Project design document form for
CDM project activities

(Version 07.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Jirau Hydro Power Plant
Version number of the PDD	3.1
Completion date of the PDD	12/05/2016
Project participant(s)	- Energia Sustentável do Brasil S.A.; - GDF SUEZ Energy Latin America Participações Ltda.
Host Party	Brazil
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (version 13.0.0)
Sectoral scope(s) linked to the applied methodology(ies)	Sectoral Scope Number 1: Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	6,180,620 tCO_2e/year

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Jirau Hydro Power Plant Project, located at the Ilha do Padre at the Madeira River (hereafter referred to as JHPP or "the Project") developed by Energia Sustentável do Brasil S.A. (ESBR or referred to as "the Project Developer") consists of the installation of a new grid-connected renewable run-of-river hydropower plant, situated in Rondônia State, in the North Region of Brazil (hereafter referred to as the "Host Country"). The project comprises the installation of 50 Bulb turbines with an installed capacity of 75 MW each, reaching an overall nominal capacity of 3,750 MW. The JHPP will be connected to the national Interconnected Grid System (*Sistema Interligado Nacional* – *SIN*) through three 500 kV transmission lines.

With the implementation of this greenfield project activity, ESBR will be able to sell renewable electricity to the SIN, avoiding the dispatch of energy from fossil-fuelled power plants in the Interconnected Grid System, as well as in the diesel generation units located in the isolated systems which are to be connected to the SIN as a result of the project activity. Thus, the baseline scenario is the same as the scenario existing prior to the start of the implementation of the project activity: electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources. This baseline scenario is in accordance with the approved consolidated baseline and monitoring methodology ACM0002 – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (version 13.0.0).

The company Energia Sustentável do Brasil S.A. was awarded the right to develop, build and operate the Jirau hydropower development on 22 July 2008[1] when the results of the auction, which took place on 19 May 2008, were ratified and the rights to the concession were effectively granted. This was achieved on the basis of a revised concept to reduce time, cost and environmental impacts of the project's construction. The effective granting of the rights to the concession on the basis of this concept was a first and decisive step towards the effective implementation of this innovative project activity[2].

ESBR is a Special Purpose Company (SPC), closely-held corporation, structured on the basis of the high levels of corporate governance established under the Brazilian Corporation Law and the regulations of the New Market Segment of the Sao Paulo Stock Exchange, as required by Resolution N° 1 of 11 February 2008 which declared public interest and priority of the implementation of the Jirau HPP[3]. The SPC was structured on the basis of a consortium which follows the principles of a private public partnership as established by law nº 11.079/04 of 30 December 2004[4], which limits the participation of public companies and thus requires that the investment shall be controlled by the private sector.

In the case of ESBR, 60% of the share capital is held by private companies and 40% is held by subsidiaries of the state owned Centrais Elétricas do Brasil S.A., here referred to as the Eletrobrás group.

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[1] "Note on ratification and granting" of the Auction No 005/2008 – ANEEL (Aviso de Ajudicação e Homologação, Leilão Nº 005/2008-ANEEL). Available at: http://www.aneel.gov.br/aplicacoes/editais_geracao/documentos/052008-Aviso%20de%20Homologa%C3%A7%C3%A3o%20e%20Adjudica%C3%A7%C3%A3o%20n%20%2005-2008%2018-7.pdf, last accessed on 5 February 2012.

[2] http://www.kelman.com.br/pdf/CANAL%20ENERGIA%2022%5B1%5D.JULHO.pdf, accessed on 9 March 2012.

[3] Publication of Resolution Nº 1 on 11 February 2008 by the National Council for Energy Policy (CNPE - Conselho Nacional de Política Energética), available at: http://www.epe.gov.br/leiloes/Documents/LeilaoJirau_3/CNPE%20-%20Resolucao%20no%201.pdf, accessed on 9 March 2012.

[4] Law nº 11.079/04 of 30 December 2004 published on 31 December 2004 in the Federal Official Journal: "Diário Oficial da União – Seção 1, Nº 252, 31 de dezembro de 2004, p. 6, (ref.: ISSN 1677-7042) - Lei Nº 11.079, de 30 de dezembro de 2004".

ESBR's shareholders at the time of the publication of the PDD for global stakeholder consultation are[5]:

- **GDF SUEZ Energy Latin America Patricipações Ltda.**, affiliate of International Power plc[6]: The Company, also referred to as GSELA, is part of the GDF SUEZ group, one of the leading energy providers in the world. The group develops its businesses on the basis of a responsible-growth model to respond to energy needs, ensure the security of supply, fight against climate change and maximize the use of resources. The Latin American branch of International Power has generation capacities of 10.7 GW. Two thirds of the electricity generated is renewable and the company continues to focus on the development of sustainable energy sources to accompany this emerging continent in its economic growth, respecting the environment and providing essential services to its people. GSELA is the main investor and, with a participation of 50.1%, the controlling shareholder of ESBR. Both ESBR and GSELA are Project Participants of the Project Activity.

- **Camargo Corrêa S.A.**: Created in 1939, the company operates in civil construction, engineering, cement, environment and others. This industrial group is actively working in over 20 countries, being one of the largest Brazilian private companies, with over 41,000 employees. Camargo Corrêa is the second private sector investor, with a participation of 9.9% in ESBR.

- **Eletrosul Centrais Elétricas S.A.**: Since 1968 active in the field of power generation and transmission, the company has over 1,500 employees and operates 58 substations, 11,000 kilometers of transmission lines, has 4 hydropower plants of a total of 977 MW under construction and nine small hydro power plants under operation. As part of Brazil's state owned Eletrobrás group, Eletrosul is a public sector company and has a participation of 20% in ESBR.

- **CHESF – Companhia Hidroelétrica do São Francisco:** Since 1948 active in the field of power generation and transmission, the company has 5,640 employees and operates 14 hydro power plants and one thermal power plant with a total installed capacity of 10,618 MW, as well as 18,000 kilometers of transmission lines. As part of Brazil's state owned Eletrobrás group, CHESF is a public sector company and has a participation of 20% in ESBR.

The sponsors of JHPP promote hydroelectricity as a clean and renewable source of energy, which is crucial for mitigating global warming. Though Brazil still has a predominantly clean energy matrix due to governmental hydropower investments of the past, the recent expansion of the energy matrix has mainly been based on fossil fuels. This is evidenced by the growth of fossil based thermal generation capacities from 7,051 MW in 1994 to 21,324 MW in 2007, which implied a growth in GHG emissions from 10.8 Million t in 1994 to 24.1 Million t in 2007[7]. In addition, as data published by Brazil's Electric Power Commercialization Chamber (*Câmara de Comercialização de Energia Elétrica* – CCEE) on 12 August 2009[8], show, an additional 9,721 MW average, or 57% of the new firm energy generation capacity contracted since the first tender of this kind in December

[5] More information as well as any applicable update is available at: http://www.energiasustentaveldobrasil.com.br/socios-acionistas.asp, accessed on 9 March 2012.

[6] The company, formerly Suez Energy Latin America, is part of International Power-GDF SUEZ plc, which was formed by a merger between International Power PLC and GDF SUEZ' international energy branch, concluded on 3 February 2011.

[7] Omar Alves Abbud; Marcio Tancredi – Centro de Estudos da Consultoria do Senado: *"Transformações recentes da matriz brasileira de geração de energia elétrica – causas e impactos principais",* March 2010, available at http://www.senado.gov.br/senado/conleg/textos_discussao/TD69-OmarAbbud_MarcioTancredi.pdf; last access on 9 March 2012.

[8] "*Novas Regras e Perspectivas para os Leilões de Energia"* (in a free translation from Portuguese: New Rules and Perspectives for Energy Auctions), Luiz Henrique Alves Pazzini, CCEE Technical Adviser, presentation at Energy Summit, Rio de Janeiro, Brazil, 12 August 2009.

2005, also stem from fossil fuelled power plants. Without the effective implementation of the Project Activity this volume in new built long term contracted thermal energy generation capacity would have been 22% higher than observed.

The importance of the JHPP for avoiding the growth of Brazil's GHG emissions, is also clearly pointed out by the Brazilian Electricity Regulatory Agency (Agencia Nacional de Energia Elétrica – ANEEL), which has highlighted the importance of the JHPP to prevent the installation of new long term fossil fuel power plants in Brazil as a key argument for the swift concession of the installation license[9]. Given the fact that the annual electricity demand growth in Brazil is estimated to be about 5.2% in the period 2009-2018[10], it is evident that structural renewable energy projects like JHPP are crucial to attain sustainable economic growth without further growth of CO_2 emissions. Considering the huge capital expenditures and risks associated to JHPP, CER revenues are a central part of JHPP's financial attractiveness (see section B.5. for details) and have been a key objective and fundament for the investors to promote the clean expansion of the Brazilian energy matrix.

The importance of hydropower as GHG mitigation technology is also recognised by the recent IPCC SRREN report[11]. The publication identifies that hydropower offers significant potential for emission reduction and for catalysing sustainable development, but that its participation in global energy supply has been dropping from 21% in 1973 to 16% in 2008 and that this process will continue unless appropriate policies to facilitate financing are being established. The report clarifies that long construction times, high upfront costs, uncertainties in relation to geological circumstances, difficulties and risks in relation to environmental licensing and thus risks for unexpected cost overruns and delays of completion, are key obstacles for the development of hydropower. As one of its recommendations to facilitate the development of such projects, the report highlights the use of carbon market instruments to support the financing of such investments.

The report also discusses local socio-environmental aspects and emphasizes that hydropower has shown to be an important inductor of socio-economic development on the basis of many co-benefits which generate indirect economic benefits of 0.4 to 1 USD per each USD invested. In relation to the local environmental impacts, the report offers two comments which are of special interest for understanding the Jirau HPP. First it highlights that *"one large-scale hydropower project of 2,000 MW located in a remote area of one river basin might have fewer negative impacts than the cumulative impacts of 400 5-MW hydropower projects in many river basins",* a concept that illustrates that the Project Activity is not only capable to reduce GHG emissions, but might also do so on the basis of less local environmental impact than numerous small hydropower plants. Second, the report describes that run–of–river power plants, especially those with the power house in the dam toe, as it is the case of the Project Activity, allow unchanged river flow and thus cause only reduced impacts on the water course.

In line with this view, the National Energy Plan for 2030, published by the Ministry of Energy and Mines (MME, 2007)[12], identifies a strong correlation between a country's economic development and the degree in which it uses its hydropower potential. Accordingly, developed countries such as

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[9] On 3 October 2008, ANEEL indicated that the revised project design and location presented by the project developers for JHPP is not only "*perfectly acceptable*" in technical terms, but that the implied anticipation of the project would allow to avoid the installation of 628 MW, mainly fuel oil thermal power plants, that would need to be contracted for a period of 15 years to cover open demand in 2012. Consequently the project and its anticipation provide "*significant reductions in greenhouse gas emissions*" in the long term. Source: Memo no. 248/2008-DR/ANEEL.

[10] According to Energy Research Company (EPE), available at: http://www.epe.gov.br/imprensa/PressReleases/20091222_1.pdf. *Accessed on 4 March 2010.*

[11] *Special Report on Renewable Energy Sources and Climate Change Mitigation*, Chapter 5 – Hydropower, published by the IPCC in 2011, available at http://srren.ipcc-wg3.de/report.

[12] Ministry of Mines and Energy (Ministério de Minas e Energia) National Energy Plan 2030 – 3 – Hydroelectric Generation (Plano Nacional de Energia 2030 – 3 Geração Hidreléctrica), available at: http://www.epe.gov.br/PNE/20080512_3.pdf, published in 2007, last access on 9 March 2012.

France (100%) Germany (83%) as well as the US, Norway, and Japan (~60%) and Sweden (55%) have developed a high degree of their hydropower potential, while Brazil (30%) and other less developed countries such as Indonesia (4%) and Congo (1%) have only developed small shares, in spite of their vast potential.

Further the report highlights that the environment around many of Brazil's hydropower plants today are among the best conserved areas as the projects are compelled to protect its surrounding which, in absence of the project, would be prone to degradation. Likewise, the urban centres close to such projects today have generally a higher human development index than that of their respective region.

Based on these considerations, the Brazilian Energy Research Company (EPE), part of the Ministry of Mines and Energy (MME), which is responsible to develop the strategies for expansion of the Brazilian energy matrix, considers economic and social as well as environmental aspects of global and local nature for its recommendations. In this context EPE also considers Brazil's insertion in international agreements such as Agenda 21, the UNFCCC and the Kyoto Protocol[12]. This view implies that all external costs and benefits are adequately assessed to identify most beneficial projects and to maximize their socio-economic benefits and minimize their impacts. According to EPE, the key environmental benefit is of global nature as hydropower projects allow the reduction of GHG emissions, a fact that can generate monetary benefits under the CDM to support the project development. On the other hand, the local socio-environmental impacts have to be identified, reduced and mitigated according to the applicable environmental regulation.

Following a summary of the Project's main contribution to sustainable development as defined on the basis of the principles defined by the MME, 2007[12].

a) Contribution to the local sustainability[13]:

- **Technological innovation to allow minimum environmental impact:**
  Minimizing the reservoir and local environmental impacts was a key priority for the development and licensing of the Jirau hydro power plant. To meet this objective, the world's largest bulb turbines with a generation capacity of 75 MW per unit are being developed and installed. These turbines are capable to work with low variable head and large flows and can be installed at the toe of a dam, which allows generating electricity without diverting or altering the natural flow of the river. In addition, these turbines have reduced impact on the aquatic fauna as they allow passage of fish larvae and spawning (MME, p 27; 59; 104)[12,14].

