.

[26] Information available at http://bit.ly/NYMsym.
[27] Information available at http://bit.ly/NYMtlQ.
[28] Information available at http://www.receita.fazenda.gov.br/Aliquotas/ContribPj.htm.
[29] Information available at http://www.bcb.gov.br/pec/metas/InflationTargetingTable.pdf.

The risk free rate (4.24%) has been taken as the 10-year US Treasury Yield as of August 2010. In order to adjust the risk-free rate (*Rf*) to the inflation adjusted rate, the expected inflation rate (for the United States) (***I***) is reduced. The inflation is calculated based on the treasury through spot TIPS (Treasury Inflation Protected Securities) which are readily quoted in the market

Sectoral Risk (*β*)

The Sectoral Risk (*β* or beta value**),** stands for the average sensitivity of comparable companies in that industry to movements in the underlying market. The beta value (*β*) is derived from the correlation between returns of US companies from the sector and the performance from returns in the US market. The beta value (*β*) has been adjusted to the leverage of Brazilian companies in the sector, reflecting both structural and financial risks. The beta value (*β*) adjusts the market premium to the sector.

The beta value (1.41) has been calculated using an average value of 0.85 (un-levered) for the US Electric-Generators in the USA (power and Electric Utility) referring to the values provided by Damodaran Online[30] and calculated in Excel sheet presented to the DOE during the project validation and levered, using the average market debt/equity ratio (50/50) which is usual for the industrial sector in Brazil and 34 % income tax.

Equity risk premium *(Rm)*

Rm represents the equity risk premium, or higher return, expected by market participants in light of historical spreads attained from investing in equities versus risk free assets such as government bond rates, investors require a higher return when investing in private companies. The market premium is estimated based on the historical difference between the S&P 500 returns and the long term US bond returns. The spread over the risk-free rate is the average of the difference between those returns.

This premium is achieved by taking the average returns of a large local or foreign equity markets performance over a specific period of time and subtracting from it the performance/returns of the corresponding risk-free securities.

The equity risk premium (6.03%) have been calculated using the annual returns on investments in stocks (11.32%) minus annual returns on Investments in T Bonds (5.28%), both sourced from A. Damodaran, New York University "Historical data on Stocks, Bonds and Bills - US".[30] The equity risk premium is considered reasonable as it measures the rate of return investors seek to compensate them for investing in higher risk equity based assets rather than risk free securities. This is deemed appropriate and acceptable

Estimated Country risk premium (*Rc*)

Brazilian country risk (*Rc*) have been considered and resulted in the risk-free rate applied to the calculation. Therefore the rate includes the Brazilian country risk. There is a higher risk associated with investing in Brazil, or in Brazilian bonds, compared to investing in a mature market such as the United States.

[30] Source http://pages.stern.nyu.edu/~adamodar/.

The country risk premium for Brazil is 2.37 %. It has been referred to the JPMorgan Emerging Markets Bond Index Plus (EMBI+) as a liquid US-dollar emerging markets debt benchmark, which tracks total returns for actively traded external debt instruments in emerging markets.

Note that in the formula above there is the factor EMBI+ (Emerging Markets Bond Index Plus), considered as the country risk premium, *Rc*. This factor accounts for the country or sovereign risk embedded in the debt of a country. Assuming that relative to the US risk-free debt market EMBI+ is 0, then Brazil's EMBI+ would calculate for the added or reduced risk relative of Brazils debt markets to the US.

Justification for the EMBI+ addition to the risk-free rate lies in the vast differences between the United States in such factors as credit risk, inflation history, politics, debt markets, and more. Ignoring these differences would result in the incorrect application of relevant environmental factors in the decision-making process of an investor in Brazil. Also, taking into account that the EMBI+ is a parameter given by the Brazilian Government, and considering that the Brazilian economy presents more variations when comparing the US economy, the 5-year average data used to calculate this parameter intend to be more conservative.

Values used in the cost of equity calculation are presented in the table below:

Table 4: Cost of equity (*Ke*) calculation

Cost of Equity (*Ke*)	
(*Rf*) Risk-free rate[31]	4.24%
(*Rm*) Equity risk premium[31]	6.03%
(*Rc*) Estimated country risk premium[32]	2.37%
(β) Sectoral Risk[31]	1.41
(*I*) US expected inflation[33]	2.17%
Cost of Equity with Brazilian Country Risk (p.a.)	12.67%

In line with the table above, *Ke* is of 12.67%. As can be seen, *Ke* derives from a risk free rate plus the market risk premium adjusted to the sector through Beta (β).

Plugging these numbers into WACC formulae:

$$WACC = 50.00\% \times 1.86\% + 50.00\% \times 12.67\% = 7.27\%$$

All information used in the calculation of the benchmark is fully reference in the WACC calculation spreadsheet (Appendix 1 to the PDD). The spreadsheet with the WACC calculation is part of the PDD.

All above mentioned benchmarks, substantiated by a third party / independent sources, are suitable to investments in the Brazilian electricity sector and, are in accordance with the date on which the

[31] Information available at: http://pages.stern.nyu.edu/~adamodar/
[32] Information available at: <http://www.ipeadata.gov.br/>
[33] Information available at: <http://www.federalreserve.gov/econresdata/researchdata.htm>.

decision to invest in the project was taken. Most importantly, all data comply with the requirements set out in the "Tool for the Demonstration and Assessment of Additionality" and the "Guidelines on the Assessment of Investment Analysis". Thus, the project participants select the most conservative benchmark applicable to the project activity which corresponds to WACC of 7.27 %.

Sub-step 2c - Calculation and comparison of financial indicators

As mentioned above, the financial indicator identified shall be the Internal Rate of Return (IRR), which can be the Project IRR or the Equity IRR. The Project IRR can be compared with the WACC as the Equity IRR with the Return on Equity (*Ke*)[34].

Key input values used in the IRR calculation, as well as a brief justification for their use, are provided in Table 5. All information used in the calculation of the IRR is also fully referenced in the IRR calculation spreadsheet (Appendix 2 to the PDD). The spreadsheet with the IRR calculation is part of the PDD.

Table 5 - IRR calculation key input values

Parameter	Value	Source
Generation Characteristics		
Installed capacity (MW)	1820	PBC[5]
Forecasted firm energy (MW_{avg})	940.6	PBC[5]
Forecasted gross annual power generation (MWh)	8,239,656	Calculated[35]
Internal Energy Consumption (%)	0.0[36]	CCEE (Commercialization Rules – Module 2)[37]
Investments, Operational Expenses and Sectoral Tariffs		
Total investment – CAPEX (BRL)	3,567,628,457	EPC Contract
O&M (BRL/yr)	16,759,000	Teles Pires Budget
TUST (BRL/kW month)[38]	Item I of the PDD	ANEEL through the Ratifying Resolution nr.1,086 dated November 16th, 2010[39]

[34] Guidance 12, Annex 5, EB 62.
[35] The expected gross annual power supplied to the gird was calculated based on the forecasted guaranteed energy generation multiplied by the number of hours (8760) in a given calendar year. In order to obtain the amount of net forecasted power supplied to the grid, the plants own consumption is subtracted from the gross generated energy.
[36] According to CCEE's commercialization rules internal consumption has to be estimated by the PPs before operation start and the prescribed CCEE's internal consumption metering procedures are implemented. The internal consumption defined by project participants is 0.2% of the total electricity generation based on project participants experience and internal estimative only. However, due to the lack of a documented evidence for this value, the internal consumption is conservatively set to zero in the calculation of the project IRR.
[37] Calculated based on "Commercialization Rules – Module 2 " Available at: <http://www.ccee.org.br/StaticFile/Arquivo/biblioteca_virtual/Regras/explicativo_09_2.pdf>
[38] Tariff for the use of electric energy transmission lines ("TUST" from the Portuguese *Tarifa do Uso do Sistema de Transmissão*). Clarification and reference in item "I", "total operating costs", "sub-step 2d-sensisitivity analysis".
[39] Available at: <http://www.aneel.gov.br/cedoc/atdsp20104080.pdf>

UBP[40] (BRL/yr)		5,515	Finance request report submitted to the Brazilian Development Bank[41]
TFSEE[42] (BRL/kW)		385.73	ANEEL Dispatch nr. 4,080 dated December 27th, 2010[43].
TAR[44] (BRL/MWh)		68.34	ANEEL Resolution nr. 1.096, dated December 14th 2010[45]
Royalties (%)		6.75	ANEEL[46]
ONS (BRL/yr)		5,462,372	ANEEL[47]
P&D (% of net operational revenues)		1.00	Art. nr. 2 of Law nr. 9.991/00[48]
Applicable Taxes			
Income tax (%)		25	Art. nr. 2 of Law nr. 9.430/96[49]
PIS (%)[50]		1.65	Art. nr. 2 of Law nr. 10.637/02[51]
COFINS (%)[52]		7.6	Law nr. 9.718/98[53]
CSLL[54] (%)		9	Art nr. 3 of Law nr. 7.689/88[55]
Power Purchase Agreements (PPA's)			
Electricity tariff, (R$/MWh)	ACR (85%)	58.35	Finance request report submitted to the Brazilian Development Bank
	ACL	145	Finance request report submitted to the Brazilian Development Bank
Others			