- **Connection of isolated systems and diversification of Brazil's electricity generation matrix:**
  The country's energy security depends on a diverse set of complementary generation assets linked by the National Interconnected Grid System, which allows compensating the regional variations of demand and supply. The development of the Madeira hydropower projects and the related connection of the isolated system of the federal states of Rondônia and Acre provide an important regional diversification to the existing energy matrix. This diversification generates additional energy supply security which allows reducing the preventive dispatch of fossil fuelled generation assets, while the interconnection allows the substitution of the fossil fuel based energy matrix of the isolated systems (MME, p. 81;

[13] Multimedia material with description of the project and its socio-environmental profile and contributions are available in English and Portuguese on ESBRs website and provide an easy accessible and transparent illustration of the projects characteristics and features. Available at: http://www.energiasustentaveldobrasil.com.br/videos.asp.

[14] As referenced by Godinho, Alexandre L., A.U. - Kynard, Boyd, "Migratory fishes of Brazil: Life history and fish passage needs, River Research and Applications, 25, 6, John Wiley & Sons, Ltd., 2009 and ANDRITZ: Low Head Hydro Turbines, Jule Centre Annual Conference, available at: http://www.engineering.lancs.ac.uk/lureg/nwhrm/project/Joule%20Centre%20conf%2008/krompholz.pdf.

88)[12]. Both effects reduce Brazil's GHG emissions in a volume which is not captured by the ex post calculation of emission reductions as adopted by the Project Participants.

- **Promotion of regional economic development:**
  Jirau HPPs promotes the development of the local economy on multiple levels. A first direct benefit is the demand for more than 10,000 direct and over 30,000 indirect jobs, leading to significant income generation and distribution. To maximize the benefits for the region, more than 7,000 workers[15], have been capacitated, providing them with essential professional skills. This is being complemented by education and training programs for the general society and by a service which helps to find job opportunities not only at the construction site, but also in other economic activities. In addition to the direct stimulus, the royalties and taxes paid by the project allow the municipality and state to improve infrastructure, education and health service for the population and represent a permanent economic stimulus for the region. To further catalyze the diversification of the local economy and swiftly raise local living standards, ESBR has established the community of Nova Mutum Paraná to receive part of the urban resettled families, as well as some of the project's employees[16] and the "Polo Industrial Porto Velho" which is the basis for the development of diverse sustainable economic activities. The settlement was designed as an eco-friendly district, comprising: kindergarten, schools, health care center, bus station, a landfill, churches, sport practicing areas and other relevant facilities. Many other socio-environmental programs suited to promote the regional sustainable economic development are described in Section D of this PDD.

A.2. Location of project activity

A.2.1. Host Party

Brazil.

A.2.2. Region/State/Province etc.

Rondônia.

A.2.3. City/Town/Community etc.

Porto Velho.

A.2.4. Physical/Geographical location

This project is located 120 km from the city centre of Porto Velho, in the Madeira River. Dam coordinates: 9˚ 15'17.96" S, 64˚ 38'40.13" W[17].

[15] JHPP Monthly Report – Internal Communication and Social Responsibility (1310-JI2-RP-USO/SG-00031-0A, June 2012, page 29).

[16] Source: Final Report submitted to IBAMA: Compliance with the Installation License (n°. 621/2009 conditions) and Implementation Status of the Socio-environmental Programs – Annex 4.14, Report of the Relocation Program for the Affected Population, pages 40-42.

[17] Source: Installation License no. 621/2009, issued by IBAMA.

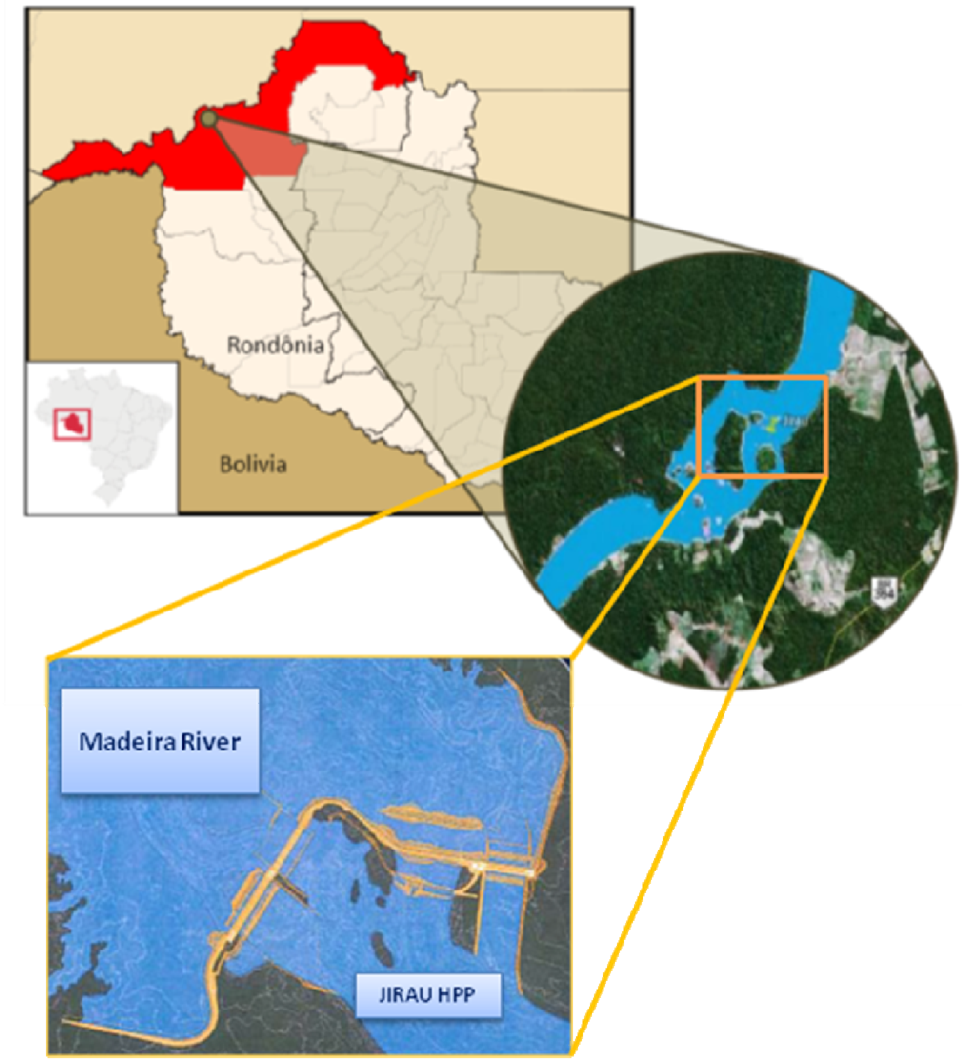

Figure 1. JHPP location (sources: www.wikipedia.org and Google Earth)

A.3. Technologies and/or measures

JHPP consists of a run-of-river hydropower project with variable reservoir to mimic the river's natural hydrology and designed to minimize environmental impacts while maximizing energy generation in a situation of high, but variable flow volumes, low dam, and low head height. The project comprises the run-of-river reservoir, the dam, the turbines, generators and other electromechanical equipment, as well as the substations and transmission lines to connect the project to the Interconnected Grid System (SIN).

The project activity implies the installation of 3,750 MW new hydro power generation capacity with a reservoir surface that varies according to the periodic hydrology fluctuation of the region. Considering the maximum reservoir surface in the wet season including the surface of the river before the installation of JHPP, the power density calculated is 10.37 W/m^2 [18]. Therefore, according to the methodology ACM0002 (version 13.0.0), project emissions can be neglected.

The main details of the Project Activity are presented below:

[18] Please refer to section B.6.3 for power density calculation.

Summary of JHPP technical details:

JHPP Project – Technical details	
Maximum Reservoir Area at maximum operational quota, including original river surface	361.60 km² (run of river) [19]
Installed capacity	3,750 MW
Maximum Firm Energy as calculated by EPE	2,279.4 MW[20]
Plant Load Factor	60.78%[21]
Turbine type	Bulb
Power Generation Unit (Turbine + Generator)	75 MW
Quantity of turbines	50
Transmission line	94 km / 3 x 500 kV

Table 1. Technical Details

ESBR will construct the earth-riprap type dam for the JHPP in a sinuous axis, with the total length of around 6,800 meters through the Madeira River, taking advantage of a section with rocks, islands and rocky outcrop, in a spot called "*Ilha do Padre*"[22]. This new project location was suggested by ESBR in order to reduce construction costs, environmental impacts[23] and anticipate generation starting date. The start of the construction of the revised project has been approved by the environmental agency IBAMA on 14 November 2008 through the issuance of the Preliminary Installation License for the work-site and the definitive installation license has been granted by IBAMA[24] on 3 June 2009. The figure below shows the projected dam.

Figure 2. JHPP dam (projected)

[19] The maximum reservoir area of 361.60 km^2 was calculated as the surface of the full reservoir including the average surface of the river before the project activity of 153.86 km² at maximum operational level of 90 m.a.s.l., which applies for the wet season from January to May. In the dry season the reservoir surface will be significantly lower as referenced in Table 2. Sources: "*Planilha Informações da Usina_ANEEL_24_out_2011*" and topographic study prepared by Topocart (received by ESBR on 3 July 2012) to determine the surface of the original river bed (average) and the total area of the JHPP's reservoir for different operational quotas as defined by the regulator.

[20] This was calculated by the Governmental Energy Research Company "Empresa de Pesquisa Elétrica – EPE" to be the maximum possible Firm Energy for the Jirau HPP in its definitive configuration: "*Avaliação Energética das Alternativas de Motorização das usinas do rio Madeira Santo Antônio e Jirau*", Brazilian Ministry of Mines and Energy, 7 November 2011.

[21] This Plant Load Factor is calculated by dividing the projected Firm Energy by the Project's installed capacity.

[22] The new project design substitutes the use of concrete and has substantially reduced excavation volumes (around 52 MM cubic meters). Source: Memo IBAMA 061-2008 (Parecer IBAMA 061-2008) .

[23] A detailed comparison of the environmental benefits offered by the optimization is available in section D.

[24] Preliminary License 563/2008 and Installation License 621/2009 (*same reference as the one previously introduced in the footnote 17, page 6*), issued by IBAMA. For further reference and information on the environmental licensing, please refer to Section D.

Reservoir:

This Project Activity was carefully planned, particularly with respect to its run-of-river reservoir. It was designed to operate with variable water levels, in order to assure that the water levels in the upstream city of Abunã, Brazil, remain unaffected and continue to follow their natural seasonal variation as defined by the National Water Authority (ANA) in the Resolution ANA No 555/2006[25].

To warrant that natural water levels at Abunã remain unaffected, an operational rule defines the plant operation and generation volumes in accordance with the river flow. As a consequence the reservoir levels at the dam will vary between a minimum of 82.5 meters in the dry season (July to October) and the maximum operational level of 90 meters in the wet season (January to April)[26]. As a consequence of this operational rule, the water levels will be below 85 meters during 5 months each year. As the total reservoir area is directly related to the water level of the reservoir, it surfaces will vary accordingly.

The annual variation of the reservoir water level, the respective total Reservoir Area, as well as the respective Increased Reservoir Surface net of the average surface of the original river (153.86 km²) are presented in the table below:

Operational level under normal conditions	Reservoir water level at the dam (m)	Total Reservoir Area (km^2)	Increased Reservoir Surface[27] (km^2)
Minimum (dry season)	82.5	174.90	21.04
Average / Regular	85.0	229.29	75.43
Maximum (wet season)	90.0	361.60	207.74

Table 2. Annual variation of reservoir water level and area

Therefore, the JHPP Project has a minimum power density of 10.37 W/m^2, calculated from the maximum total Reservoir Area in the wet season, while the Brazilian average power density is around 1.96 W/m^2 [28]. In the dry season Reservoir Area is much smaller and close to the average surface of the original river bed.

Power House

JHPP will have two power houses, one at each riverbank. The water intake/power house on the right side of the river will be composed by a total of 28 installed generation units (turbine + generator). The left side will be constituted of a total of 22 installed generation units.

Turbines and generators

The project comprises the installation of 50 new Bulb turbines, which are designed to operate in low head/high flow rivers. The turbines will be installed directly in the river bed, at the toe of the dam, which allows the generation of electricity without deviation or flow alteration of the river and thus minimizing environmental impacts. To achieve these benefits, ESBR decided to implement state of art 75 MW Bulb turbines specially designed and constructed for the JHPP, representing a significant technological progress in Bulb turbine engineering. As part of these special turbines will

[25] Available at: http://www.aneel.gov.br/arquivos/PDF/DHJirau.pdf, last access on 4 March 2010.

[26] *Same reference as the one previously introduced in the footnote 19, page 8.*

[27] The average surface of the river before the project activity of 153.86 km² was considered for these calculations (s*ame reference as the one previously introduced in the footnote 19, page 8*).

[28] Bezerra et al, 2010, *Measuring the Hydroelectric Regularization Capacity of the Brazilian Hydrothermal System*, available at: http://www.psr-inc.com.br/portal/psr_pt_BR/iframe.html?altura=4000&url=/app/publicacoes.aspx, last access on 9 March 2012. Figure 9 of the article provides the Flooded area / Installed Capacity of all Brazilian hydropower plants in 2007 (0.51 km^2/MW) and can easily be converted into W/m^2.

be acquired from the Chinese manufacturer Dongfang Electric Corporation and another part from a consortium of international suppliers with equipment manufacturing facilities in Brazil (comprised by Voith, Alstom, and VAtech), an intricate and sophisticated logistic plan to deliver the equipments to the project site is necessary to assure that the project timeline is complied with.