[40] Tariff for the use of a public good ("UBP" from the Portuguese *Uso do Bem Público*).
Clarification and references in item "II", "total operating costs", "sub-step 2d-sensisitivity analysis".
[41] UHE Teles Pires prior consultation (from the Portuguese "Consulta prévia para enquadramento UHE Teles Pires"). March 2011.
[42] Inspection tariff ("TFSEE" from the Portuguese *Taxa de Fiscalização de Serviços de Energia Elétrica*). See clarification and references in item "III", "total operating costs", "sub-step 2d-sensisitivity analysis".
[43] Available at: http://www.aneel.gov.br/cedoc/atdsp20104080.pdf
[44] Updated Reference Tariff ("TAR" from the Portuguese *Tarifa Atualizada de Referência*). This input is used to calculate the Financial Compensation for the Hydrological Exploitation of Water Resources ("CFURH" from the Portuguese *Compensação Financeira pela Utilização de Recursos Hídricos*).). See clarification and references in item "IV" and "V", "total operating costs", "sub-step 2d-sensisitivity analysis".
[45] Available at: <http://www.aneel.gov.br/cedoc/reh20101096.pdf>
[46] ANEEL (2005). Atlas da Energia Elétrica do Brasil (2ª edição). Compensação Financeira e Royalties (available at <http://www.aneel.gov.br/aplicacoes/atlas/energia_hidraulica/4_11.htm>, retrieved on 11 November 2011).
[47] Available at: <http://www.aneel.gov.br/cedoc/rea2004328.pdf> Full calculation available in appendix 2, IRR calculation.
[48] Available at: <http://www.planalto.gov.br/ccivil_03/Leis/L9991.htm>.
[49] Available at: <http://www.normaslegais.com.br/legislacao/tributario/lei9430.htm>.
[50] Social Integration Program ("PIS" from the Portuguese *Programa de Integração Social*).
[51] Available at: <http://www.receita.fazenda.gov.br/Legislacao/Leis/2002/lei10637.htm>.
[52] Social Security Financing Contribution ("COFINS" from the Portuguese *Contribuição para o Financiamento da Seguridade Social*).
[53] Available at: <http://www.normaslegais.com.br/legislacao/tributario/lei9718.htm>.
[54] Social contribution on net profits ("CSLL" from the Portuguese *Contribuição Social sobre o Lucro Líquido*). Available at: <http://www.receita.fazenda.gov.br/Aliquotas/ContribCsll/Aliquotas.htm>.
[55] Available at: <http://www.planalto.gov.br/ccivil_03/Leis/L7689.htm>.

Depreciation (years)	10 and 25	Normative Instruction nr. 162[56], dated 31/12/1998 and Normative Instruction nr. 130[57], dated 10/11/1999

The IRR of the project calculated using the assumption presented above shows that without considering CERs revenues is 3.38%, significantly lower than the chosen benchmark, WACC of the sector of 7.27%. The result clearly demonstrates that the project activity has a less favorable indicator than the benchmark and cannot be considered as financially attractive.

Sub-step 2d: Sensitivity analysis

The sensitivity analysis, as established by the "*Guidance on the Assessment of Investment Analysis*", is to be conducted considering variables that constitute more than 20% of either total project costs or total project revenues, including initial investment costs. Hence, variations will be done by altering the following parameter:

- Reducing investment expenses (investment costs).
- Increasing project's revenues (electricity tariff);
- Increasing energy generation by the plant (power generation);
- Reducing cost of operational (total operating costs)

Financial analyses were performed altering each of these parameters by 10%, as well as the variation needed to reach the benchmark, and assessing what was the impact on project's IRR (guidance 21, EB62, Annex 5). The result is presented below in Table 6.

Table 6 – Sensitivity analysis

	IRR with 10% variation	Variation to reach the benchmark
Original value	3.38%	n.a.
Investment costs	4.37 %	- 32.30 %
Electricity tariff	4.57%	35.10 %
Power generation	5.63 %	18.00 %
Total operating costs	3.97 %	- 72.00 %

In the next paragraphs it is discussed why these variations do not reflect a realistic range of assumptions for the input parameters of the financial analysis.

Investment costs: A decrease of 32.30% in investment costs is very unlikely to happen, as it is much more likely that hydropower projects will rather experience cost increases during construction. The total investment necessary to build the plant as it is presented in the cash flow corresponds to the estimated investment cost made by the project owner. Specifically for the Project the PPs will sign an EPC contract, which can be used to confirm preliminary estimations. This type of contract fixes the price

[56] Available at: http://www.receita.fazenda.gov.br/legislacao/ins/ant2001/1998/in16298.htm
[57] Available at: http://www.receita.fazenda.gov.br/legislacao/ins/ant2001/1999/in13099.htm

to build the plant and any variation either in favor or against the project is in charge of the construction company which means that no variation in project IRR can be reasonably attributed to a variation in the investment costs.

The conclusion is backed up by peer-review literature findings related to the estimation of construction costs and schedules in developing countries. Using a sample of 125 projects (59 thermal and 66 hydropower) Bacon and Besant-Jones (1998)[58] show that although the ratio of actual to estimated cost can be smaller than one (indicating actual investment smaller than estimated), less than 10% of the analysed projects disbursed less than forecasted. One of the conclusions of the paper is that "the estimated values were significantly biased below actual values".

From the above information the PPs are confident to state that a reduction in the project activity investment expenses is very unlikely and a reduction of 32.30% in investments costs is not possible.

Electricity tariff: The electricity tariff of the Project was established by the energy auction carried out by the *Chamber of Electric Energy Commercialization* (CCEE from the Portuguese "Câmera de Comercialização de Energia Elétrica") on December 17th, 2010[59]. The value of the electricity tariff was fixed at R$58.35[60] for a term of 30 years (initiating on 1 January 2015) which will be commercialized in the Regulated Contracting Environment (ACR). According to the auction notice, 85% of the forecasted annual power supply to the grid[61] at the time of the auction has to be commercialized in the ACR. The remaining energy can thus be commercialized in the Free Contracting Environment (ACL), here at an estimated price of R$145. Since the tariff for the ACR is fixed, a variation of 35.10% in total revenues from the electricity sales in the ACL, which corresponds to a significant smaller share of the forecasted power generation, is required to reach the benchmark, clearly not a plausible scenario.

Annual power supplied to the grid: The expected annual power supplied to the grid by the Project as established by the Mines and Energy Ministry (Ordinance MME n°27/2010) is calculated based long-term historical hydrological data (available since 1930s) and therefore the long term average annual power supplied is unlikely to be significantly different to the value used in the financial analysis.

The Brazilian electricity model defines that electric energy commercialization is performed in two market environments, the *Regulated Contracting Environment* (ACR[62]) and the *Free Contracting Environment* (ACL[63]).

In the ACR, electric energy sellers and distributors can participate through public auctions regulated by ANEEL and made operational by CCEE. In order to ensure the compliance with the market demand, the distribution agents can acquire energy in accordance with article 13 of Decree N°5.163/2004:

- Electric energy purchase auctions from existing and new generation plants;

[58] R. W. Bacon and J. E. Besant Jones (1998). *Estimating construction costs and schedules – Experience with power generation projects in developing countries.* Energy Policy, vol. 26, nr. 4, pp 317-333.
[59] MME Ordinance 820 4-Oct-2010 (retrieved from <www.aneel.gov.br/cedoc/prt2010820mme.pdf> on 11 November 2011).
[60] Results of the 11th auction of new power generation 04/2010 ANEEL - Hydro Projects 2015-H30 (retrieved from http://www.aneel.gov.br/aplicacoes/editais_geracao/documentos/resultado_A-5_4-2010.pdf on 11 November 2011).
[61] ANEEL-Auction Notice nr. 04/2010, Annex VIII (from the Portuguese "ANEEL - Edital Leilão N°04/2010, Anexo VIII").
[62] Regulated Contracting Environment ("ACR" from the Portuguese *Ambiente de Contratação Regulada*), official definition available at: <http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=fbcca5c1de88a010VgnVCM100000aa01a8c0RCRD>.
[63] Free Contracting Environment ("ACL" from the Portuguese *Ambiente de Contratação Livre*), official definition available at: <http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=84dca5c1de88a010VgnVCM100000aa01a8c0RCRD>.

- Distributed generation, as long as the contracting (hiring) is preceded by a public call made by the distribution agent and limited by an amount of 10% of the distributors market;
- Plants that generate electric energy from wind, small hydropower and biomass plants that were contracted in the first stage of the *Alternative Energy Sources incentive Program*[64] and;
- Bi-national Itaipu Hydropower plant.

In the Free Contracting Environment, generation and commercialization agents as well as electric energy importers, exporters and free consumers can participate. In this environment electric energy purchase and selling volumes as well as their price can be freely negotiated through bilateral contracts. Additionally to the existence of two commercialization environments as explained above, a short-term market (administrated by CCEE) where the difference between the generated/consumed physical energy and contracted energy are accounted for and liquidated. Participation is compulsory for generators, distributors, importers, exporters, traders and free consumers connected to the SIN. The market price used in the short term market is denominated *Settlement Price Difference* (PLD, from the Portuguese “Preço de Liquidação das Diferenças”). The PLD is calculated based on the predominance of hydroelectric generation, which aims to find the optimal balance between the present benefit of using hydroelectric resources (water) and storing it, measured in terms of the expected fuel oil savings consumed by thermoelectric plants. Therefore, based on hydrological conditions, energy demand, fuel prices, deficit cost, operation start of new projects and availability of generation and transmission equipments, the pricing model obtains the optimal dispatch for a given period, defining the hydraulic and thermal generation for each sub-market.

In order to share and mitigate the hydrological risks associated with the centralized dispatch and optimization of the hydrothermal system by ONS, the *Reallocation Energy Mechanism* (MRE from the Portuguese “Mecanismo de Realocação de Energia”) is used. The objective is to ensure that all plants that are part of the MRE receive their levels of physical guarantee regardless of their level of energy generation, provided that the total generation of the MRE is not below the total physical guarantee of the system. This means that the MRE reallocates energy by transferring the surplus from those that produced beyond their physical guarantee to those that generated less. In other words, the intention of the MRE is to assure that all generators commercialize the guaranteed energy assigned to them independently from their real energy generation.

The reallocation/transfer of energy between hydro’s incurs in the cost called “minimum water cost” which is based on an optimization tariff determined by ANEEL to cover the incremental cost incurred in the operation and maintenance of the plant, payment of a financial tariff compensation fee of hydrological resources used which is calculated based on the amount of energy generated. Whenever attributed energy of a generator after being reallocated in the MRE is higher than the contracted one, the generator is entitled to sell this surplus in the short term market at the momentary PLD value. The same applies in the opposite situation, in which the generator will have to purchase energy from the short term market if they don’t comply with their contractual obligations (energy generation deficit). Consequently, this means that if a plant generates more energy and it is reallocated in the MRE, the compensation fee the plant receives will not generate any additional revenues, but only cover the cost (O&M) of its additional generation.