Most hydro power plants in Brazil were implemented in highlands, where the net fall is fairly high. Consequently, these hydro power plants mostly use Francis turbines. The Project Activity will be installed in a lowland area, requiring the use of Bulb turbines which are adequate for high flow volumes but low head heights. Today there are only 3 large hydro power plants with Bulb turbine installed in Brazil[29] (Igarapava, Canoas 1 e Canoas 2). Bulb turbines are not only unusual in Brazil, but the largest Bulb turbines ever built so far have an installed capacity of 66 MW[30,31]. JHPP will use 75 MW Bulb turbines, clearly a technological advance which was driven by the necessity to achieve both, minimal environmental impacts and high performance and efficiency.

The figure below presents the structure of a Bulb turbine.

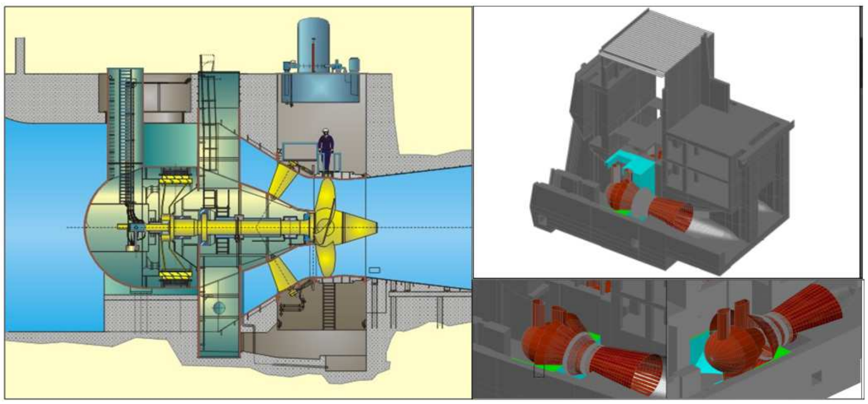

Figure 3. Design of a Bulb turbine

The projected starting date of operation of the generation units according to the latest schedule adopted by ESBR at the time of the publication of this PDD for Global Stakeholder Consultation is presented in table below[32]:

Month	Units in operation
Oct 2012	1
Nov 2012	3
Dec 2012	4
Jan 2013	6
Feb 2013	10
Mar 2013	13
Apr 2013	15
May 2013	17

[29] EIA Tome A Chapter VII page 2.

[30] EIA - Pareceres dos Consultores sobre o Estudo de Impacto Ambiental do Projeto para Aproveitamento Hidrelétrico de Santo Antônio e Jirau, Rio Madeira – RO, page 8.

[31] Available at: http://www.epe.gov.br/PNE/20080512_3.pdf, as previously introduced in footnote 12, page 4.

[32] Due to delays in project implementation and revision of the Project's installed capacity which was decided on the basis of a new power sales auction that took place on 17 August 2011 and was ratified on 18 October 2011, this schedule is different from the one used for the Investment Analysis in Section B5.

Month	Units in operation
Jun 2013	17
Jul 2013	19
Aug 2013	21
Sep 2013	21
Oct 2013	23
Nov 2013	25
Dec 2013	26
Jan 2014	29
Feb 2014	30
Mar 2014	33
Apr 2014	35
May 2014	37
Jun 2014	39
Jul 2014	42
Aug 2014	42
Sep 2014	44
Oct 2014	44
Nov 2014	45
Dec 2014	47
Jan 2014	49
Feb 2014	50

Table 3. Projected starting date of operation of each turbine

Technical details[33]

Turbines		
Manufacturer	ALSTOM / ANDRITZ / VOITH	DONG FANG ELECTRIC MACHINERY
Number of units	28	22
Nominal power	76,550 kW	76,500 kW
Nominal flow per unit	549.13 m^3/s	542.65 m^3/s
Age	New	New
Technical Lifetime[34]	30 years	30 years
Generators		
Manufacturer	ALSTOM / ANDRITZ / VOITH	DONG FANG ELECTRIC MACHINERY
Nominal power	83,334 kVA	83,334 kVA
Nominal voltage	13,800 V	13,800 V
Power factor	0.90	0.90
Age	New	New
Technical Lifetime[34]	30 years	30 years

[33] Sources: ESBR, Basic Project Design, August 2010 (document reference: 1110-JI1-RT-USC/GR-00002) and nameplates of the power generation units.

[34] According to the "Tool to determine the remaining lifetime of equipment" (Version 01), Annex 15, EB 50, the default technical lifetime for water-cooled electric generators is 30 years, while the technical lifetime for turbines is 150,000 operating hours, which is equivalent to an operational lifetime of 30 years at a load factor of 57%, compatible with the plant load factor of the Jirau HPP of 60.8%. As the bulb turbines are and integrated electromechanical unit, the overall operational lifetime of 30 years according to the default values defined is applicable. This is in line with the concession and depreciation period.

Power Generation Unit (Turbine + Generator)		
Output Capacity	75 MW	75 MW
Jirau Hydro Power Plant		
Total power units	50	
Total Inst. Cap.	3,750 MW	

Table 4. General Technical Details of Turbines and Generators

Transmission lines[33]

JHPP will be connected to the Interconnected Grid System through a substation in Porto Velho. Project transmission installations will include the construction of a step-up substation, increasing voltage from 13.8 kV to 500 kV and three 94 km 500 kV transmission lines which will connect the power plant to the collecting Porto Velho substation.

A.4. Parties and project participants

Party involved (host) indicates 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)	• Private entity: Energia Sustentável do Brasil S.A. • Private entity: GDF SUEZ Energy Latin America Participações Ltda.	No

A.5. Public funding of project activity

There is no public funding from Annex I parties available for the project.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

- ACM0002 – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (version 13.0.0) (hereafter referred to as "ACM0002").
- "Tool for the demonstration and assessment of additionality" (version 06.0.0) (hereafter referred to as "Additionality Tool").
- "Tool to calculate the emission factor for an electricity system" (version 02.2.1) (hereafter referred to as "Emission Factor Tool").

B.2. Applicability of methodology and standardized baseline

ACM0002 (version 13.0.0) is applicable to the proposed project due to the following reasons:

- The project activity is a grid-connected renewable power generation project activity that installs a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (Greenfield plant);
- The project activity does not involve a capacity addition, a retrofit of (an) existing plant(s) or a replacement of (an) existing plant(s);

- The project activity is the installation of a hydro power plant with a new run-of-river reservoir;
- The project activity results in a new single reservoir and the power density of the power plant is greater than 4 W/m^2 after the implementation of the project activity (see section B.6.3. for the calculation of the power density);
- The project activity does not involve switching from fossil fuels to renewable energy at the site of the project activity;
- The project activity is not a biomass fired plant;
- The project activity meets the applicability conditions of the “Tool to calculate the emission factor for an electricity system”, and the “Tool for the demonstration and assessment of additionality”.

The Additionality Tool is applicable to this project activity, as it is included in ACM0002.

The Emission Factor Tool is applicable to this project activity as it will supply renewable electricity to the grid.

B.3. Project boundary

As per the methodology ACM0002 (version 13.0.0), the greenhouse gases and emissions sources included in or excluded from the project boundary are shown in the table below.

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	For geothermal power plants, fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam	CO_2	No	Not applicable for hydro projects.
		CH_4	No	Not applicable for hydro projects.
		N_2O	No	Not applicable for hydro projects.
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO_2	No	Not applicable for hydro projects.
		CH_4	No	Not applicable for hydro projects.
		N_2O	No	Not applicable for hydro projects.
	For hydro power plants, emissions of CH_4 from the reservoir	CO_2	No	Minor emission source.
		CH_4	Yes[35]	Main emission source.
		N_2O	No	Minor emission source.

Table 5. Emissions sources included in or excluded from the project boundary

[35] Methane (CH_4) emissions from reservoir are not applicable for JHPP, as the Power Density of the project activity is above the 10 W/m^2 threshold and, according to the methodology ACM0002 (version 13.0.0), those emissions are minimum and can be neglected, as further explained in sections B.6.1 and B.6.3 of this PDD. Power Density will be monitored to confirm that threshold is met or to calculate default Project Emissions in case threshold is not retained during periods.

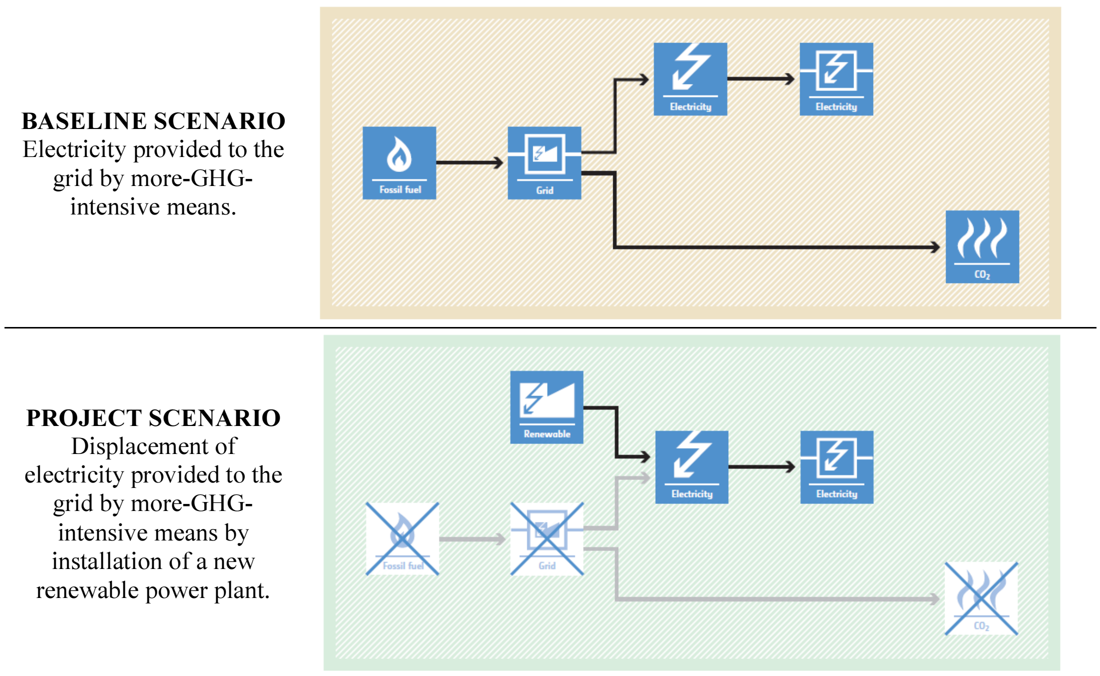

Figure 4. Flow diagram of the baseline and project scenarios[36]

The project boundary is presented in the figure below.

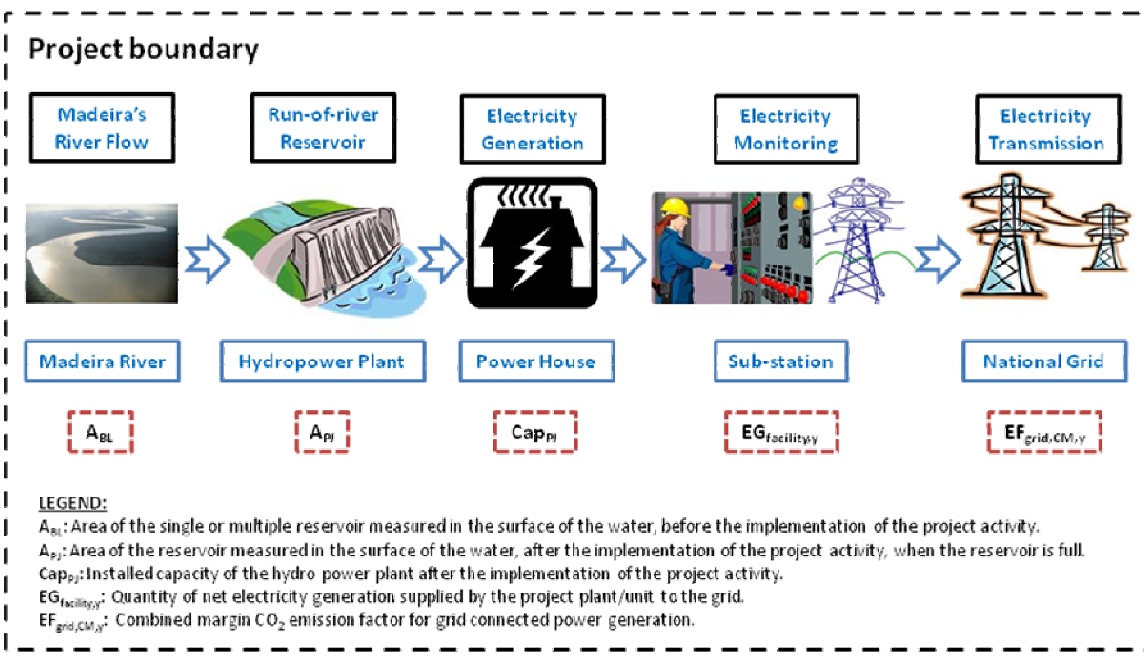

Figure 5. Flow diagram of the project boundary and key monitoring variables

[36] "CDM Methodologies Booklet - Information including EB 63 - November 2011". Available at: http://cdm.unfccc.int/methodologies/documentation/meth_booklet.pdf#2.3, accessed on 2 April 2012.

B.4. Establishment and description of baseline scenario

According to ACM0002 (version 13.0.0), if the project activity is the installation of a new grid-connected renewable power plant/unit, 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 reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".

JHPP is a grid-connected run-of-river hydro power generation project, therefore it is a typical base load generation plant with high investment costs, but low operational costs. When dispatching its renewable electricity to the grid, it displaces electricity that would otherwise be produced by other sources, mainly those using fossil fuel. This electricity displacement will occur at the system's margin, i.e. mainly fossil fuelled thermal generation will be substituted. Furthermore, JHPP substitutes or delays the construction of other fossil fuel generation units that would have to be build to meet growing power demand[37].