[64] PROINFA, from the Portuguese “Programa de Incentivo as Fontes Alternativas de Energia Eletrica”.

Moreover, being UHE Teles Pires defined by ANEEL as a participant in the apportionment of the losses which occur within the basic network, these losses should have been considered. As per the sector regulation, UHE Teles Pires is only allowed to negotiate a quantity of electricity already discounting these losses.

The proposed project activity is contractually bound to sell 85% of its assured energy in the ACR market at a fixed price as determined by the energy auction and the rest, minus losses, to the ACL market. It is relevant to mention that the figure used in the financial analysis already take into account the optimization of the hydropower potential of the plant, which increased the firm energy of the plant by 2.75% from 915.4 MW_{avg} at the time of the auction to 940.6 MW_{avg}. Based on the aforementioned, assuming a consistent increase of 18.00% in the long term average annual power supplied to the grid is definitely not possible.

Total operating costs: The results of the sensitivity analysis shows that if the Project incurred a reduction of 72.00% of the operating costs the IRR of the Project would reach the 7.27% benchmark. This is not a plausible scenario and, in the following paragraphs a few reasons are disclosed to confirm the appropriateness of the assumed operation costs.

The following tariffs are part of the operating costs as described below:

I. "TUST" is the tariff for the use of electric energy transmission lines which was fixed by ANEEL until 2021[65];

Table 7 - Annual ANEEL TUST tariff evolution

Period	TUST Tariff R$ kW/month
Jul/14 - Jun/15	9.070
Jul/15 - Jun/16	8.849
Jul/16 - Jun/17	8.628
Jul/17 - Jun/18	8.407
Jul/18 - Jun/19	8.186
Jul/19 - Jun/20	8.186
Jul/20 - Jun/21	8.186
Jul/21 - Jun/22	8.186
Jul/22 - Jun/23	8.186
Jul/23 - Jun/24	8.186

II. "UBP" is the tariff for the use of a public good which was determined by the Auction Notice[66] and consists of an annual value of R$ 5,514,831.81.

III. "TFSEE" is a inspections tariff charged by ANEEL which as demonstrated in the Table 8 below has been constantly increasing;

[65] The transmission lines usage tariff was established by ANEEL (Resolution nr. 1086 dated November 16th, 2010).
[66] ANEEL Public Notice 04/2010 – Annex 9 – Instruments and parameters.

Table 8 - Annual ANEEL inspection tariff evolution[67]

Year	TFSEE Tarrif R$/ kW
2011	385.73
2010	363.60
2009	335.42
2008	303.78
2007	289.22

IV. "CFURH" is considered the financial compensation for the hydrological exploitation of water resources and are established as 6.75% of effective measured generated electric energy[68] multiplied by the Updated Reference Tariff ("TAR"). This value is fixed by ANEEL according to the Federal constitution, article 20 which defines potential hydrological resources as a property of the Union and therefore establishes that a financial compensation for its exploitation is required.

V. "TAR" represents the updated Reference Tariff[69] and is one parameter that is used to calculate the financial compensation mentioned in item IV. This tariff is fixed by ANEEL and revised every four years, but updated annually as demonstrated in Table 9 below.

Table 9 - Reference tariff price evolution

Year	Determined by Resolution	TAR tariff value (R$)
2011	ANEEL N° 1096, 14.12.2010	68.34
2010	ANEEL N° 917, 08.12.2009	64.69
2009	ANEEL N° 753, 16.12.2008	62.33
2008	ANEEL N°586, 11.12.2007	60.04
2007	ANEEL N°404, 12.12.2006	57.63
2006	ANEEL N°192, 19.12.2005	55.94
2005	ANEEL N°285, 23.12.2004	52.67
2004	ANEEL N°647, 08.12.2003	44.20
2003	ANEEL N°797, 26.12.2002	39.43

VI. "ONS" tariff refers to the reimbursement of part of the administration and operation costs of ONS applied to all generation, transmission and distribution agents as well as free consumers that are connected to the national grid[70].

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[67] ANEEL Ordinance nr. 360 dated February 4th, 2011.
[68] ANEEL (2005). Brazilian Atlas of Electric Energy (2nd edition) - "Compensação Financeira e Royalties" (available at http://www.aneel.gov.br/aplicacoes/atlas/energia_hidraulica/4_11.htm, retrieved on November 11th, 2011).
[69] Available at: <http://www.aneel.gov.br/area.cfm?idArea=536>.
[70] ANEEL Resolution nr. 328 dated August 12th, 2004.

VII. P&D (Research & Development) tariff corresponds to at least 1% of each independent energy generator net income as determined by Article N°2 of Law N°9.991 dated on July 24th, 2000[71].

Operation and maintenance costs are contractually established between the project developer and the service provider at a fixed rate. Furthermore, all applicable tariffs as described and demonstrated above are determined by specific national entities and a decrease in operating costs/tariffs is very unlikely to happen; more importantly, it's more realistic to expect an increase as demonstrated above. Additionally, all prices are corrected based on the annual inflation rate. Therefore, no significant decrease of the O&M costs can be reasonably expected.

These results clearly show that only under very unrealistic and highly favorable circumstances it would be possible to reach the Project IRR benchmark. We can conclude that the IRR is lower than the benchmark for a realistic range of assumptions for the key input parameters and therefore, that the Project is not financially attractive.

Outcome of sub-step 2d

The IRR of the project activity without being registered as a CDM project is significantly below the sector benchmark, demonstrating that project activity is not financially attractive to investors. Then, alternative scenario 2 would be the most plausible alternative to the project activity, *i.e.* the continuation of the current situation with additional electricity supplied by the Brazilian Interconnected Grid.

Step 3. Barrier analysis

Not applicable.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity

According to the additionality tool, "*projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc*".

Based on the definition presented above, the tool provides a stepwise approach to be applied while conducting the common practice in order to identify similar projects to the proposed CDM Project Activity. Furthermore, the tool establishes that this approach shall be used if the proposed CDM Project Activity complies with one of the measures listed below:

(a) Fuel and feedstock switch;

(b) Switch of technology with or without change of energy source (including energy efficiency improvement as well as use of renewable energies);

(c) Methane destruction;

(d) Methane formation avoidance.

[71] Law 9,991 dated July 24th, 2000.

The proposed CDM Project Activity matches option (b) since it consists of a switch from grid electricity to electricity generation from hydropower plant[72].

The stepwise approach prescribed in the additionality tool is applied in the next paragraphs.

Step 1: *Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity*

Considering that *Teles Pires Hydropower Plant Project Activity* has 1,820 MW of installed capacity and applying the output range of +/-50% , only plants with installed capacity between 910 and 2,730 MW will be considered in this analysis.

Step 2: *In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all}. Registered CDM project activities shall not be included in this step*

The plants considered in the analysis were selected following the following definitions for output and geographical area as presented in the additionality tool.

(i) Output

The additionality tool defines output as "goods or services with comparable quality, properties, and application areas (e.g. clinker, lighting, residential cooking)". Therefore, in the case of the project, the output considered is identified as the range of installed capacity defined in ***Step 1*** above, *i.e.*, between 910 and 2,730 MW of all the plants interconnected in the Brazilian Interconnected System.

(ii) Applicable geographical area

The additionality tool states: *"Applicable geographical area covers the entire Host Country as a default; if the technology applied in the project is not country specific, then the applicable geographical area should be extended to other countries".*

The technology to be applied in the project is not country specific. Nevertheless, Brazil has an extension of 8,514,876.599.6 square kilometers[73] (with over 4,000 km distance in the north-south as well as in the east-west axis) and 6 distinct climate regions: sub-tropical, semi-arid, equatorial, tropical, highland-tropical and Atlantic-tropical (humid tropical). These varieties of climate obviously have strong influence in the technical aspects related to a hydropower projects. As cited by Veselka[74], the climate affects all major aspects of the electric power sector from electricity generation, transmission and distribution system to consume demand for power. Therefore, it is reasonable to assume that the technology may vary considerably from location to location within the country.

In addition, projects that deliver electricity to the national grid can differ significantly from each other considering the project type, the region to be implemented, climate, topography, availability of transmissions lines, river flow regularity (in the case of hydropower projects), etc. For those reasons alone

[72] EB 62, Annex 8

[73] Source: http://www.ibge.gov.br/english/geociencias/cartografia/default_territ_area.shtm.

[74] Veselka, T.D. (2008). *Balance of power: A warming climate could affect electricity*. Geotimes-Earth Energy and Environment News, American Geological Institute. Retrieved on 20-05-2012 from http://www.agiweb.org/geotimes/aug08/article.html?id=feature_electricity.html.

it is extremely difficult and not reasonable to compare different hydropower potential and plants without taking into account the mentioned specificities. Moreover, hydro-power plants cannot be optimally placed with respect to load centers and transmission lines, or easily transferred (moved to a new region where a better tariff is offered) as, for example, modular fossil-fuel-fired (diesel, natural gas) power plants. Differences may be even larger if no big water storage is possible, as in the case of the proposed run-of-river hydropower project activity.

Nevertheless, for over-conservativeness reasons all hydropower projects connected to the enormous SIN[75] and the plants that present an installed capacity between the range established in ***Step 1*** above will be considered in the analysis. Other CDM Project Activities, defined by the tool as *the ones registered (…) and that have been published on the UNFCCC website for global stakeholder consultation as part of the validation process* were not taken into consideration. In addition, only plants that started commercial operation before 19/08/2011 (starting date of the project activity) were considered.

Then, taking into account the ANEEL database[76], the result of Step 1 shows that there are 24 plants interconnected to the Brazilian Interconnected System (SIN, from the Portuguese "*Sistema Interligado Nacional*" with installed capacity between 910 and 2,730 MW, in which twenty plants are hydropower plants, three are thermo power plants and one nuclear power plant. The table below presents the identified plants connected to the SIN that applying the installed capacity criteria.

Table 10 - Identified operational plants with installed capacity between 910 and 2730 MW with operational starting date before August, 19th 2011[77]

Plant	Installed Capacity (MW)	Type	Operational Starting Date
Paulo Afonso IV	2,462.4	Hydropower plant	1979
Itumbiara	2,080.5	Hydropower plant	1981
São Simão	1,710.0	Hydropower plant	1978
Bento Munhoz da Rocha Neto	1,676.0	Hydropower plant	1980
Eng° Souza Dias	1,551.2	Hydropower plant	1974
Eng° Sérgio Motta	1,540.0	Hydropower plant	2003
Luiz Gonzaga	1,479.6	Hydropower plant	1988
Itá	1,450.0	Hydropower plant	2000
Marimbondo	1,440.0	Hydropower plant	1975
Salto Santiago	1,420.0	Hydropower plant	1980
José Ermírio de Moraes	1,396.2	Hydropower plant	1979
Serra da Mesa	1,275.0	Hydropower plant	1998
Ney Aminthas de Barros Braga	1,260.0	Hydropower plant	1992

[75] It approximately overlaps in size the entire European Union (Bertoni, A. *et al.*, 2012. *Operation of the Brazilian Renewable Energy System*.International Conference on Renewable Energies and Power Quality).
[76] Availabel at: Available at: http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp.
[77] The complete list with all plants considered in the analysis was supplied to the validating DOE.

José Richa	1,240.0	Hydropower plant	1999
Furnas	1,216.0	Hydropower plant	1963
Emborcação	1,192.0	Hydropower plant	1982
Machadinho	1,140.0	Hydropower plant	2002
Salto Osório	1,078.0	Hydropower plant	1975
Sobradinho	1,050.3	Hydropower plant	1979
Luiz C. Barreto de Carvalho	1,048.0	Hydropower plant	1969
Santa Cruz	1,000.0	Thermo power plant (NG)	2004
Governador Leonel Brizola	1,058.3	Thermo power plant (NG)	2004
Mário Lago	922.62	Thermo power plant (NG)	2001
Angra II	1,350.0	Nuclear power plant	2001

The result of N_{all} for the range identified above in Step 1 (910 MW – 2,730 MW), is that there are 24 operational plants interconnected to the Brazilian SIN. Therefore, $\boldsymbol{N_{all}}$ = 24.

Step 3: *Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number* N_{diff}.

According to the guidelines on common practice, d*ifferent technologies are technologies that deliver the same output and differ by at least one of the following (as appropriate in the context of the measure applied in the proposed CDM project and applicable geographical area):*

(i) Energy source/fuel;

(ii) Feed stock;

(iii) Size of installation (power capacity)

(iv) Investment climate in the date of the investment decision, inter alia:

- Access to technology;
- Subsidies or other financial flows;
- Promotional policies;
- Legal regulations;

(v) Other features, inter alia:

- Unit cost of output (unit costs are considered different if they differ by at least 20 %);

Considering the information above, it was identified the following types of technologies that differ from the proposed project activity:

(a) Energy source/fuel:

As mentioned above, different technologies are technologies that can differ in the energy source or fuel applied. Taking into account that the Teles Pires Hydropower Plant Project Activity is a hydropower

plant and generates electricity derived from a renewable energy source (water), Santa Cruz, Governador Leonel Brizola and Mário Lago thermo power plants and Angra II nuclear power plants identified in ***Step 2*** above, shall not be compared to the proposed project activity since they apply different technologies in order to generate electricity.

(b) Investment climate in the date of the investment decision, inter alia:

With respect to the investment climate in the date of the investment decision, more specifically to the regulatory framework, until the beginning of the 1990's, the energy sector was composed almost exclusively by state-owned companies. From 1995 onwards, due to the increase in international interest rates and the lack of state investment capacity, the government started the privatization process. However, by the end of 2000 results were still modest. Although further initiatives, aiming to improve electric generation in the country, were taken between the 1990's and 2003, they did not attract enough new investments to the sector.

During 2003 and 2004, the Federal Government announced the new model for the Brazilian Electricity Market sustained by Laws n°10.847 and 10.848 of March 15th, 2004 and Decree n°5.163 of July 30th, 2004. This new model defined the creation of:

- A new institution responsible for the long term planning of the energy sector (Energy Research Company – EPE);
- An institution to evaluate continuously the electric energy supply (Electric Sector Monitoring Committee - CMSE) and;
- An institution to continue performing the activities that were taking care by the Wholesale Electric Energy Market (MAE) related to the commercialization of the interconnected electric energy system.

According to OECD[78], "Central to the new model is the creation of the 'Pool' (ACR), matching electricity demand and supply capacity through long-term contracts, which will replace on a competitive bases the "initial contracts" inherited from the 1990s. These contracts were designed as a bridge between the 1980s and the new environment after the privatization of most distribution companies and schedule to gradually expire after 2002. The new framework is inspired by the "single-buyer" model, where an entity - typically the government - buys all electricity from producers and sells it to distributors. However, although establishing a common mechanism for the purchase of energy, the model allows market risk to be shared among participants instead of being borne exclusively by the government, which acts rather like an auctioneer than a buyer. With long-term contracts set through the Pool, price uncertainty will be broadly restricted to electricity traded in the free, short-term market and bilateral contracts between generators and large consumers."

A comparison between the old Electricity Markets and its transition to the New Model can be seen in detail in the Table 11[79] below:

Table 11 - Brazilian electricity market development

Old Model (until 1995)	Free Market Model (1995 - 2003)	New Model (2004)

[78] Regulation of the Eletricity Sector IN OECD Economic Surveys of Brazil 2005.
[79]Electricity Markets Comparison retrieved on 03 October 2011 from http://bit.ly/NYNJ8P.

Financing through public resources	Financing through public and private resources	Financing through public and private resources
Vertically Integrated Companies	Companies divided by activity: generation, transmission, distribution and commercialization	Companies divided by activity: generation, transmission, distribution, commercialization, import and export
Predominantly State Owned Companies	Emphasis on privatization and starting new companies	Coexistence between state owned and private companies
Monopolies - Nonexistent competition	Generation and commercialization competition	Generation and commercialization competition
Captive consumers	Free and captive consumers	Free and captive consumers
Regulated tariffs in all segments	Generation and commercialization prices freely negotiated	*Free Environment (ACL):* Generation and commercialization prices freely negotiated *Regulated Environment(ACR):* Auction and bidding for the lowest tariff
Regulated Market	Free Market	Regulated and Free market
Determinative planning: Energy System planning coordinating group	Indicative planning by the National Energy Policy Council	Planned by the Energetic Research Company (EPE)
Contracting: 100% of the Market	Contracting: 85% of the Market (until august/2003) and 95% (until December/2004)	Contracting: 100% of the Market + reserve
Energy balance surplus / deficit is divided between consumers	Energy balance surplus / deficit is settled by the Wholesale Electric Energy Market (MAE)	Energy balance surplus / deficit are settled by the Electric Energy Commercialization Chamber (CCAA) and through a compensation mechanism (MCSD) for distributors.

Concluding, the Brazilian energy supply crisis originated from the fatigued old state-owned energy model, evolving through a free market until reaching the new, more competitive and more robust actual model. Since the exhaustion of the state-owned models investment capacity was perceived, a fast transition to a private model was attempted. However, this new model was not capable of achieving the required effects and an alternative sectoral model had to be constituted in order to enable a balanced co-existence of public and private capital in a competitive environment.

Taking into account this new regulatory framework, it is clearly only reasonable to consider projects for which the decision making process happened after March of 2004.

Therefore, considering the explanations provided in item *(a)* and *(b)* above, 4 plants apply different energy source/fuel and 20 plants started operation before 2004, $N_{diff} = 24$.

Step 4: *Calculate factor* $F=1-N_{diff}/N_{all}$ *representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity. The proposed project activity is a "common practice" within a sector in the applicable geographical area if the factor F is greater than 0.2 and* $N_{all}-N_{diff}$ *is greater than 3.*

From the results discussed above, we have:

N_{all} - N_{diff} = 24 – 24 = 0 < 3 and,

$F = 1- N_{diff} / N_{all} = 1 – 24/24 = 0 < 0.2$

Therefore, the proposed CDM Project Activity is not a common practice.

Sub-step 4b. Discuss any similar options that are occurring

Considering the analysis provided in Sub-step 4a, there are no similar options occurring, therefore the proposed project activity cannot be considered common practice.

In conclusion, as Sub-steps 4a and 4b are satisfied, i.e., *(i) similar activities cannot be observed* or (ii) similar activities are observed, but essential distinctions between the project activity and similar activities can reasonably be explained, then the proposed project activity is additional.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

Project Emissions (PE_y)

The project emissions are accounted for by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$ Equation 1

Where:

PE_y Project emissions in year y (tCO_2e/yr)

$PE_{FF,y}$ Project emissions from fossil fuel consumption in year *y* (tCO_2e/yr)

$PE_{GP,y}$ Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e/yr)

$PE_{HP,y}$ Project emissions from water reservoirs of hydro power plants in year *y* (tCO_2e/yr)

According to the methodology, project emissions due to fossil fuel combustion and emissions of non-condensable gases from the operation of geothermal power plants are set to zero for hydropower projects ($PE_{GP,y} = PE_{HP,y} = 0$).

Emissions from water reservoirs of hydro power plants ($PE_{HP,y}$)

As per the ACM002, for hydro power project activities that result in new single or multiple reservoirs:

- The methodology is not applicable if the power density (*PD*) of the project activity is less or equal to 4 W/m^2;
- CH_4 and CO_2 emissions from the reservoir shall be accounted if the power density of the project activity is greater than 4 W/m^2 and less than or equal to 10 W/m^2 and;

- Emissions from water reservoir are set to zero if the power density of the project activity is greater than 10 W/m^2.

Project emissions from water reservoirs are calculated as follows:

$$PE_{HP,y} = \frac{EF_{Res} \times TEG_y}{1000} \qquad \text{Equation 2}$$

Where:

$PE_{HP,y}$	Project emissions from reservoirs of hydropower plants in year y (tCO_2e);
EF_{Res}	Default emission factor for emissions from reservoirs of hydro power plants, and the default value as per EB 23 is 90 kg CO_2e/MWh;
TEG_y	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y (MWh).

The power density of the project activity is determined as per the equation below:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \qquad \text{Equation 3}$$

Where:

PD	Power density of the project activity, in W/m^2
Cap_{PJ}	Installed capacity of the hydro power plant after the implementation of the project activity (W)
Cap_{BL}	Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero
A_{PJ}	Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2);
A_{BL}	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.