The JHPP does not modify or retrofit an existing generation facility. Therefore, its baseline is defined as described in ACM0002 (version 13.0.0).

For this project, the baseline emissions are the emissions related to the energy that would be dispatched to the grid in absence of the project activity.

B.5. Demonstration of additionality

Before entering into a formal discussion of the project's additionality according to Steps 1 to 4, as defined by the Additionality Tool, and in order to satisfy the requirements of EB 22 Annex 3[38] as well as the of the CDM Project Standard (paragraphs 43-45), the following Section 1 provides an overview of *the national and/or sectoral policies and circumstances* that are relevant for the project development and implementation. This shall facilitate the assessment of the baseline situation that would have occurred in the absence of the CDM project activity and provide a background for the demonstration of the project's additionality.

Furthermore, Section 2 provides an overview and detailed assessment about how the Project Participants consistently considered the CDM during the project development as well as its relevance for the effective project implementation. This Section is in line with the requirements of the Section C of the CDM Project Standard (paragraph 26-28) for *"Demonstration of prior consideration of the clean development mechanism*".

Section 1: Overview about relevant *national and/or sectoral policies and circumstances:*

Brazil is known for having a predominantly renewable electricity generation matrix with a high participation of hydropower which accounted for 81.2% of the total installed capacity in 2007[39]. According to a study developed by Abbud and Tancredi (2010) for the Brazilian Senate[40], this is a result of governmental investments in large hydropower plants with reservoirs which were developed and funded by the government in the years before the privatisation process which

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[37] The substitution or delay in construction of new fuel oil thermal power plants is particularly expressive considering the anticipation of JHPP resulting from the change in project location, as indicated clearly in a document from the Brazilian Electricity Regulatory Agency, ANEEL. Source: *Ofício n^{o}. 248/2008-DR/ANEEL apud* KELMAN, page 246-249, 2009.

[38] Available at http://cdm.unfccc.int/EB/022/eb22_repan3.pdf, last access on 4 April 2012.

[39] According to EPE, Decanal Expansion Plan 2007-2016, Graph 6, page 156, available at http://www.epe.gov.br/PDEE/20080111_2.pdf.

[40] *Same reference as the one previously introduced in the footnote* 7*, page 3.*

initiated in 1995. The National Energy Plan 2030, published by the Brazilian Ministry of Mines and Energy, further explains that this focus on hydropower developments was a strategic decision taken by the Brazilian government back in the 50's, in spite of more competitive fossil fuel based generation options[41]. As a matter of fact, the key reason for the privatisation process initiated in 1995 was that the governmental companies responsible for the development of these large hydropower projects had accumulated large financial deficits and could no longer afford the necessary capital intensive investments. As a consequence, hydro power investments dropped significantly and the construction of some ongoing projects had to be suspended (Abbud and Tancredi, p. 8).

To solve the investment crisis in the 90's, the Brazilian energy sector underwent several reforms which will be explained in Sub-step 1b. The key objective of these reforms was to attract private capital to recover the financial situation of the state owned companies and to assure growth and security of energy supply to respond to Brazil's economic and social necessities. Thus, as a consequence of the financial and economic imbalances, as well as difficulties in the subsequent privatisation and regulatory redefinition, Brazil not only went through a severe energy crisis in 2001, but also saw the escalation of its thermal generation capacity from 7,051 MW in 1994 to 21,324 MW in 2007 (Abbud and Tancredi, p. 8), an increase of 14,273 MW, which corresponds to about 6 times the firm generation capacity of the Jirau HPP.

This expansion of 202% was also responsible for a growth in the sector's GHG emissions from 10.8 Million t in 1994 to 24.1 Million t in 2007. This strong augmentation in carbon intensive generation capacities occurred due to the fact that only very limited new hydropower capacity could be effectively implemented during this period and in spite of important policies and measures to promote the installation of complementary renewable energies such as biomass cogeneration, wind and small hydropower as initiated in 2002 (i.e. PROINFA).

This pattern remained with the establishment of the new sector regulation initiated in March 2005, which is based on the firm forward contracting of electricity in centralized governmentally regulated auctions. Between the first auction, which occurred in December 2005 and November 2007, only 1,415 MW of Firm Energy from new hydropower concessions could be contracted. Consequently, the Madeira HPPs Santo Antonio and Jirau, which were auctioned in December 2007 and May 2008, were the first new developments that could add significant generation capacity. In spite of that, fossil fuelled plants were again the predominant source and between 2005 and 2008 a total of 15,400 MW of coal, fuel oil and gas fired power plants were contracted (Abbud and Tancredi, p. 17 and 39). In addition to that, the development of infrastructural hydropower plants above 2,000 MW of installed capacity had completely ceased since the 80's[42] and was only possible in a completely revised context which led to the development and effective implementation of the Jirau hydropower plant at the Madeira River.

The studies for hydropower developments at the Madeira River initiated in 2001 and though the original proposal was the development of one plant with a bigger reservoir and installed capacity, the final decision was to approve[43] two separated plants, in order to minimize the flooded area and environmental impacts. Following that, in the period from 2003 to 2005, the Environmental Impact Study, covering the whole Madeira complex, was developed by Leme Engenharia Ltda[44]. On 26 June 2006[45], the Environmental Impact Study was approved by the Brazilian Environmental Institute (IBAMA), which is the responsible regulator for granting the preliminary license (Licença

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[41] Ministry of Mines and Energy (Ministério de Minas e Energia) National Energy Plan 2030 – 3 – Hydroelectric Generation (Plano Nacional de Energia 2030 – 3 Geração Hidreléctrica), Section 3.1., page 73, available at: http://www.epe.gov.br/PNE/20080512_3.pdf, published in 2007, last access on 9 March 2012.

[42] Available at the ANEEL website: http://www.aneel.gov.br/area.cfm?idArea=37&idPerfil=2, accessed on 4 April 2012.

[43] The Inventories were approved by ANEEL on 16 December 2002 by publication of dispatch 817 in the Federal Official Journal (Diário Oficial da União), available at: http://www.aneel.gov.br/cedoc/dsp2002817.pdf.

[44] Leme Engenharia Ltda is the Brazilian subsidiary of Tractebel Engineering, which is part of the GDFSUEZ group. http://pt.leme.com.br/tractebel_engineering/overview.

[45] Memo MMA/IBAMA – N^{O} 08/2006 (Informação Técnica No 08/2006 – COHD/CGENE/DILIC/IBAMA).

Prévia)[46]. In sight of the high capital intensity, but also the relevance of the Madeira projects for a clean expansion of the Brazilian Energy Matrix, Leme Engenharia[47] had identified that:

> *"The hydropower plants shall, by generating renewable electricity, maintain Brazil as a country with low carbon emissions, thus contributing with the reduction of global greenhouse gas emissions and contributing to the sustainable development of the nation. In any case Certified Emission Reductions generated by the Projects, according to the rules of the Clean Development Mechanism as defined by the Kyoto Protocol and the Marrakesh Accords, shall help to make the projects viable".*

The document shows that the Madeira projects were seen as key opportunities to supply the country's growing energy demand with clean and renewable energy, but also that additional financial support is required to promote their effective implementation and to compensate for their huge capital intensity, technical difficulties and the long construction time. Finally, after all necessary public consulting and environmental licensing procedures were concluded[48], the preliminary license was issued by IBAMA on 9 July 2007[49].

In parallel to the licensing process, Brazil underwent important political discussions about its national climate policy and mitigation efforts, which were crucial for the effective implementation of the project activity. One prominent example of the early mitigation efforts[50] was the implementation of the PROINFA program[51], created on the basis of a presidential decree (*Medida Provisória* Nº 14) on 21 December 2001[52] and which turned into Law Nº 10.438, on 26 April 2002[53]. As a result of the PROINFA, 3,299.4 MW[54] of renewable generation capacity from small hydropower, wind and biomass generation plants were contracted. Complementary to this governmental effort, CDM played an important role as 3,006 MW of renewable generation capacity have been registered so far under the UNFCCC and another 12,486 MW are under validation[55]. Now in spite of these impressive numbers and significant mitigation efforts, the mentioned 14,237 MW of fossil fuelled thermal generation capacity had to be built between 1994 and 2007 and additional 15,400 MW were contracted between 2005 and 2008.

The importance of the Madeira Hydropower plants for effective GHG mitigation can be understood when analysing the Energy Expansion Plan 2006-2015 (Plano Decenal de Expansão 2006-2015)[56]. During the presentation of its results, the Brazilian Energy Research Company (EPE) projected an annual growth of 5.2% in energy consumption and declared the relevance of the Madeira hydropower plants to supply the increasing energy demand and prevent the installation of additional fossil fuelled energies such as coal and gas, which would lead to an increase in GHG emissions by another 15 Million t CO_2 p.a.[57].

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[46] A detailed description of the environmental licensing process is presented on Section D.1.

[47] Leme Engenharia, Estudo de Impacto Ambiental (EIA) – Aproveitamentos Hidrelétricos Santo Antonio e Jirau, Rio Madeira – RO. Maio de 2005 (Tomo A Volume 1- p VII-3).

[48] A description of the public consultation and environmental evaluation procedure is presented in Section D.

[49] Licença Prévia (*Preliminary License*) N° 251/2007, available at:

http://www.aneel.gov.br/arquivos/PDF/Licen%C3%A7a%20Pr%C3%A9via.pdf.

[50] Other examples are reduction in transmission fees for complementary energies with dispatch below 30 MW average granted by ANEEL in 2004 (Normative Resolution 77, available at http://www.aneel.gov.br/cedoc/ren2004077.pdf), as well as the possibility to sell such energy on the free market.

[51] Details available at http://www.mme.gov.br/programas/proinfa/, last access on 9 March 2012.

[52] Available at: http://www.aneel.gov.br/cedoc/mpv2001014.pdf, accessed on 13 April 2012.

[53] Available at: http://www.aneel.gov.br/cedoc/lei200210438.pdf, accessed on 13 April 2012.

[54] As referenced by page 35, Table 2 of the National Plan for Climate Change, available at http://www.forumclima.org.br/index.php/biblioteca/documentos-fbmc, last access on 9 March 2012.

[55] Calculated as of 1 April 2012 from data obtained at http://cd4cdm.org/, last access on 5 April 2012.

[56] Available at: http://www.epe.gov.br/PDEE/20060702_01.pdf, accessed on 9 March 2012.

[57] EPE also stated that the government had the intention to give priority to hydro power in combination with complementary energies such as biomass on the basis of specific energy purchase tenders. Available at:

In this context, the Brazilian government adopted regulatory actions to integrate climate change mitigation activities into its policies. The establishment of the Interministerial Committee on Climate Change (*Comitê Interministerial sobre Mudança do Clima – CIM*)[58] on 21 November 2007 and the publication of Resolution Nº 1[59] on 11 February 2008 by the National Council for Energy Policy (*Conselho Nacional de Política Energética*), indicating Jirau HPP as a project of public interest with priority for tendering and implementation, represent a first action in this direction.

Shortly after that, on 28 April 2008[60], the Brazilian Development Bank (*Banco Nacional de Desenvolvimento* - BNDES) announced the indicative financing conditions to support the implementation of the Jirau Hydropower Plant, considering among other conditions, the reduction of the financing cost and the extension of the loan payback period, which were essential for the viability of such a capital intensive project with long construction period and long term maturity, as will be explained below.

Following that, on 4 June 2008[61], the Interministerial Committee on Climate Change submitted a draft of the legislation which would later establish the National Climate Change Mitigation Policy. As requested by Decree Nº 6.263, the proposal defined strategic objectives, strategies and measures for mitigation and adaptation as well as the development of the National Climate Change Mitigation Plan. Specifically in relation to policies and incentives that promote GHG mitigation, Article 6 of the law defines that the Instruments of the National Policy on Climate Change are: i) "*existing measures, or measures to be created, to stimulate the reduction of GHG emissions" (§VI);* ii) *"specific credit lines and financing conditions offered by private and public banks (§ VI); and* iii) *"the financial and economic measures for climate change mitigation and adaptation that exist under the UNFCCC and the Kyoto Protocol" (§ VI).*

Some months later, on 4 September 2008, the Interministerial Committee on Climate Change published the National Climate Change Mitigation Plan for public comments in the federal official journal (*Diário Oficial da União*)[62], which was finalized in December 2008[63]. The publication offers a good summary of Brazil's regulatory evolutions and mitigation activities in all relevant sectors (Chapter I, page 15-19). In relation to the relevance of hydropower for climate change mitigation, the document clearly defines that:

- Key strategies for reducing GHG emissions in the energy sector are to: i) substitute fossil fuels with other non–emitting sources such as hydropower, solar, wind and sustainable biomass; ii) energy efficiency (page 30);
- Considering Brazil's economic growth and the corresponding energy demand, the objective to maintain the country's energy matrix clean requires the development of the country's hydroelectric potential (page 31);
- Accordingly, the Energy Expansion Plan for 2007-2016 (*Plano Decenal de Expansão de Energia – PDE 2007/2016)*[64]*,* with an emphasis on socio-environmental issues and GHG

http://www.eletrobras.gov.br/IN_NUCA/mostrar_informe.asp?flag=true&menu=1872-17/08/2006#, "Substituição das hidrelétricas pode aumentar emissão de gases poluentes".

[58] This Committee was created with the clear attribution to develop, implement, monitor and evaluate the National Policy on Climate Change (Plano Nacional sobre Mudança do Clima – PNMC), as well as to propose and implement priority short term actions. Decree No 6.263, dated 21 November 2007. Available at: http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2007/Decreto/D6263.htm.

[59] *Same reference as the one previously introduced in the footnote* 3*, page 2.*

[60] *"BNDES announces support conditions for the Jirau plant at the Madeira river (BNDES divulga condições de apoio para usina Jirau, no rio Madeira)"* 28 April 2008, Available at http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Sala_de_Imprensa/Noticias/2008/20080428_not068_08.html, last access on 9 March 2012.