The project's reservoir area[80] under the normal maximum water level of 220 m is 134.70 km^2, of which 40.6 km² is part of the normal river bed[81] and, therefore, the increased flooded area is 94.10 km². In spite of the methodology determination for A_{BL} to be zero for new reservoirs, a few projects were registered discounting the river bed (A_{BL} = surface area of the river before the implementation of the project). All of them base their procedure in a clarification approved by the CDM EB[82], where one reads: "in order to calculate power density, the correct equation will be the increased power capacity divided by the increased flooded area measured in the water surface". Additionally, there is at least one case of a project with new reservoir and using ACM0002, version 7 - where the provision for A_{BL} to be zero for

[80] ANEEL Ordinance nr. 3,504 dated August 26th, 2011. Available at: <http://www.aneel.gov.br/cedoc/dsp20113504.pdf>.
[81] ANEEL's UHE Teles Pires Project datasheet for the feasibility studies and basic project ("Ficha Resumo – Estudos de Viabilidade e Projeto Básico"), April 2008.
[82] AM_CLA_0049 available at <http://cdm.unfccc.int/methodologies/DB/AS1DOF3L010BY57ZT2UZNQ8Y9K83CN/view.html>.

new reservoirs, that changed its power density post-registration, discounting the surface area of the river (see project 2539). Using both approaches:

$$PD = \frac{1820 - 0}{134.70 - 40.60} = 19.34 \text{ W/m}^2$$

$$PD = \frac{1820 - 0}{134.70 - 0} = 13.51 \text{ W/m}^2$$

Here the most conservative figure will be used - 13.51 W/m^2 – and, if applicable, it will be revised in the first monitoring period.

Therefore, as the Project power density is greater than 10, emissions from water reservoir are zero ($PE_{HP,y}$ =0).

Baseline Emissions (BE_y)

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} \qquad \text{Equation 4}$$

Where:

BE_y Baseline emissions in year y (tCO_2/yr)

$EG_{PJ,y}$ Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)

$EF_{grid,CM,y}$ Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” (tCO_2/MWh)

Calculation of $EG_{PJ,y}$

The project activity is the installation of a new grid connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, thus $EG_{PJ,y}$ is calculated according to option (a) Greenfield renewable energy power plants as follows:

$$EG_{PJ,y} = EG_{facility} \qquad \text{Equation 5}$$

Where:

$EG_{PJ,y}$ Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)

$EG_{facility,y}$ Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr)

Determination of $EF_{grid,CM,y}$

The Project Activity is connected to the Brazilian National Interconnected System (SIN). The grid emission factor is calculated by the Brazilian DNA, according to the "Tool to calculate the emission factor for an electricity system".

Step 1: Identify the relevant electricity systems

By means of the Resolution number 8[17], issued on May 26th, 2008, the *Interministerial Commission on Global Climate Change* (CIMGC from the Portuguese "Comissão Interministerial de Mudança Global do Clima"), the Brazilian DNA, delineated the electricity system as the National Interconnected Grid (SIN), for CDM purposes. It covers all the five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest) as presented in the figure below.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

The option chosen to calculate the operating margin and build margin emission factor is Option I: Only grid power plants are included in the calculation.

Step 3: Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is calculated by the Brazilian DNA[83] based on the following method: Option (c): Dispatch data analysis OM

[83] Available at: http://www.mct.gov.br/index.php/content/view/74689.html

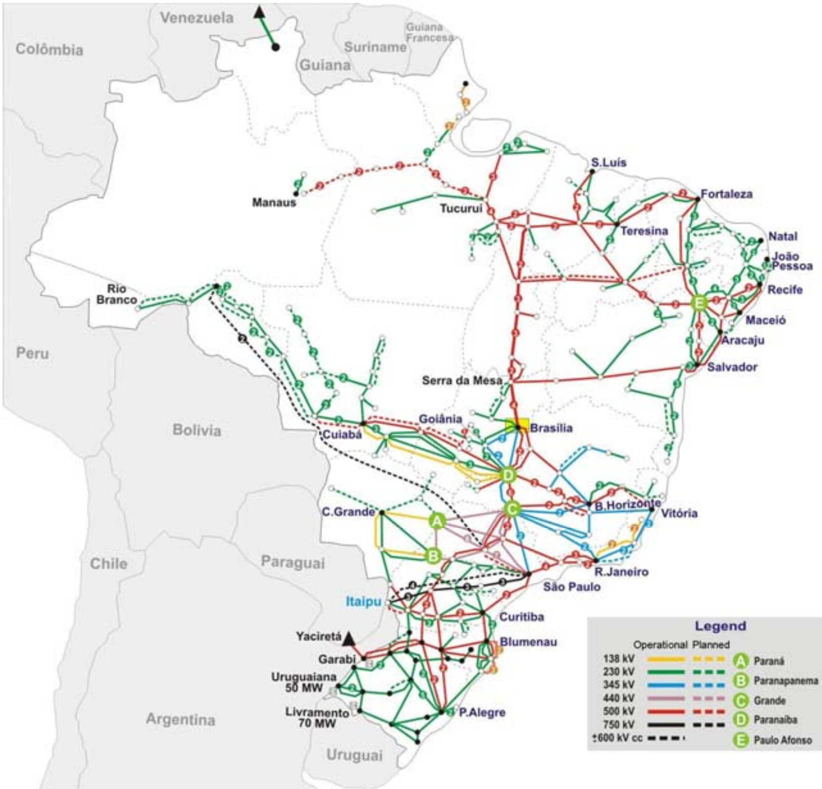

Figure 4 – Brazilian Interconnected System. (Source: ONS)

Step 4: Calculate the operating margin emission factor according to the selected method

The dispatch data analysis OM emission factor ($EF_{grid,OM\text{-}DD,y}$) is determined based on the grid power units that are actually dispatched at the margin during each hour h where the project is displacing grid electricity. The emission factor is calculated as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_{h} EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}} \qquad \text{Equation 6}$$

Where:

$EF_{grid,OM\text{-}DD,y}$	Dispatch data analysis operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{PJ,h}$	Electricity displaced by the project activity in hour *h* of year *y* (MWh)
$FE_{EL,DD,h}$	CO_2 emission factor for grid power units in the top of the dispatch order in hour *h* in year *y* (tCO_2/MWh)
$EG_{PJ,y}$	Total electricity displaced by the project activity in year *y* (MWh)
h	Hours in year *y* in which the project activity is displacing grid electricity
y	Year in which the project activity is displacing grid electricity

Calculation of hourly CO_2 emission factor for grid power units ($EF_{EL,DD,h}$)

Project participants do not have access to the Brazilian DNA calculation of the hourly emission factor nor to the spreadsheet used. Only final values are available for public consultation.

Calculation to determine the set of grid power units *n* on top of the dispatch

Project participants do not have access to the Brazilian DNA determination of the set of power units *n* nor to the spreadsheet used. Only final values for the hourly emission factor ($EF_{EL,DD,h}$) are available for public consultation.

Step 5: Calculate the build margin (BM) emission factor

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}}$$ Equation 7

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$FE_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

Calculation to determine the set of power units m included in the build margin

Project participants do not have access to the Brazilian DNA determination of the set of power units *m* nor to the spreadsheet used. Only final values for the hourly emission factor ($EF_{EL,DD,h}$) are available for public consultation.

Calculation of the CO_2 emission factor for each power unit m ($EF_{EL,m,y}$)

Project participants do not have access to the Brazilian DNA calculation of the CO_2 emission factor for each power unit *m* nor to the spreadsheet used. Only final values are available for public consultation.

In terms of vintage of data, project participants chose: option 1 (*ex-ante*).

Step 6: Calculate the combined margin (CM) emission factor

The calculation of the combined margin (CM) emission factor is based on one of the following methods:

(a) Weighted average CM; or

(b) Simplified CM.

The weighted average CM method (option A) should be used as the preferred option according to equation below:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot \omega_{OM} + EF_{grid,BM,y} \cdot \omega_{BM}$$ Equation 8

Where:

$EF_{grid,CM,y}$	Combined margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year *y* (tCO_2/MWh
ω_{OM}	Weighting of operating margin emission factor (%)
ω_{BM}	Weighting of build margin emission factor (%)

For ω_{OM} and ω_{BM} the default value of 0.5 is used according to the “Tool to calculate the emission factor for an electricity system”.

Leakage Emissions (LE_y)

No leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, and transport). These emissions sources are neglected.

Emission Reduction (ER_y)

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{Equation 9}$$

Where:

ER_y	Emission reductions in year *y* (tCO_2/yr)
BE_y	Baseline emissions in year *y* (tCO_2/yr)
PE_y	Project emissions in year *y* (tCO_2/yr)

B.6.2. Data and parameters fixed ex ante

This section shall include a compilation of information on the data and parameters that are not monitored throughout the crediting period but that are determined only once and thus remain fixed throughout the crediting period and that are available when validation is undertaken.

Data / Parameter	w_{OM}
Unit	Fraction
Description	Weighting
Source of data	"Tool to calculate the emission factor for an electricity system"
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Default weight value for Operating Margin according to the "Tool to calculate the emission factor for an electricity system"
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	w_{BM}
Unit	Fraction
Description	Weighting
Source of data	"Tool to calculate the emission factor for an electricity system"
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Default weighting value for Build Margin according to the "Tool to calculate the emission factor for an electricity system"
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	$EF_{grid,BM,y}$
Unit	tCO_2/MWh
Description	Grid build margin
Source of data	Brazilian Designated National Authority for the CDM
Value(s) applied	0.1404
Choice of data or Measurement methods and procedures	BM is calculated according to methodology ACM0002 and the "Tool to calculate the emission factor for an electricity system" by the Brazilian DNA. Project proponents chose Option 1: calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. The Brazilian DNA's most recent calculation published is based on 2010 data, thus it is used in the PDD.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	Cap_{BL}
Unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity (W)
Source of data	ACM0002
Value(s) applied	0.0
Choice of data or Measurement methods and procedures	The project consists of a new power plant. As defined in the methodology, for new hydro power plants, this value is zero.
Purpose of data	Calculation of project emissions.
Additional comment	-

Data / Parameter	A_{BL}
Unit	m^2
Description	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the eservoir is full (m^2). For new reservoirs, this value is zero
Source of data	ACM0002
Value(s) applied	0.0
Choice of data or Measurement methods and procedures	The project consists of a new power plant. As defined in the methodology, for new hydro power plants, this value is zero.
Purpose of data	Calculation of project emissions.
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

All equations used to estimate the emission reductions were provided in section B.6.1. Detailed information of how the equations were used, and values applied are provided in the CER calculation spreadsheet (Appendix 3 to the PDD). The spreadsheet with the CER calculation is part of the PDD.