[61] Available at http://www.camara.gov.br/sileg/integras/574554.pdf. last access on 9 March 2012.

[62] Available at http://www.siqueiracastro.com.br/informe/regmeio_01/porplanclima.pdf, last access on 9 March 2012.

[63] Available at http://www.forumclima.org.br/index.php/biblioteca/documentos-fbmc (*same reference as the one previously introduced in the footnote 54, page 17*).

[64] Available at: http://www.epe.gov.br/PDEE/20080111_2.pdf, accessed on 9 March 2012.

mitigation, defines investments in the rage of BRL 90 Billion to expand the country's hydropower capacity and to reduce more than 27 Million t in annual GHG emissions (page 33).

Furthermore, (Chapter IV.5 – page 114) the document describes the importance of adequate economic instruments, governmental policies and financial incentives that shall induce the private sector to develop GHG mitigation activities. The section makes clear reference to the CDM, but also to complementary policies, including preferential financing to make mitigation activities economically viable. Specifically, the document refers to the BNDES and its different financing and credit lines, including the Finem, which is applicable for infrastructure investments such as the JHPP.

In addition, the document (page 118) describes the importance of the CDM as support to national GHG mitigation projects and identifies the development of Brazil's hydropower potential as one of the key opportunities to reduce the growth of GHG emissions with the support of the Clean Development Mechanism.

Now in fact, the Energy Expansion Plan - 2007/16[64], published in December 2007, states that its studies and recommendations consider the priority of addressing climate change mitigation and to promote sustainable development (page 55 of Volume 1), and that the expansion of hydropower in harmony with the local socio-economic and environmental context and in synergy with other renewable energies (biomass cogeneration, wind and solar), are key to satisfying the growing energy demand without undue growth of GHG emissions. In spite of these efforts, the plan concludes that fossil fuelled energy generation will still be necessary to satisfy the fast growing demand, especially if the development of the country's hydropower potential is constrained or inhibited.

Based on this context, the document (page 420) defines that a special effort shall be undertaken by governmental and private stakeholders to make Jirau and other hydropower projects of highest priority viable. In spite of this effort, which clearly targets to reduce the growth of GHG intensive energies in the Brazilian energy matrix, and the further objective in relation to the expansion of complementary renewable energies such as biomass and wind, the plan still projects that an additional 8,715 MW of fossil fuelled thermal generation capacity will be added to the system and lead to a growth in GHG emissions to 44 Million t per year in 2016 (page 436).

The further evolution and consolidation of Brazil's GHG mitigation effort led to the definitive publication of Law Nº 12.187/09[65] of the Climate Change National Policy Law. In addition to the principles already discussed above, the definitive law (Article 6) defines that its instruments comprise:

- *existing measures or measures to be created to stimulate measures [...] that contribute to the reduction of GHG emissions, among them the establishment of preferential criteria for tendering processes, such as those for private public partnerships, as well as the authorisation or granting of concessions for the exploitation of [...] natural resources which imply the reduction of GHG emissions (§XII);*
- *specific credit lines and financing conditions offered by private and public banks (§ VII) as well as other national financial and economic measures (§ X);*
- *the financial and economic measures for climate change mitigation [...]that exist under the UNFCCC and the Kyoto Protocol (§ X).*

In summary, the evolutions of the Brazilian GHG mitigation policy clearly determines the development of the Jirau HPP project activity and effectively assures its viability by: 1) defining the granting of its concession as priority due to the Project's national interest; 2) structuring it as a Private Public Partnership with participation of state-owned companies; and 3) developing and

[65] Available at http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2009/lei/l12187.htm.

offering adequate credit lines and financing conditions that were decisive for the economic viability of the project activity. As the later is an economic incentive in complement to the CDM, it will be discussed in more detail as part of the Investment Analysis under Step 2.

Section 2: Assessment and references about the Project Participants' consistent prior consideration of CDM during the Project's development and implementation process.

For the purpose of understanding the development of the project activity and to allow the evaluation of CDM consideration in line with the provision of Section C of the CDM Project Standard, it is important to understand the sequence of actions that have been taken to adequately evaluate, develop and implement the project under the CDM. According to § 26, "*If the start date of a proposed CDM Project Activity* (the Project Starting Date) *is prior to the date of publication of the PDD for global stakeholder consultation, the project participant shall demonstrate that the CDM benefits were considered necessary in the decision to undertake the project as a proposed CDM project activity."*

Accordingly, this section provides an overview of the main project milestones and provides applicable references for the CDM related activities. Further, it describes the evolution of the activities and defines the Project Starting Date in line with the provisions of § 28 of the CDM Project Standard document. This section also provides the references required to demonstrate that continuing and real actions have been taken to secure CDM status for the proposed project activity in parallel with its implementation, as required by Section IV, paragraph 9 of the Clean Development Mechanism Project Cycle Procedure (CDM-PCP).

Summary of the evolution that led to the implementation of the project activity under the CDM:

The GDF SUEZ group, which is the controlling shareholder and founder of ESBR, has a long history in the carbon market. GDF SUEZ was created in a merger between Suez and GDF, concluded on 22 July 2008, but long before that both parties were engaged in the carbon market. In fact, both were founding members of the Prototype Carbon Fund[66] and Suez, with its global activities in Environmental Services and Energy, was also a pioneer in the direct investment and development of CDM projects. Already in the year 2001, at the inception of the CDM, Suez was actively developing opportunities to promote GHG reduction projects and to generate carbon credits for its European subsidiaries. Prominent proof of this effort is the *"Salvador da Bahia Landfill gas Management Project"* (Project Number 0052, registered with the UNFCCC on 15 August 2005), developed by Suez Environment's affiliate BATTRE[67] and the Lages Methane Avoidance Project (Project Number 0268, registered with the UNFCCC on 23 April 2006), developed by Suez Energy International's affiliate Tractebel Energia[68]. In parallel to the development of these first experiences, Suez Energy was revising its investment strategy in order to further integrate the climate change variable into its investment practice. A clear public and prestigious testimony of this is the Suez Reference Document 2007[69], which was published on 18 March 2008 in response to the group's regulatory obligations, as defined by the French Financial Market Authority.

Besides addressing in depth the issue of climate change and the risks and opportunities that arise from the emerging regulation for the group's current and future business, the document defines the following strategic priorities: (i) Strategies for GHG mitigation; (ii) Experience and guidance for

[66] In addition, during 2011, the company widened its scope with specific interest in the post 2012 market by investing in different Post 2012 carbon funds managed by NEFCO, KFW, ICF and the World Bank.

[67] http://cdm.unfccc.int/UserManagement/FileStorage/FS_285759185, accessed on 5 March 2010. In 2006 Suez sold the Salvador de Bahia LFG management project as part of a restructuring process.

[68] Available at: http://cdm.unfccc.int/UserManagement/FileStorage/UBL2IQM06M8EZCXW1GTRYC25Y9HY1Q, last access on 5 March 2010.

[69] Suez Reference Document 2007, English version available at www.gdfsuez.com/document/?f=files/en/2007-referencedocumentsuez.pdf, French version available at http://www.gdfsuez.com/fr/finance/investisseurs/publications/publications/, last access on 9 Mach 2012.

integration of CDM in project developments; (iii) Specific focus on hydropower developments in Brazil and specially the Madeira projects.

With regards to (i), the document shows that Suez had developed a complex and ambitious GHG mitigation policy and compliance strategy with targets for growth of renewable energy generation capacities (including hydropower, solar, biomass and wind energy), focus on innovation (including the development of Carbon Capture and Storage technologies), the development of new energy and environmental services that reduce GHG emissions for its clients, as well as emission trading covering EU ETS emission allowances and Certified Emission Reductions. In relation to (ii), the document explains that the group has acquired significant experience and positive results with the development and registration of CDM projects, that new CDM projects are being developed in Asia and Latin America and that further investments are under evaluation and will be developed if the additional revenues generated by the CDM cover the additional cost of the GHG reduction project. In relation to (iii), the document explains that the Brazilian regulation has evolved with the specific objective to make large hydropower projects viable and that the Madeira hydropower plants are the first projects of such nature to be developed in Brazil. In summary, the document shows that Suez implemented a clear and comprehensive policy in relation to climate change and the consideration of CDM revenues in its investments, as well as the specific interest in developing the Madeira hydropower plants.

In addition, the document refers to the role of Tractebel Engineering (TE) for the identification and assessment of CDM opportunities for the group. In fact, TE developed a CDM feasibility assessment for the Madeira River Hydro Project to support Suez' development activities for the Santo Antonio and Jirau hydropower projects, which was delivered on 6 November 2007. Furthermore, in order to have a complementary view on the CDM feasibility of the Madeira projects, a study from Pricewaterhouse Coopers was obtained on 30 November 2007 to assess the CDM potential of the hydropower generation assets, as well as of the reforestation activities which will follow the implementation of the project.

The high importance that has been attributed to CDM is also shown by further evolutions in the company's investment policy in early 2008. For the first time, on 14 February 2008, the Suez group internally distributed global price projections for Certified Emission Reductions to be used in project evaluation for investment decision[70]. Following that, on 5 May 2008, as part of the continuous update, revised prices for Certified Emission Reductions were circulated. Though projections had decreased when compared to the first communication in February, CER prices at that time were projected to be in the range of 16 € for 2012 and rising to over 20 € in 2020[71,72].

Based on this strategic orientation, Suez Energy International initiated the development of several renewable energy projects in Latin America, among them Eólica Monte Redondo project (registered under Project Number 4449)[73] and the Laja Hydropower Project in Chile (requesting registration)[74], Proyecto Eólica Guanacaste in Costa Rica (registered under Project Number 4147)[75], the Dos Mares Hydropower Project in Panama (under validation)[76], as well as five wind

[70] These projections are part of a set of global commodity prices which are regularly updated and distributed to make sure that all investments are being evaluated on a consistent basis. Though the documents are confidential they were made available to the Designated Operational Entity.

[71] A company internal note from 23 April 2008 explains that *"CERs are emission reductions that can be used to achieve the Kyoto target of a country. The biggest buyer of CERs is the EU-ETS. However, there is a cap on the use of CERs. If there would be an oversupply of CERs (too many projects in developing countries) the price of CERs could be driven by project costs. We believe that the number of CERs generated remains below this cap, in which case the CER price will continue to be driven by the EUA price".*

[72] The specific appetite for CDM can be understood on the basis of the fact that, under the European Emission Trading Scheme, GDF SUEZ had an annual compliance gap of 14 Mio t CO_2 and the authorization to use up to 3 Mio CERs per year to meet its obligations. In this context it makes more sense for the group to invest in own international CDM projects than to buy surplus allowances from other EU ETS participants (New Carbon Finance: Top 20 shortest companies in the EU ETS, 23 March 2009).

[73] Available at http://cdm.unfccc.int/Projects/DB/TUEV-RHEIN1296695607.41/view.

[74] Available at http://cdm.unfccc.int/Projects/Validation/DB/SHVQMDULNXILP24VPSCKB588LLW4OF/view.html.

[75] Available at http://cdm.unfccc.int/Projects/DB/DNV-CUK1290767325.42/view.

[76] Available at http://cdm.unfccc.int/Projects/Validation/DB/GHUWXFROH80MZE3Y1PVPIES8XTDQ5V/view.html.

power projects under development by Tractebel Energia in Brazil (Fleixeiras I; Guajiru; Mundaú, Trairi e Porto do Delta, all under validation).

In order to pursue the developments and eventually the implementation and operation of one or both of the Madeira hydropower plants, Suez Energy Latin America Participações[77] founded Energia Sustentável do Brasil S.A. (ESBR) on 15 July 2007[78]. The company's initial focus was the Santo Antonio hydropower plant, which had its auction scheduled for 12 December 2007, but its bid was not selected. Based on this experience, the investor focused on the development of the Jirau HPP and on 19 May 2008 its proposal, which was based on a fully revised project concept that allowed considerable reduction of environmental impacts[79] as well as costs, resulted in the most competitive bid. Shortly after that, on 28 May 2008, ESBR presented the revised engineering and construction concept and its main financial assumptions to a group of commercial banks, and on 30 May 2008 also to the BNDES[80]. All these presentations conclude that the project is fully eligible under the CDM and disclose that CERs revenues are being considered as an important source of revenue. Subsequently, on 24 June 2008, ESBR submitted to BNDES the first complete Feasibility Study Report (*Roteiro de Financiamento*) in order to formally initiate the financing request and loan negotiation process according to BNDES' procedures. This official document contains a full description of the project activity and its economic profile, including a first CAPEX estimate and details of all projected operational costs and revenues. In addition to the projected revenues from generation and sales of electricity, the Feasibility Study Report includes revenues from generation and sale of Certified Emission Reductions. For the purpose of submission to the BNDES, a conservative floor carbon price of minimum 5 €/ CER has been defined, in line with the public market data for post 2012 prices as provided by the GTZ at that time[81], rather than using GDFSUEZ' company internal long term prices projections which are based on EU ETS market equilibrium price projections.

In parallel to these first discussions about the Project's economic profile and loan financing, ESBR worked towards the formal acceptance of its revised engineering proposal, which included a complete redesign and relocation of the dam when compared to the original concept as offered by the government. Though these changes were fully in line with the concession agreement offered, the proposal had to be assessed and approved by different authorities. After ESBR made available all necessary documents, the first relevant formal approval was granted on 22 July 2008, when ANEEL (*Agência Nacional de Energia Elétrica*), the responsible regulatory agency, published the "Note on ratification and granting" of the concession rights *(Aviso de ajudicação e homologação)*[82]. On the same day ESBR announced the investment of 9 billion BRL[83] and declared that it was waiting for this legal milestone to request the installation license[84]. In line with this declaration, the installation license was requested the day after, on 23 July 2008[85], which is also the day the

[77] The company later changed name to GDF SUEZ Energy Latin America Patricipações, which is the controlling shareholder of ESBR.