Baseline emissions (BE_y)

As described in section B.6.1, baseline emissions (BE_y) are calculated directly from electricity supplied by the project to the grid ($EG_{PJ,y}$) multiplied by the emission factor ($EF_{grid,CM,y}$).

The estimation of the net electricity generated by the plant, equivalent to the total amount of energy effectively dispatched to the national grid, is based on the assured energy determined for the plant. Additionally, as per article 28 of the Federal Decree[84] nr 5.163/2004, the amount of electricity established in the *Electric Power Commercialization Agreements within the Regulated Ambience* (CCEAR from the

[84] Information available in Portuguese at <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/Decreto/D5163.htm>.

Portuguese "Contratos de Comercialização de Energia Elétrica no Ambiente Regulado") must be the estimated amount of electricity to be dispatched to the grid at the Gravity Point[85] of the system. Therefore, the transmission losses have to be discounted from the estimated total electricity to be generated by the plant.

The assured energy is equal to 940.6 MWaverage. transmission losses at the Gravity Point are 2.22%[86] and internal consumption is assumed to be zero[87]. Assuming that the plant will be operational 8760 hours/year, the total net energy generated by the plant in non leap years is 8,056,736 MWh/year[88].

Additionally, the calculation of the combined margin CO_2 emission factor for grid connected power generation ($EF_{grid,CM,y}$) follows the steps established in the "*Tool to calculate the emission factor for an electricity system*", as explained above in section B.6.1.

Detailed information of how the equations were used, and values applied are provided in the CER calculation spreadsheet (Appendix 3 to the PDD). The spreadsheet with the CER calculation is part of the PDD. The summary of the results is presented below.

The dispatch data analysis operating margin emission factor is calculated by the Brazilian DNA and made publicly available at http://www.mct.gov.br/index.php/content/view/74689.html. An estimated average operating margin emissions factor for 2010, assuming constant generation throughout the year, is used here for the ex-ante estimation of the emission reductions.

$$EF_{grid,OM\text{-}DD,y} = 0.4796 \text{ tCO}_2\text{e/MWh}$$

The build margin emission factor is calculated by the Brazilian DNA and made publicly available at http://www.mct.gov.br/index.php/content/view/74689.html.

$$EF_{grid,BM,y} = 0.1404 \text{ tCO}_2\text{e/MWh}$$

Applying the results presented above in the Equation 8 and considering the weights ω_{OM} = 0.5 and ω_{BM} = 0.5:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot \omega_{OM} + EF_{grid,BM,y} \cdot \omega_{BM}$$

$$EF_{grid,CM,y} = 0.5 \times 0.4796 + 0.5 \times 0.1404 = 0.3100 \text{ tCO}_2\text{e/MWh}$$

Finally, baseline emissions can be determined applying the results of $EG_{facility,y}$ and $EF_{grid,CM,y}$ to Equation 4:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}$$

$$EG_{PJ,y} = EG_{facility,y} = 8{,}056{,}736 \text{ MWh/year (when fully operational)}$$

[85] The Gravity Point is the virtual point where the losses of the generation and consumption points become even. At this point all the purchases and sales of electric power at the CCEE are computed. The losses of electric power are shared equally between the points of generation and consumption, where half the losses are deducted from the total amount generated and the other half is added to the total amount consumed (Electric Power Commercialization Chamber (from the Portuguese *Câmara de Comercialização de Energia Elétrica* – CCEE) <www.ccee.org.br>).

[86] Source: Average of transmission losses as presented in the CCEE annual reports from 2007 to 2010.

[87] The internal consumption was defined by project participants as of 0.2% of the total electricity generation by UHE Teles Pires based on project participant experience and internal estimatives. However, due to the lack of a documented evidence for this value and aim to be conservative, the internal consumption was considered zero in the calculation of the project ER.

[88] For non leap years (365 days) and, 8,078,809 MWh for leap years (366 days).

$$BE_y = 8{,}056{,}736 \text{ MWh/year} \times 0.3100 \text{ tCO}_2\text{/MWh}$$

$$BE_y = 2{,}497{,}446 \text{ tCO}_2\text{/year}$$

Project emissions (PE_y)

The project's reservoir area under the normal maximum water level of 220 m is 134.70 km^2.

With an installed capacity of 1,820 MW, the power density of the project activity is 13.51 W/m2 (refer to A.4.3 for the calculation). Therefore, once the project's power density is above 10W/m^2, no calculation of project emissions is required.

Leakage emissions (LE_y)

The calculation of leakage emissions is not required by the methodology.

$$LE_y = 0 \text{ tCO}_2\text{/MWh.}$$

Emission reductions (ER_y)

Applying the results discussed above to **Equation 1** one obtains for non leap years:

$$ER_y = BE_y – PE_y - LE_y$$

$$ER_y = 2{,}497{,}446 – 0 – 0 = 2{,}497{,}446 \text{ tCO}_2\text{/year}$$

B.6.4. Summary of ex ante estimates of emission reductions

Table 12 – Emission reductions estimation of the project activity

Year	Baseline Emissions tCO_2e	Project emissions tCO_2e	Leakage tCO_2e	Emission reductions tCO_2e
2015	2,497,446	0	0	2,497,446
2016	2,504,288	0	0	2,504,288
2017	2,497,446	0	0	2,497,446
2018	2,497,446	0	0	2,497,446
2019	2,497,446	0	0	2,497,446
2020	2,504,288	0	0	2,504,288
2021	2,497,446	0	0	2,497,446
2022	2,497,446	0	0	2,497,446
2023	2,497,446	0	0	2,497,446
2024	2,504,288	0	0	2,504,288
Total	**24,994,984**	**0**	**0**	**24,994,984**
Total number of crediting years	10			
Annual average over the crediting period	2,499,498	0	0	2,499,498

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data monitored and required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter	$EG_{facility,y}$
Unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plant to the grid in year *y*
Source of data	Electricity meter(s)
Value(s) applied	8,056,736
Measurement methods and procedures	According to ACM0002, (i) the quantity of electricity supplied by the project plant/unit to the grid and (ii) the quantity of electricity delivered to the project plant/unit from the grid shall be monitored. The measurement of this parameter will be carried out by energy meters installed at the substation in accordance with Module 12 of the Procedures established by the National Electric System Operator (“ONS” from the Portuguese *Operador Nacional do Sistema)*.
Monitoring frequency	Continuous measurement and at least monthly recording.
QA/QC procedures	Energy metering QA/QC procedures are explained in Section B.7.3. The equipment used to meter electricity production by the plant has by legal requirements extremely low level of uncertainty. Energy will be measured continuously, aggregated each 15 minutes and will be monthly consolidated. Electricity generation by the plant as published by CCEE will be used to cross check project participant’s information.
Purpose of data	Calculation of baseline emissions.
Additional comment	Consolidation reports issued by CCEE already discount losses.

Data / Parameter	Cap_{PJ}
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data	Project site.
Value(s) applied	1,820,000,000
Measurement methods and procedures	The installed capacity will be determined based on recognised standards.
Monitoring frequency	Yearly.
QA/QC procedures	In Brazil the installed capacity of hydropower plant is determined and authorized by the competent regulatory agency. In addition, any modification also has to be authorized and be publicly available. Hence, on a yearly basis, any new authorization to increase the installed capacity of the plant will be monitored.
Purpose of data	Calculation of project emissions.
Additional comment	-

Data / Parameter	$EF_{grid,OM,y}$
Unit	tCO_2/MWh
Description	Grid operating margin
Source of data	Brazilian Designated National Authority for the CDM
Value(s) applied	0.4796
Measurement methods and procedures	OM is calculated according to methodology ACM0002 and the “Tool to calculate the emission factor for an electricity system” by the Brazilian DNA. Project proponents chose Option (c): Dispatch data analysis OM. The dispatch data analysis operating margin emission factor is calculated by the Brazilian DNA. An estimated average operating margin emissions factor for 2010, assuming constant generation throughout the year, is used here for the ex-ante estimation of the emission reductions. The calculation is also available in appendix 3 to the PDD.
Monitoring frequency	Yearly.
QA/QC procedures	Official source of data.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data / Parameter	A_{PJ}
Unit	m^2
Description	Area of the reservoir measured on the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data	Project Developer
Value(s) applied	134,700,000
Measurement methods and procedures	The project’s reservoir area under the normal maximum water level of 220 m is 134.70 km^2, of which 40.6 km^2 is part of the normal river bed and, therefore, the increased flooded area is 94.10 km^2.
Monitoring frequency	Yearly.
QA/QC procedures	In Brazil, every modification carried out in hydropower plants has to and be made publicly available and authorized by the competent regulatory agency.
Purpose of data	Calculation of project emissions.
Additional comment	-

B.7.2. Sampling plan

Not applicable.

B.7.3. Other elements of monitoring plan

The monitoring plan of the emission reductions by the project activity is in accordance with the procedures set by the methodology ACM0002, version 13.0.0.

The Project owner will proceed with the necessary monitoring measures as established in the applicable official procedures from ONS, ANEEL and, CCEE.

ONS is the entity responsible for coordinating and controlling the operation of generation and transmission facilities in the SIN under supervision and regulation of ANEEL which is the regulatory agency determining conditions for the electric power market to develop a balance between the agents and the benefit of society. CCEE is a not-for-profit, private, civil organization company that is in charge of carrying out the wholesale transactions and commercialization of electric power within the SIN, for both ACR and ACL.