[78] The other shareholders entered the company later, i.e. Eletrosul Centrais Elétricas S.A. on 21 November 2007, Camargo Corrêa Investimentos em Infra-Estrutura S.A. and Companhia Hidrelétrica do São Francisco ("Chesf") on 5 May 2008. Later, in July 2008, Suez and GDF merged to form GDF-Suez.

[79] For a clear understanding on how the revised engineering concept has contributed to the reduction of environmental impacts, please see Section D.1.

[80] This was the first contact with the BNDES and the commercial banks to present the Project and following the definition of the project design and represents the start of negotiations with the BNDES and the "Intermediating Banks".

[81] GTZ CDM Highlights 59, March 2008, available at: http://www.gtz.de/en/themen/umwelt-infrastruktur/umweltpolitik/18324.htm, last access on: 4 March 2012.

[82] Available at: http://www.aneel.gov.br/aplicacoes/editais_geracao/documentos/052008-Aviso%20de%20Homologa%C3%A7%C3%A3o%20e%20Adjudica%C3%A7%C3%A3o%20n%20%2005-2008%2018-7.pdf, last access on 9 March 2012.

[83] On 22 July 2008, the date of homologation of the auction, ESBR announced that it will invest 9 Billion BRL and request 70% of financing from the Brazilian Development Bank. *Consortium to request BNDES to finance 70% of the total of 9 billion BRL,* available at *http://www.estadao.com.br/economia/not_eco210078,0.htm*.

[84] ESBR President explains that he was waiting for homologation to request installation license, File "2008_07_22 GLOBO ESBR to request license this week", available from http://oglobo.globo.com/economia/energia-sustentavel-vai-pedir-licenciamento-de-jirau-ainda-nesta-semana-3608092.

[85] ESBR's official request of the license for installation of the JIRAU HPP construction site at Ilha do Padre, as sent to IBAMA on 23 July 2008, was made available to the DOE.

homologation was officially published in the Federal Official Gazette of Brazil [86], which legalized the results of the auction and effectively awarded ESBR with the rights to the concession. Most important for the definitive investment decision and the next steps was the implicit confirmation that a revision of the engineering concept, as proposed by ESBR, in principle is compatible with the concession agreement and that the regulator would no longer accept questionings from third parties about the validity of the auction results[87]. In addition to the legal certainty which was necessary to initiate further regulatory steps and investments, the ratification of ESBR as concessionary also implied the legal obligation to proceed towards the signature of the Power Purchase Agreements and thus implies an important obligation for the effective implementation of the Project Activity.

An overview about key project development steps and relevant references for CDM consideration is being provided in the table below. All references were made available to the DOE.

Status	Date	Evidence of CDM consideration
CDM evidence and Project Milestone	26/06/2006	The Environmental Impact Assessment (EIA) Report for the Madeira River HPP developments (Santo Antonio and Jirau) as developed by Leme Engineering is approved. The report makes clear reference to the importance of CDM revenues for the project's financial sustainability[88].
Project Milestone	09/07/2007	IBAMA issues Initial Environmental License on the basis of the EIA RIMA[89].
Project Milestone	15/07/2007	Energia Sustentável Brasil S.A. (ESBR) is founded and initiates studies for the development of the Madeira hydropower plants.
CDM evidence	06/11/2007	CDM assessment report on Madeira river hydropower plants delivered to the Project Participants by Tractebel Engeneering.
CDM evidence	30/11/2007	CDM assessment report on Madeira river hydropower plants delivered to the Project Participants by Pricewaterhouse Coopers.
CDM evidence	14/02/2008	Company internal CER price scenarios for evaluation of project investment opportunities are distributed.
Project Milestone	11/02/2008	Resolution Nº 1[90], issued by the National Council for Energy Policy indicates the Jirau HPP as a project of public interest and with priority for tendering and implementation.
Project Milestone	28/04/2008	The Brazilian Development Bank (BNDES) announces[91] the indicative financing conditions to *support* the implementation of the Jirau HPP.
Project Milestone	19/05/2008	ESBR offered the most competitive bid in the auction of the concession to develop and explore the Jirau hydropower development.
CDM evidence	28/05/2008	JHPP presentation to a group of commercial banks including CDM revenues.
CDM evidence	30/05/2008	JHPP presentation to the BNDES including CDM revenues.
CDM evidence	24/06/2008	Official submission of the JHPP Feasibility Study Report as part of the request for inclusion of the JHPP in the BNDES formal loan approval process (CERs revenues included in the

[86] "Federal Official Gazette of Brazil", page. 405. Section 3. Of 23/07/2008, available at http://www.jusbrasil.com.br/diarios/707633/dou-secao-3-23-07-2008-pg-405

[87] *Same reference as the one previously introduced in the footnote* 2*, page 2.*

[88] *Same reference as the one previously introduced in the footnote 47, page 17.*

[89] *Same reference as the one previously introduced in the footnote 49, page 17.*

[90] *Same reference as the one previously introduced in the footnote* 3*, page 2.*

[91] *Same reference as the one previously introduced in the footnote 60, page 18.*

Status	Date	Evidence of CDM consideration
		documentation).
Project Start	22/07/2008	ANEEL (*Agência Nacional de Energia Elétrica*), the responsible regulatory agency, published the "Note on ratification and granting" of the concession rights *(Aviso de ajudicação e homologação)*[92]. This awards ESBR with the rights to the concession and therefore is the legal base and obligation for effective start of the project implementation. On the same day ESBR announced the investment to the public[93] and declared that it will take immediate steps to request the installation license to start construction[94].

Table 6. Milestones of the JHPP and activities undertaken to develop the JHPP under the CDM

Assessment of the Project Starting Date:

According to the Glossary of CDM terms[95]:

> "*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*".

The granting of the rights to the concession, as obtained on 22 July 2008, represented the regulatory approval of the previous auction and therefore implies legal grounds and certainty as well as the obligation for ESBR to initiate the effective implementation of the project activity. As determined by this formal act, ESBR proceeded with the signature of the respective Concession Agreement, which took place on 13 August 2008, and the Power Purchase Agreements, which were signed on 10 October 2008. Consequently, the Project Starting Date represents the formal recognition of the auction's validity and the effective granting of the rights to explore the hydrological potential of Jirau and implies material obligations and binding milestones for the project development and implementation. This achievement is, therefore, the inception of the effective project implementation and thus the earliest possible project starting date.

The effective construction only initiated on 14 November 2008, as it depended on a sequence of further regulatory approvals and ultimately the environmental licensing. However, these steps became possible and mandatory only after ANEEL declared ESBR's proposal as valid and granted it with the right to the concession.

Thus we can conclude that 22 July 2008 is the earliest date on which the investor could effectively initiate, and also incurred the obligation to the development of the project activity.

The subsequent project development steps and milestones as well as the ongoing actions implemented by the Project Developer to obtain CDM status will be discussed in the following section and are summarized in the next table below.

Description of ongoing action:

According to paragraph 28 (b) of the Clean Development Mechanism – Project Standard (CDM-PS), project participant shall provide evidence that continuing and real actions were taken to secure CDM status for the proposed project activity in parallel with its implementation. As from the Project Starting Date, which was defined by the granting of the rights to the concession as described above, ESBR had to follow several regulatory and concrete steps to effectively

[92] *Same reference as the one previously introduced in the footnote* 1*, page 2.*

[93] *Same reference as the one previously introduced in the footnote 83, page 22.*

[94] *Same reference as the one previously introduced in the footnote 84, page 22.*

[95] CDM Glossary of Terms, version 05, available at: http://cdm.unfccc.int/Reference/catalogue/document?doc_id=000002803.

implement the project activity and to assure concomitant registration of the Jirau HPP as a CDM project.

A first step towards the CDM project development was taken on 23 September 2008, when a CDM development proposal was requested from the consulting company Econergy Brazil. The general terms of the CDM consultancy proposal were then approved by the Board of ESBR on 24 October 2008 and, subsequently, the contract with Econergy Brazil was negotiated and duly signed on 2 March 2009. Further it was defined that GSELA would be responsible to manage the CDM development process and that it would gain a preferential right for the purchase of the CERs generated by the project.

It is important to mention that the first CDM development activities considered the original installed capacity of 44 turbines totalizing 3,300 MW, as foreseen in the official governmental documentation. Though the option for two additional turbines was already foreseen by the investor, it could not be confirmed or approved by the regulator at the early development stage of the project, and thus CDM development started on the basis of the plant specifications as defined by the official concession documents. This was necessary to satisfy the CDM rules and the principles of transparency and consistency defined at the VVM applicable at that time (version 01). Based on these facts, and in spite of the fact that the definitive Project Starting Date is before 02 August 2008[96], ESBR submitted a first notification to document its CDM consideration to the Brazilian DNA (Interministerial Commission on Global Climate Change - CIMGC) on 13 February 2009. Although this notification is not required as per the "*Guidance on the Demonstration and Assessment of Prior Consideration of the CDM*" (version 01, Annex 46/EB41), due to the fact the Project Starting Date is before 02 August 2008, its submission to the Brazilian DNA documents ongoing intention to pursue CDM registration for the project activity.[97]. This first notification was sent to the Brazilian DNA only, as the referred guidelines allowed project participants to inform "*a Host Party DNA and/or the UNFCCC secretariat*" of such notice. The notification to the Brazilian DNA accurately describes the Jirau HPPs location at Ilha do Padre with its respective coordinates, but it references the original installed capacity of 3,300 MW, as stipulated by the government, and thus did not include the possible expansion with two additional turbines due to the lack of formal references for this configuration[98].

During the PDD development and on the basis of the "*Guidelines for the Reporting and Validation of Plant Load Factors*" published on 17 July 2009 which allowed the definition of the plant load factor on the basis of documents provided to banks, the consultancy firm considered the overall aspects of the revised project concept, including: (i) location of the dam at Ilha do Padre; (ii) the installation of 46 turbines, totalizing 3,450 MW of installed capacity; (iii) the anticipation of the generation schedule when compared to the original schedule as foreseen in the "Invitation to Bidding" document.

In parallel to the initial PDD development, ESBR focused on the conclusion of the regulatory approvals as necessary to allow swift construction start. Immediately after having been granted with the rights to the concession, ESBR sought the governmental agencies' (ANEEL and IBAMA) endorsement of the revised project concept by demonstrating the technical feasibility and the environmental benefits of changing the location of the dam to Ilha do Padre. Based on an extensive set of information provided to the respective governmental agencies, the Preliminary Installation License (*Licença de Instalação de Obras no Canteiro Pioneiro nº.563/2008*) was finally

96 For this reason CDM consideration is to be shown according to § 26 of the CDM Project Standard as demonstrated in Section B5/Section 2 of this PDD.

97 At the time of elaboration of the note, the Project Participants assumed that the issuance of the Preliminary Installation License, which occurred on 14 November 2008, would represent the most appropriate start date for the project activity as it implied effective start of the construction and the entry into force of the EPC contract for civil works with Camargo Correia, which effectively represents the first and major element of the capital expenditure for the project activity.

98 The Guidelines for the Reporting and Validation of Plant Load Factors was not available at that time and therefore project participants could not know that plant load factors submitted to BNDES in the Feasibility Study Report could have been used to justify the increased projected load factor and Firm Energy. Thus original documentation and definitions of the "Invitation to Bidding" were seen as the only formally valid references.

obtained on 14 November 2008, which was necessary to initiate preparative construction works. Later, on 11 March 2009 ESBR obtained the approval of the new project configuration, though still with an installed capacity of 3,300 MW, and shortly after that, on 3 June 2009 the definitive Installation License. Although ESBR had obtained the formal approval and ratification of the auction on 22 July 2008, these project milestones were essential to effectively initiate construction on 14 November 2008, as well as a legal basis to seek the approval of the expansion to 3,450 MW as envisaged before the Project Starting Date.

Though not required, as the project activity's starting date is before 02 August 2008, project participant documented this change in project design by submitting a second and revised Prior CDM Notification, which was sent on 24 August 2009 to the UNFCCC and the Brazilian DNA. The notification also allows demonstrating that real and continuing actions were taken. This second notification refers to the same project name and location of the first notification, but already considers 46 turbines and the revised installed capacity of 3,450MW, as referenced by the Project Feasibility Study Report submitted to the Brazilian Development Bank as early as 24 June 2008.

In parallel, during July and August 2009, ESBR requested several validation proposals in order to formally start the validation of the PDD under the CDM rules and focused on the finalization of the PDD document, which was concluded on 9 March 2010. At the same time, ESBR identified the technical possibility to further expand the generation capacity of the Jirau HPP and to add 6 turbines, i.e. to increase the total installed capacity to a total of 3,750 MW[99], instead of adding only two turbines as had been envisaged before. Now as such a substantial project revision would only turn possible after concluding the applicable regulatory approvals which would grant the necessary Firm Energy for sale and thus justify the incremental investment, ESBR immediately informed the respective regulators and requested the applicable revision of the basic project design and consequently the amendment of the necessary regulatory approvals.

On the basis of the uncertainties about the definitive project design, ESBR had to take the decision to put the CDM development activities on hold until the plant specifications were defined as such significant changes during the validation process would have implied difficulties and delays, as already experienced with other projects[100]. In the light of this situation, as well as to understand the specific requirements and expectations in relation to demonstration of the contribution to Sustainable Development and for local stakeholder engagement, ESBR had a meeting with the Brazilian DNA on 29 April 2010 to discuss the project and the applicable steps to be taken.

Later, on 11 August 2010, and on the basis of the engineering studies developed by its experts, ESBR submitted to ANEEL a Memo to formally request the inclusion of 6 turbines in the Basic Project Design and therefore approve an installed capacity of 3,750 MW. This request obtained formal approval on 29 July 2011 through the Decision N° 3,104. As part of the process to include the project's incremental Firm Energy in the A-3 energy sales tender, which was planned for August 2012, ESBR had to seek the approval from the Brazilian Energy Research Company (EPE). The respective Technical Sheet was issued by EPE on 13 July 2011 and defines the revised technical parameters, the specifications of the 6 additional turbines and the incremental capital expenditures necessary for the capacity addition. On the basis of these regulatory milestones, on 1 August 2011, the Ministry of Mines and Energy finally published[101] the revised Firm Energy for the Optimized Project of a total installed capacity of 3,750 MW and defined that 209.3 MW average would be eligible for sale under the A-3 auction.

[99] In order to demonstrate the intention of expanding JHPP installed capacity to 3,750 MW, several communications have been exchanged with governmental agencies, such as the Energy Research Company (EPE) (Memo MP/FB – 225/2010), Ministry of Mines and Energy (MME) (Memo MP/FB – 216/2010), National Water Agency (ANA) (Memo VP/FB – 232/2010), Brazilian Development Bank (BNDES) (VP/FB – 242) and the Brazilian Electricity Regulatory Agency (ANEEL) (VP/FB – 633). All these communications will be made available to the validation auditor.

[100] The Dos Mares HPP, also an investment of the GDF SUEZ group had to re-initiate the validation as a consequence of an increase of its installed capacity during the first validation process.

[101] Ordinance 26, published by the Ministry for Mines and Energy on 01 August 2011, available at: http://www.aneel.gov.br/cedoc/prt2011026spde.pdf.

As a result of these regulatory definitions, on 12 August 2011, ESBR presented the Optimized Project to the BNDES in order to request an additional credit line for financing the incremental capital expenditures on the basis of the additional cash flows that were expected from selling the incremental Firm Energy under the A-3 auction. The presentation given to the BNDES confirms the technical and economic assumptions of the expansion and shows that revenues from generation and sales of Certified Emission Reductions were again part of the economic assumptions for the expansion of the plant's generation capacity[102].

Finally, on 17 August 2011, the auction took place and ESBR's bid for the sales of 209.3 MW was selected and finally declared valid on 18 October 2011[103]. On the same day of the auction (17 August 2011), which marked the clear expectation that the sale of the incremental Firm Energy would be concluded and thus the Jirau optimization could be effectively implemented, ESBR sent the third formal notification on its intention to develop JHPP as a CDM project. This submission informed the UNFCCC about the progress in the definition of the project's installed capacity to 3,750MW on the basis of 50 bulb turbines of 75 MW installed capacity each, as approved by the regulators. In addition, the notification complies with the requirement of paragraph 9 of the CDM Cycle Procedure, which requires using the *F-CDM-Prior consideration form* to inform the UNFCCC secretariat every two years after the initial notification about the progress of the project activity.

In parallel to the progress of the regulatory approvals, as of 19 July 2011, ESBR requested GSELA' support to reinitiate the CDM process and the Project Participants defined that the process would initiate immediately after the confirmation of the definitive installed capacity and the respective Firm Energy. Furthermore, it was defined that it would be most efficient to conduct the process with GSELA internal team. Based on these considerations, on 3 August 2011, the Project Participants entered into a CDM development contract and also negotiated the resolution of the original CDM development contract with Econergy, which was concluded on 22 August 2011.

In parallel to the applicable revisions of the PDD, the Project Participants also requested validation proposals and entered into contractual negotiations with the chosen Designated Operational Entity.

An overview about all applicable steps is given in the table below.

Status	Date	Evidence of continuous action to secure CDM status
CDM evidence	23 September 2008	First request for CDM consultancy proposal to start PDD writing and assist registration process.
Project Milestone	10 October 2008	PPAs for the Regulated Market are signed with different distribution companies.
CDM evidence	24 October 2008	ESBR Board approves terms of CDM management and preferential right for CER purchase by GSELA.
Project Milestone	14 November 2008	Issuance of Preliminary Installation License (no.563/2008) by IBAMA. As a consequence of the license, the EPC contract for civil works with Camargo Corrêa came into force.
CDM evidence	13 February 2009	Notification sent to the Brazilian DNA by ESBR considering an installed capacity of 3,300 MW. Although this notification was not required per Annex 46 of the EB 41[104], the notification documents ongoing action to develop the Jirau HPP as CDM project activity.
CDM evidence	2 March 2009	Contract signed with Econergy for PDD development

[102] As referenced by the document submitted to the Brazilian Development Bank a price of 8 €/CER has been considered for the expansion, in line with the prevailing market conditions at that moment.

[103] According to Article 4 of Ordinance 26 as published by the Ministry for Mines and Energy on 01 August 2011, the effective signature of the PPAs is necessary to safeguard the validity of the Ordinance and therefore the Project activity's incremental firm Energy. This has not been concluded yet, but will be concluded before the end of the validation process.

[104] "Guidance on the demonstration and assessment of prior consideration of the CDM" (version 01), EB41 Annex 46, available at: http://cdm.unfccc.int/EB/041/eb41_repan46.pdf.

Status	Date	Evidence of continuous action to secure CDM status
		services.
Project Milestone	11 March 2009	Approval of the revised engineering design at Ilha do Padre by ANEEL (Memo 946/2009-SGH/ANEEL).
Project Milestone	3 June 2009	Issuance of the Installation License (nº 621/2009) by IBAMA.
CDM evidence	24 August 2009	Adjusted notification sent to both DNA and UNFCCC to inform about new installed capacity of 3,450 MW and to demonstrate that real and continuing actions were taken.
CDM evidence	July and August 2009	Various validation proposals received by ESBR.
CDM evidence	7 January 2010	Presentation of the Jirau HPP CDM file in the meeting of the Sustainability Committee as part of the local stakeholder consultation process.
Project Milestone	March 2010	Notification on the intention to include additional turbines and expand firm energy sent to: i) Ministry of Mines and Energy (MME); ii) Energy Research Company (EPE); iii) Water Energy Agency (ANA); iv) Brazilian Development Bank (BNDES).
CDM evidence	9 March 2010	First PDD draft delivered by Econergy.
CDM evidence	29 April 2010	Meeting with the Brazilian DNA to discuss the status of the JHPP CDM process.
Project Milestone	28 May 2010	Notification to the Brazilian Electricity Regulatory Agency (ANEEL) on the intention to include additional turbines and expand Firm Energy (Memo VP/FB – 633/2010).
Project Milestone	11 August 2010	Approval request of the Optimized Project concept submitted to ANEEL (VP-MC 1092-2010).
Project Milestone	13 July 2011	The Brazilian Energy Research Company EPE issues the Technical Data Sheet (*Ficha de Dados)* for the inclusion of the Jirau HPP expansion in the A-3 energy sales tender.
Project Milestone	29 July 2011	Approval of the Optimized Project Concept by ANEEL (Decision nº 3104 from SGH/ANEEL).
Project Milestone	1 August 2011	Ministry for Mines and Energy published Ordinance 26/11 to define Jirau HPPs incremental Firm Energy for sale under the A-3 Auction to be 209.3 MW[105].
CDM evidence	3 August 2011	Contract signed between ESBR and GSELA for PDD development services.
CDM evidence	12 August 2011	Presentation to the BNDES to present the request for additional credit line for the financing of the Jirau HPP expansion on the basis of the projected firm energy sale as well as additional revenues from sales of CERs.
CDM evidence	17 August 2011	ESBR participates to the A-3 Auction for sales of 209.3 MW average as defined by the regulator.
CDM evidence	17 August 2011	Revised notification to the UNFCCC Secretariat. The notification informs about the revised installed capacity of 50 turbines as defined on the basis of the participation in the A-3 auction.
CDM evidence	22 August 2011	ESBR signs a distract with Econergy as defined in the CDM consultancy agreement with GSELA.
Project	18 October 2011	Note on ratification and granting of the A-3 auction

[105] *Same reference as the one previously introduced in the footnote 101, page 26.*

Status	Date	Evidence of continuous action to secure CDM status
Milestone		where ESBR sold the additional firm energy.
CDM evidence	28 March 2012	Start of the local stakeholder consultation and publication of the PDD in Portuguese on ESBR's company website.
CDM evidence	24 April 2012	Start of the global stakeholder consultation and publication of the PDD on the UNFCCC website.

Table 7. JHPP development milestones and ongoing actions to pursue CDM registration.

Assessment of Ongoing Action:

According to paragraph 28 (b) of the Project Development Mechanism Project Standard (CDM-PS),

> *"Project participants shall provide evidence that continuing and real actions were taken to secure CDM status for the proposed project activity in parallel with its implementation."*

Based on the Project and CDM development history summarized in the table above and the explanations provided, the continuous action to secure CDM status in parallel to the ongoing implementation and construction is demonstrated on the basis of: i) contracts with consultants; ii) draft versions of PDD; iii) correspondence with the Brazilian Development Bank; iv) evidence of negotiation with DOEs for validation agreements; v) correspondence with the Brazilian DNA and the UNFCCC Secretariat on the project; vi) agreements on the commercial preference for the purchase of the CERs; vii) project activity related meeting with the Brazilian DNA; and viii) report about the CDM presentation in local stakeholder meeting, which are all valid references according to the criteria defined by the CDM-PS.

In addition, Project Participants have provided a clear explanation why the project validation was not initiated before as referenced by the regulatory approvals of the applicable plant specifications, which were necessary to effectively initiate the validation process.

Furthermore, although this is not an applicable requirement for this project, as the Project Starting Date is before 02 August 2008, the Project Participants decided to voluntarily follow the provision of paragraph 9 of the Clean Development Mechanism Project Cycle Procedure (CDM-PCP) which requires that:

> *"…project participants shall inform the secretariat of the progress of the project activity every subsequent two (2) years after the initial notification, using the "Prior consideration of the CDM form "(F-CDM-Prior consideration)"."*

Based on these definitions, the Project Participants proceed to a formal discussion of the project's additionality based on Step 1 to 4 as defined by the Additionality Tool.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Define realistic and credible alternatives to the project activity(s) through the following Sub-steps:

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

- **Alternative 1:** The proposed project activity without CDM, i.e. the construction of a new hydro power plant with an installed capacity of 3,750 MW connected to the grid, implemented without considering CDM revenues;
- **Alternative 2:** Continuation of the current situation, i.e. electricity will continue to be generated by the existing installed capacity of the grid;
- **Alternative 3:** The expansion of the grid using thermal power plants.

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

The Brazilian Regulatory Environment

The Brazilian Regulatory Framework for the electric sector went through important structural and conceptual changes over the past 2 decades, resulting in three different regulatory models: the State Owned Model (until 1995); the Free Market Model (1995 to 2003); and the New Model, implemented in 2004 and valid up to date. Under the State Owned Model, the energy sector was dominated by almost exclusively state-owned and verticalized companies that covered the segments of generation, transmission and distribution. During the period of state monopoly, the major part of the currently existing generation capacity has been built, mostly consisting of large hydropower plants with important energy reservation capacity.

From 1995 on, due to lack of capacity to further finance the necessary investments for the expansion in energy generation, transmission and distribution, the government initiated a partial privatization process, structured by four main pillars: (i) creation of a competitive environment (free market), with a gradual elimination of industrial captive consumers; (ii) partial dismantling of the state owned verticalized companies by dividing and privatizing the segments of generation, transmission and distribution; (iii) allowing free access to the transmission lines for generators and consumers; and (iv) placing the operation and planning responsibilities to the private sector[106].

The adoption of the Free Market Model allowed the participation of private entities and the implementation of the Concession Law (Law No 8,987 of 13 February 1995)[107] and promoted the construction of some small and midsized hydropower plants in Brazil.

Unfortunately, the model did not provide sufficient investment in generation capacity as needed to satisfy the growing demand and it resulted in an energy crisis in 2001, when energy consumption of consumers and industry was rationed and Brazil’s economic development was badly hit. As a response to this crisis, a new regulatory framework was put in place in 2004, resulting in a more active role of Brazil’s government by virtually suspending the privatization process initiated in the 1990’s and centralizing the functions of electricity planning at national government level[108], while promoting private sector investments to fund the required expansion in generation capacity. This new regulatory model provided a more efficient mechanism of power procurement between generators and distributors, primarily by creating two parallel electricity trading environments: the Regulated Contracting Environment, referred to as ACR (*Ambiente de Contratação Regulada),* where energy is finally contracted based on the lowest tariffs defined by a regulated auctioning process, and the Free Contracting Environment (*Ambiente de Contratação Livre* - ACL).

When evaluating the initial effects of these regulatory changes since 2005 it must be observed that the immediate demand for energy and capacity has been satisfied mostly with the installation of thermal power plants. In fact, between 2005 and 2007, 57% of the new generation capacity added/contracted stems from fossil fuel burning plants, while non conventional resources like biomass, wind, and small hydro power plants accounted for only 3% of the new capacity under development, the rest being represented by the installation of large hydropower plants, mainly the Madeira complex (Santo Antonio and Jirau HPPs), which represents 22% of the total Firm Energy contracted in the period[109].

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106 Aguiar F.L. Institutional Model of the Brazilian Electric Sector (in a free translation from Portuguese of “*Modelo Institucional do Setor Elétrico Brasiliero*”), 2007, available at http://www.realestate.br/images/File/arquivosPDF/DST_FernandoAguiar.pdf, last access on 5 March 2010.

107 Concession Law (Law N° 8,987 of 13 February 1995), available at: http://www.planalto.gov.br/ccivil_03/leis/L8987cons.htm, accessed on 10 April 2012.