As presented at Section B.7.1 above and according to ACM0002, the parameters to be monitored for Teles Pires project are as follows:

(i) Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* ($EG_{facility,y}$);

(ii) Installed capacity of the hydro power plant after the implementation of the project activity (Cap_{PJ});

(iii) Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (A_{PJ}).

(iv) Grid operating margin ($EF_{grid,OM,y}$)

(i) Quantity of net electricity generation supplied by the project plant/unit to the grid in year y ($EG_{facility,y}$)

The total electricity exported to the grid will be monitored by Companhia Hidrelétrica Teles Pires following the procedures and requirements established by ONS which defines the technical characteristics and precision class of 0.2% of maximum permissible error of the electricity meters to be used[89]. In addition, ONS also governs the electricity meter calibration requirements which should be conducted every two years[90] and performed by an entity accredited under the Brazilian Calibration Net (from the Portuguese Rede Brasileira de Calibração – RBC).

There will be two energy meters, a principal and backup meter, located at the local substation which measure the electricity delivered to the grid by UHE Teles Pires.

According to the procedures established by ONS, it will be possible to monitor total electricity exported to the grid. Beyond that, energy information will be controlled in real time by CCEE. Once the measurement points are physically defined and the invoice measurement system and the communication infrastructure are installed, the measurement points will be registered in the SCDE (System of Energy Data collection) managed by CCEE.

[89] National Electric System Operator. Grid Procedures – Module 12: measurement for billing/Submodule 12.2 Installation of the measurement for billing. (from the Portuguese ONS – Operador Nacional do Sistema. Procedimentos de Rede – Módulo 12: medição para faturamento / Submódulo 12.2: Instalação do sistema de medição para faturamento). Available at http://www.ons.org.br/procedimentos/modulo_12.aspx.

[90] National Electric System Operator. Grid Procedures – Module 12: measurement for billing/Submodule 12.3 Maintaneance of the system of measurement for billing. (from the Portuguese ONS – Operador Nacional do Sistema. Procedimentos de Rede – Módulo 12: medição para faturamento / Submódulo 12.3: Manutenção do sistema de medição para faturamento. Available at http://www.ons.org.br/procedimentos/modulo_12.aspx.

There will be at least two energy meters (principal and backup) for which the model, type and precision class (0.2% of maximum permissible error) are specified by ONS grid procedures[91]. In addition, before the operations start, ONS demands that these meters are calibrated by an entity with Brazilian Calibration Network (RBC form the Portuguese "Rede Brasileira de Calibração") accreditation. According ONS, these meters have to be calibrated every two years after operation start. The SPC responsible for the implementation and operation of the *Teles Pires Hydropower Plant Project Activity*will be responsible for these calibrations. In order to confirm and to give certainty about the energy measurement, it will be controlled in real time by the plant and by CCEE.

(ii) Installed capacity of the hydro power plant after the implementation of the project activity (Cap_{PJ})

Installed capacity of the power plant will be checked by DOE during on-site visit[92] at every verification and cross-checked with official documents, *e.g.* ANEEL resolution.

(iii) Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (A_{PJ})

The reservoir area will be monitored through topographical studies (made at the time of the project design) and water reservoir levels, which is monitored in real time by the project sponsors. The water level to be compared with the topographical study will be based on the average water level that will be verified annually.

Data can be cross-checked with official documents, *e.g.* engineering/environmental studies and/or ANEEL Summary sheet.

(iv) Grid operating margin ($EF_{grid,OM,y}$)

The grid operating margin is calculated according to methodology ACM0002 and the "Tool to calculate the emission factor for an electricity system" by the Brazilian DNA applying option (c) of the tool: Dispatch data analysis OM.

This value will be updated annually during the verification of the Project as published by the Brazilian DNA.

Teles Pires Hydropower Plant Project Activity will also be responsible for the maintenance of the equipments' monitoring, for dealing with possible monitoring data adjustments and uncertainties, for review of reported results/data, for internal audits of GHG project compliance with operational requirements and for corrective actions. Yet, it is also responsible for the project management, as well as for organizing and training of the staff in the appropriate monitoring, measurement and reporting techniques.

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[91] From what is established in the relevant regulation of the energy sector in Brazil, all the plants delivering electricity to the grid have to implement a "invoice metering system" (from the Portuguese *Sistema de Medição e Faturamento – SMF*) in accordance with specifications defined by the National Electric System Operator ("ONS" from the Portuguese *Operador Nacional do Sistema Elétrico Nacional*). According to the relevant grid procedure ("sub-module 12.2: Installation of the SMF") principal and backup meters are components of the system. The PPs (generation agents in the ONS document) are responsible for the design (to be approved by ONS), operation and maintenance of the SMF.

[92] It is important to mention that it may have differences between the sum of the nominal power of turbines/generators of the project and the environmental licenses/ANEEL authorizations. In Brazil, it is really common equipment tag with a total power with slight difference than the one presented in the ANEEL authorization or the environmental licenses. However, this slight difference is known by governmental entities and participants of the electric sector and it is deemed accepted, since this slight difference does not impact the assured energy of projects, and then, it does not impact the electricity commercialization or the capacity of energy supply. Therefore, this will not impact the additionality or the emission reductions of the project presented in this PDD.

It is important to mention that ANEEL can visit the plant and inspect operation and maintenance of the facilities at any time. Yet, during the periodic verifications, the plant will provide all the necessary documents evidencing the amount of net energy exported to the grid. This data is going to be kept for at least two years after the crediting period ends.

All data collected on-site will be checked internally before being compiled in an electronic format, to ensure that it is complete and of appropriate quality. A final check of the data and project analysis prior to any verification will be carried out.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

19/08/2011

According to the CDM Glossary of Terms the starting date of a CDM project activity is "*the earliest date at which either the implementation or construction or real action of a project activity begins*". Furthermore the guidance also clarifies that "*the start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity (…), for example, the date on which contracts have been signed for equipment or construction/operation services required for the project activity*".

In order to determine the most appropriate starting date, first a timeline of the project activity milestones is presented in Table 13.

Table 13 – Project activity milestones timeline

28 Septemeber 2010	EIA-Rima approval (electronic copy submitted to the DOE)
17 November 2010	Auction final rules released[93]
13 December 2010	Preliminary environmental license (electronic copy submitted to the DOE)
17 December 2010	Energy auction[93]
22 December 2010	PPs informed the Brazilian designated national authority and the UNFCCC secretariat in writing of the commencement of the project activity and of their intention to seek CDM status (electronic copy of communications and confirmation of receipt submitted to the DOE).
3 February 2011	Finance request submitted BNDES (electronic copy submitted to the DOE)
7 June 2011	Concession contract[94]
18 August 2011	The contract to develop the CDM project activity was signed between Ecopart Assessoria em Negócios Empresariais Ltda. and Companhia HidrelétricaTeles Pires.

[93] ANEEL – Public Notice nr. 04/2010.
[94] MME concession contract nr. 02/2011-MME-UHE Teles Pires.

19 August 2011	EPC contract (electronic copy submitted to the DOE)
26 August 2011	Basic project design approval[3]

Under the new model of the Brazilian electricity sector, companies willing to get the rights to explore hydroelectric potentials above 30MW have to participate in a public auction which results in the concession to explore the hydropower potential.

Several steps are necessary to build the plant, such as securing finance, signing the power purchase agreement, determining the most appropriate engineering, procurement and construction contract, etc. From the milestones described in Table 13, the first significant financial commitment towards the project construction is the signature of the EPC contract.

Hence, although this event does not represent the financial closure, the companies participating on the SPC committed themselves to the terms of the contract assuming that the project will be built. For that reason the date of the EPC contract, 19 August 2011, is defined as the project starting date.

C.1.2. Expected operational lifetime of project activity

35 years - 0 months.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

The proposed project activity applies the fixed crediting period type.

C.2.2. Start date of crediting period

01/01/2015 or on the date of registration, whichever occurs later.

C.2.3. Length of crediting period

10 years - 0 months.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

The decision related to the implementation of a hydroelectric plant is complex and involves a number of governmental and non-governmental agents. The governmental ones are mainly responsible for regulating the electric energy sector, water resource management, control natural resources and soil use. Among non-governmental agents are the ones interested in exploiting the electricity market, investors, product and equipment suppliers, NGO's and the directly and indirectly affected population. Hence, for the implementation of a successful hydropower plant, a consensus between all parties has to be reached, meaning that the following points are met:

- Existent energy demand that justifies the project activity;
- Technical viability for its execution;
- Implementation and operation of the plant lead to reversible impacts and / or are possible to be compensated (counterbalanced);
- Absence of conflicts between the plant's operation and comprehensives area water use;
- Local population can be duly compensated, and;
- Interested agents in constructing and financing the plant.

Additionally, the implementation of a hydroelectric plant has to be in accordance with National Regulations in order to receive all necessary permits to starts is construction and operation. According to Clause 25 by means of item IV of the Brazilian Constitution, the Project entity must elaborate an *environmental impact study* (EIA from the Portuguese "Estudo de Impacto Ambiental") and a corresponding *environmental impact report* (RIMA from the Portuguese "Relatório de Impacto Ambiental") and make them publically available[95] before utilising natural resources and beginning the construction of the project.

Furthermore, normative instruction nr. 65/2005, through which the *Brazilian Institute of Environmental and Renewable Natural Resources* (the federal environmental agency, IBAMA from the Portuguese "Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis") establishes the procedures required for licensing hydropower plants and Federal Decree nr. 99274/90, complemented by CONAMA's Resolutions[96] 01/86, 06/86, 06/87, 09/87 and nr. 237/97, set forth a three-stage process for the issuing of licenses as follows:

a) A *Preliminary License* (LP from the Portuguese "Licença Prévia") is granted during the preliminary planning stage of a project for a maximum term of five-years. The license approves the location and design of the project, certifies its environmental feasibility and establishes the basic requirements and conditions to be complied with during subsequent implementation stages.

b) The *Installation License* (LI from the Portuguese "Licença de Instalação") authorizes the installation of the project activity in accordance with the specifications contained in the approved plans, programs and projects, including environmental mitigation provisions and other conditions.

c) The "Operation License" (LO from the *Portuguese* "Licença de Operação") authorizes operation of the project activity in accordance with environmental mitigation measures and operating requirements. The Operating License can vary from 4-10 years and is renewable within the legal timeframe established by the competent environment agency.

[95] Brazilian Institute of Environmental and Renewable Natural Resources ("IBAMA" from the Portuguese *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis*). Computarized system of national environmental licensing (from the Portuguese *Sistema Informatizado de Licenciamento Ambiental Federal*). Available at http://www.ibama.gov.br/licenciamento/.

[96] Brazil's federal environmental entities are the policy-setting *National Environmental Council* (CONAMA from the Portuguese "Conselho Nacional do Meio Ambiente") and the policy-enforcing IBAMA.

The process starts with a previous analysis (preliminary studies) by the local environmental department. After that, if the project is considered environmentally feasible, the sponsors have to prepare the Environmental Assessment, which is basically composed by the following information:

- Reasons for project implementation;
- Project description, including information regarding the reservoir;
- Preliminary Environmental Diagnosis, mentioning main biotic, and anthropic aspects;
- Preliminary estimation of project impacts; e
- Possible mitigating measures and environmental programs.

The result of those assessments is the LP, which reflects the environmental local agency positive understanding about the environmental project concepts.

In order to obtain the LI it is necessary to present (a) additional information about previous assessment; (b) a new simplified assessment; or (c) the Environmental Basic Project, according to the environmental agency decision informed at the LP.

The LO is a result of pre-operational tests during the construction phase to verify if all exigencies made by environmental local agency were completed.

The plant possesses the LP and LI. LP nr. 386 was issued on 13 December 2010 and was valid until 12 December 2012. LI nr. 818 was issued on 19 August 2011 and it is valid until 18 August 2015. Both licenses were issued by the Brazilian Institute of Environment and Natural Resources ("IBAMA" from the Portuguese *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis*). Given that, the project does not imply in negative transboundary environmental impacts, on the contrary, otherwise the license would not be issued.

D.2. Environmental impact assessment

The growing global concern regarding the sustainable use of resources is driving a requirement for more sensitive environmental management practices. Increasingly this is being reflected in countries' policies and legislation. In Brazil the situation is no different; environmental rules and licensing process policies are very strict in line with the best international practices.

As mentioned in section D.1, hydropower plants have to do an environmental impact assessment and a respective environmental impact report in order to obtain the necessary licenses to the project.

Following the procedures as required by the host Party the federal *Energetic Research Company* (EPE from the Portuguese "Empresa de Pesquisa Energética") prepared the *environmental impact study* (EIA) and a corresponding *environmental impact report* (RIMA). The documents were approved by IBAMA on 28 September 2010[97], demonstrating that the identified environmental impacts are not significant.

[97] IBAMA, Opinion nr. 85/2010.

All the documents related to the environmental impact assessment are publicly available[95], including licenses, official technical opinions, public hearing reports and additional requirements.

In addition, actions to mitigate the impacts caused by construction of the UHE Teles Pires constitute important measures to control the effects directly associated with the project, which will be conducted through the implementation of social and environmental programs. The main objectives of social and environmental programs are to prevent, minimize, compensate, monitor and eventually eliminate negative impacts arising from development in order to maximize the positive impacts, enhancing the beneficial effects of the project.

The proposed programs were developed and targeted to meet a regional level plan in order to prepare the region for receiving the project in a sustainable manner.

The set of socio-environmental programs can be characterized as a management tool that aims to ensure the overall implementation of commitments made by the contractor, with regard to the proper environmental and social management of the enterprise and to comply with the applicable environmental legislation. This set of planned actions, called the Environmental Management Plan was developed through five axis of action, designed to organize the programs to be developed. The following are selected plans included in each line of action.

Axis 1 – Programs directly linked to the construction

- Environmental plan for the construction
- Deforestation and reservoir associated areas cleaning
- Recruitment and demobilization of manpower
- Fish rescue in affected areas

Axis 2 – Monitoring, control, management and conservation plan

- Seismicity monitoring
- River slopes stability and erosion processes monitoring
- Groundwater monitoring
- Seeds and seedlings rescue and implementation of seedling nursery
- Hydro-sedimentary monitoring
- Fauna scientific rescue
- Water limnological and quality monitoring
- Climate monitoring
- Fauna monitoring
- Malaria action and control plan
- Cultural historical and archaeological heritage preservation

Axis 3 – Compensatory programs

- Implementation of the reservoir permanent preservation area
- Loss of land and economic activities disruption compensation
- Labor re-insertion and local economic activities support
- Environmental compensation – conservation unit
- Tourism activities support and revitalization
- Social infrastructure strengthening
- Forest restoration

Axis 4 and 5 – Support and special programs

- Social communication
- Environmental education
- Environmental conservation plans and reservoir environs use

More information on each of the above mentioned programs is available in the document "Summary of Social & Environmental Activities of the Basic Environmental Project, UHE Teles Pires – Preventive, Mitigating, Control and Compensatory Measures[98]" (electronic copy submitted to the DOE during the validation process).

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

According to the federal and local states legislation, the environmental licensing process requests public hearings with the local community.

Three public hearings were carried out in November 2010 in the cities of Paranaita, Alta Floresta and Jacareacanga. Hearing reports are part of the environmental licensing documents publicly available at IBAMA's website[95].

Besides, in accordance with resolution # 7, issued on March 5th 200899, the CIMGC requests, among other documents, comments from local stakeholders in order to provide the Letter of Approval for a CDM project activity. The Resolution determines that the project proponent has to send invite for comments, at least, the following agents involved in and affected by project activity:

- Municipal governments and City Councils;
- State and Municipal Environmental Agencies;
- Brazilian Forum of NGOs and Social Movements for Environment and Development;

[98] Summary of Social and Environmental Activities presented in the Environmental Project Design of UHE Teles Pires (from the Portuguese *Resumo das Atividades dos Programas Socioambientais do Projeto Básico Ambiental da UHE Teles Pires – Medidas Preventivas, Mitigadoras, de Controle e Compensatórias*). December 2011.
[99] Available at: <http://www.mct.gov.br/>.

- Community associations;
- State Attorney for the Public Interest (state and federal);

The same resolution also requires that at the time these letters are sent, a version of the PDD in the local language and a declaration stating how the project contributes to the sustainable development of the country must be made available to these stakeholders at least 15 days previous to the starting of the Global Stakeholder Process (GSP).

The Portuguese version of the PDD was published at the internet website <http://sites.google.com/site/consultadcp/> on December 2011 which is also when the invitation letters were sent to the following agents:

- Federal Attorney for the Public Interest;
- State Attorneys for the Public Interest of Mato Grosso and Pará;
- Environmental Agencies of Mato Grosso and Pará;
- Brazilian Forum of NGOs and Social Movements for Environment and Development;
- City Halls of Paranaíta and Jacareacanga;
- City Councils of Paranaíta and Jacareacanga;
- Environmental Agencies of Paranaíta and Jacareacanga;
- Community Associations of Paranaíta and Jacareacanga;

Copies of the letters and post office confirmation of receipt are available upon request and will be submitted to the DOE during the validation of the Project Activity.

E.2. Summary of comments received

Detailed summary of comments and answers submitted as an annex to the PDD.

E.3. Report on consideration of comments received

Detailed summary of comments and answers submitted as an annex to the PDD.

SECTION F. Approval and authorization

The only Party involved in the proposed project activity is the Host Country, Brazil. In Brazil, in order to obtain the Letter of Approval (LoA), the Project Participants must submit the Final Validation Report to the Brazilian DNA ("CIMGC" from the Portuguese *Comissão Interministerial de Mudança Global do Clima*). The procedures established by the Brazilian DNA in order to obtain the LoA, are determined in Resolution nr. 1 dated September, 11th 2003. Further information related to the methods

and procedures for the issuance of the Brazilian LoA can be obtained in the *Manual for submission of project activities under CDM*[100] (from the Portuguese *Manual para submissão de atividades de projeto no âmbito do MDL*).

[100] Available at http://www.mct.gov.br/upd_blob/0025/25268.pdf

Appendix 1: Contact information of project participants

Organization name	Companhia Hidrelétrica Teles Pires
Street/P.O. Box	Rua Lauro Miller 116 – Sala 508
Building	-
City	Rio de Janeiro
State/Region	RJ
Postcode	22290-160
Country	Brazil
Telephone	+55 (21) 3253-0353
Fax	+55 (21) 3251-0252
E-mail	cferreira@uhetelespires.com.br
Website	-
Contact person	Mr. Celso Ferreira
Title	-
Salutation	Mr.
Last name	Ferreira
Middle name	-
First name	Celso
Department	-
Mobile	-
Direct fax	+55 (21) 3251-0252
Direct tel.	+55 (21) 3253-0353
Personal e-mail	cferreira@uhetelespires.com.br

Organization name	Ecopart Assessoria em Negócios Empresariais Ltda.
Street/P.O. Box	Rua Padre João Manoel 222
Building	-
City	São Paulo
State/Region	SP
Postcode	01411-000
Country	Brazil
Telephone	+55 (11) 3063-9068
Fax	+55 (11) 3063-9069
E-mail	focalpoint@eqao.com.br
Website	www.eqao.com.br
Contact person	Mrs. Melissa Sawaya Hirschheimer
Title	-
Salutation	Mrs.
Last name	Hirschheimer
Middle name	Sawaya
First name	Melissa
Department	-
Mobile	-
Direct fax	+55 (11) 3063-9069
Direct tel.	+55 (11) 3063-9068
Personal e-mail	focalpoint@eqao.com.br

Appendix 2: Affirmation regarding public funding

No official development assistance or related public funding was or will be used in *Teles Pires Hydropower Plant Project Activity.*

Appendix 3: Applicability of selected methodology

This section is intentionally left blank. For details please refer to section B.2.

Appendix 4: Further background information on ex ante calculation of emission reductions

This section is intentionally left blank. For details please refer to sections B.6.1 and B.6.3 above.

Appendix 5: Further background information on monitoring plan

This section is intentionally left blank. For details please refer to section B.7.3.

Appendix 6: Summary of post registration changes

Not applicable.