108 For further information, please refer to *Moody’s Global Infrastructure – Regulatory Environment Improves for Brazilian Electric Utilities*, August 2008.

109 *Same reference as the one previously introduced in the footnote* 8*, page 3.*

The table below summarizes the evolution of the regulatory framework for the Brazilian electric sector:

State Owned Model (until 1995)	Free Market Model (1995 to 2003)	New Model (2004)
Financing using public funds.	Financing using public and private funds.	Financing using private and public funds.
Verticalized companies.	Companies classified by activity: generation, transmission, distribution and commercialization.	Companies classified by activity: generation, transmission, distribution, commercialization, imports and exports.
Predominantly State-controlled companies.	Opening up of the market and emphasis on the privatization of the companies.	Coexistence between State-controlled and private companies.
Monopolies – No competition.	Competition in generation and commercialization.	Competition in generation and commercialization.
Captive Consumers.	Both Free and Captive Consumers.	Both Free and Captive Consumers.
Tariffs regulated throughout all sectors.	Prices are freely negotiated for the generation and commercialization.	Free environment: Prices are freely negotiated for the generation and commercialization.
Regulated Market.	Free Market.	Coexistence between Free and Regulated Market.
Determinative Planning – Coordinator Group for the Planning of Electricity Systems (GCPS).	Indicative Planning coordinated by the National Council for Energy Policy (CNPE).	Indicative Planning coordinated by the Energy Research Company (EPE).

Table 8. Energy regulatory frameworks in Brazilian history[110]

Characteristics of the different market environments: The free and the regulated Market:

Within this new regulatory framework, the Power Generators, which can be state owned companies or privately owned Independent Power Producers, have two options to sell their energy and thus to finance their projects. Under the ACR, the investors offer the electricity to be generated by their investments under regulated auctions. The rules, terms and eligible technologies for these auctions are defined by the Ministry of Mines and Energy (MME) and the Brazilian Electricity Regulatory Agency (Agência Nacional de Energia Elétrica - ANEEL); while the auction is executed by the Electric Power Commercialization Chamber (Câmara de Comercialização de Energia Elétrica - CCEE). Main modalities for such auctions refer to different duration and starting date of the respective *Power Purchase Agreements* (PPAs), which may have duration of 20 or 30 years, depending on the economic or operational lifetime of the underlying energy source and technology. After conclusion and regulatory ratification (*homologação*) of the auction, the PPAs are signed between the respective energy generator and a pool of regulated distribution companies which are defined by the regulators. Such long-term PPAs with a pool of distribution companies represent a convenient option to define a reliable long term cash flow, which is not only important to protect the equity investor from unexpected market variations, but also a key requirement to obtain appropriate conditions for third party financing.

The auctions are designed for one or a set of specific technologies and resources and therefore allow the government to influence the expansion of the Brazilian generation park. In the case of large hydropower projects with an installed capacity above 50 MW, the project is necessarily based

[110] Available at: http://www2.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=3df6a5c1de88a010VgnVCM100000aa01a8c0RCRD.

on a governmental concession to explore the natural resource. Under the Free Market Model such concessions were auctioned against the highest bid for acquisition of the concession and then it was the investors right to develop the project and commercialize the energy according to his strategy and convenience. This concept changed under the New Model, where concessions are granted to the investor who offers the minimum price for the electricity to be generated under the concession agreement. As a transitional measure between the Free Market Model and the New Model, owners that had acquired concessions under the Free Market Model were allowed to compete under the auctions on the same basis as thermal generation projects which do not depend on any concession agreement.

Alternatively, Independent Power Producers have the option to sell electricity to the Free Electricity Market ACL where authorized electricity purchasers and electricity sellers negotiate among themselves the conditions and clauses of their PPAs, such as price, duration, guarantees, off take and delivery obligations and payment conditions. In the case of hydropower concessions, such as the Jirau HPP, the share of energy that can be sold under the free market and was fixed to be 30% for the project activity.

Usually PPA durations in the free market are short to medium term, covering mostly between one and three years, which is completely different from the long duration of the 20 or 30-year PPAs as defined in the captive market and which implies an important risk of contract renovation and renegotiation. In addition, contracts are signed with individual industrial clients and not with a portfolio of regulated distribution companies, a fact that implies increased exposure to the client's credit risk. In conclusion, selling electricity to the Free Electricity Market implies an increased level of risk and exposure to the oscillation of the demand and electricity price.

The figure follow represents a comparison of the Free and the Captive Energy Markets:

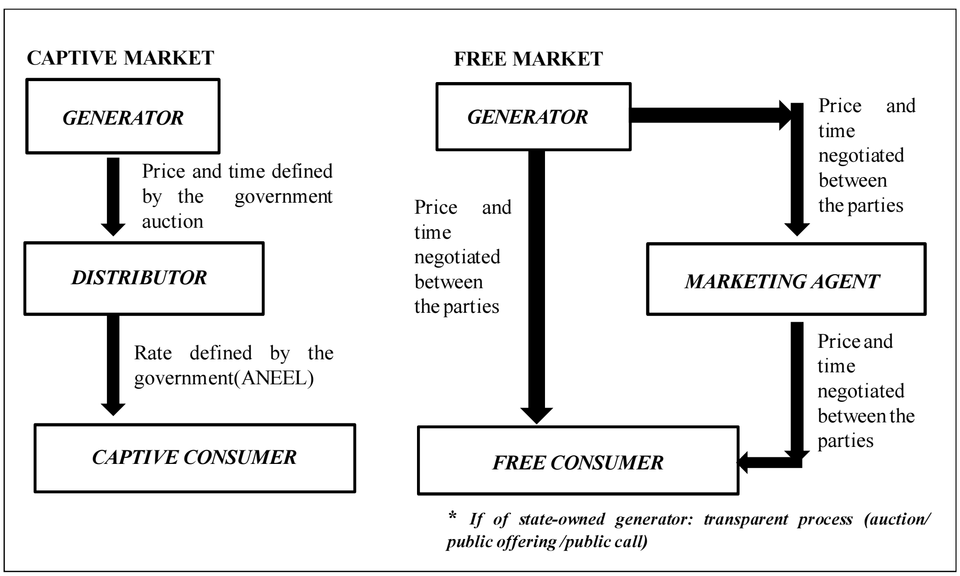

Figure 6. Captive and Free Market

Policies and incentives for the promotion of renewable energies:

As mentioned above, initially hydropower concessions acquired under the Free Market Model as well as new hydropower concessions competed like for like with thermal power plants of any type and there was no structural policy for differentiation or preference between these energy types, while non conventional renewable energies such as biomass cogeneration and small hydropower plants and wind were supported by policies such as the Program for the Support of Alternative Energy Sources (PROINFA - Programa de Incentivo às Fontes Alternativas de Energia). Later, for the first time in June 2007 the government used another tool to promote such non conventional renewable energies by organizing dedicated auctions for exclusive contracting of energy from

these sources[111]. Likewise, the government organized specific auctions for the promotion of the Madeira hydropower plant and even declared the Jirau HPP as priority project of national interest.

In addition to the policies presented, the most important incentive for a clean expansion of the Brazilian electricity generation matrix is being offered by the Brazilian Development Bank BNDES. Traditionally the Brazilian state owned development bank, and as such the government's main instrument for economic development policies, is the main source of third party infrastructure funding and of special importance to the capital intensive projects developed by the electricity sector. Now starting in late 2007 the BNDES developed a general policy to incentivize hydropower and other renewable low GHG emitting electricity sources by providing more attractive financing conditions when compared to GHG intensive technologies such as coal and fuel oil fired thermal power plants.

Within the context presented, the project activity Jirau HPP benefits from preferential BNDES financing and the respective policies and incentives will be further analyzed in Sub-step 2b to assure their adequate treatment in the definition of the project's baseline and additionality discussion.

In conclusion, the project activity is in full compliance with the applicable laws of Brazil and the regulations of the electricity sector.

The alternative scenarios also do not suffer any restrictions and is in full compliance with Brazil's laws and the mentioned norms and regulations.

Step 2. Investment analysis

The "Tool for the demonstration and assessment of additionality" (version 06.0.0), (hereafter referred to as "Additionality Tool") states that project participants may choose to apply Step 2 (Investment analysis) or Step 3 (Barrier analysis) to demonstrate the additionality of the project activity. Accordingly, the investment analysis shall determine whether the proposed project activity is *not*:

1) *The most economically or financially attractive; or*
2) *Economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs).*

To conduct the investment analysis, the Project Participants used the following steps under consideration of the "Guidelines on the assessment of investment analysis" (Version 05)[112], (hereafter referred to as "Guidelines for Investment Analysis"):

Sub-step 2a. Determine appropriate analysis method

According to the Additionality Tool, three options can be applied to conduct the investment analysis. Among these options, there are the simple cost analysis (Option I), the investment comparison analysis (Option II) and the benchmark analysis (Option III). Since this project will generate financial/economic benefits other than CDM-related income, through the sale of generated electricity, Option I (Simple Cost Analysis) is not applicable.

Both Option II and Option III are applicable for the JHPP case. However, the project participants decided to apply Option III – benchmark analysis, as this is fully appropriate for assessing the financial attractiveness of the project activity.

[111] Under the first dedicated Non Conventional Renewable Energy Auction from June 2007, 542 MW of biomass and 97 MW of small hydropower generation capacity were contracted and shortly after the Jirau auction, in August 2008, 2,379 MW of biomass generation capacity were contracted in an exclusive reserve auction.

[112] Available at: http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf, last access on 28 August 2012.

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

According to the Additionality Tool, the discount rates (benchmarks) used in the investment analysis of the project activity can be derived, among other options from:*"Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert or documented by official publicly available financial data".*

Based on this provision, Project Developers have defined a project specific benchmark using the Capital Asset Pricing Model (CAPM) and official and publicly available parameters that are standard in the market, while taking into account the specific provisions of the "Guidelines on Investment Analysis". According to Guidance 15, *"If the benchmark is based on parameters that are standard in the market, the cost of equity should be determined either by: (a) selecting the values provided in Appendix A; or by (b) calculating the cost of equity using best financial practices, based on data sources which can be clearly validated by the DOE, while properly justifying all underlying factors."*

Based on this rule, the *"Default Benchmark"* according to option (a) and a *"Project Specific Benchmark"* as well as a *"Standard Benchmark under Baseline Conditions"* according to option (b) are being used as complementary criteria for the discussion of the project activity's additionality. In addition, a brief comparison with other third party references and applicable literature is offered in order to demonstrate accuracy and validity of the project specific benchmark as calculated.

Based on provision (b) of guidance 15 as mentioned, a CAPM model for the calculation of the project specific cost of equity under the consideration of the Jirau HPP specific third party financing condition and an industry beta has been developed. The model therefore reflects the return required by financial markets to compensate for systemic risks of investments in the Brazilian power sector, as well as the impact of the project specific financial leverage from the perspective of the project starting date. The necessity to contemplate the specific impact of third party financing from the BNDES is readily addressed by the use of the CAPM where the calculation of the leveraged beta allows capturing the impact of third party financing on the equity investor's exposure to systemic market risk.

The table below provides an overview about the calculation and the specific references that were used.

Variable	Value	Parameter / Formula / Comment	Reference
Rfr - Risk-Free Rate (in real terms)	3.02%	Calculated by Ruben C. Trevino and Barbara M. Yates in real terms based on data from 1954 -2007. This variable and reference was also used by the CDM Methodologies Pannel in its Information Note *"Default values for equity return for CDM projects"*.	[1] [2]
ERP - Equity Risk Premium	6.42%	Equity Risk Premium calculated and published by Damadoran for 1928-2007 This reference, was also used by the CDM Methodologies Pannel in its Information Note *"Default values for equity return for CDM projects"*.	[2] [3]
Rc - Estimated Country Risk Premium	2.68%	EMBI+Brazil, average calculated from January 2005 to June 2008, calculated based on JP Morgan data.	[4]
β - Unleverged Industry Beta	0.63	Unlevered Beta for Electric Utilities, representing the USA country average as calculated and published by Damadoran in January 2008.	[5]
Wd - Target Debt / Total Capital	70.00%	Project Specific expected leverage from BNDES based on the limit on Debt Service	[6]

		Coverage Ratio and as projected in the FSR. This was also communicated by the PP on the Project Starting Date[113].	
We - Target Equity / Total Capital	30.00%	Shareholder Equity necessary to finance the balance of the project after BNDES debt financing.	Calculated
t - Marginal Tax Rate	34.00%	Corporate Marginal Tax Rates - Brazil as of, before and after April 2008, Source: KPMG, published by Damadoran.	[7]
β - Industry Beta adjusted for leverage	1.61	$\beta L = \beta U*[1+(1-t)*(D/E)]$	Calculated
Ke - Cost of Equity – real terms USD	16.05%	Ke = Rf + β*ERP + Rc	Calculated

[1] Ruben C. Trevino, Ph.D., and Barbara M. Yates, Ph.D., Treasury Bills and Inflation, Journal of Financial Planning, available at: http://www.fpanet.org/journal/CurrentIssue/TableofContents/TreasuryBillsandInflation/.

[2] Fiftieth meeting report of the CDM Meth Panel, Annex 8, available at http://cdm.unfccc.int/Panels/meth/meeting/11/050/mp50_an08.pdf.

[3] Damadoran Website: Historical data on Stocks, Bonds and Bills – US, data from 1928-2007. Detailed references are available in the Jirau HPP Investment Analysis Spreadsheet.

[4] GP Morgan Market Data average of historical data from EMBI+ Brazil, calculated from 01 January 2005 to 31 May 2008, period compatible with the calculation of the Basic Brazilian Interest rate TJLP as discussed in Sub-step 2c/Section 2. Detailed references are available in the Jirau HPP Investment Analysis Spreadsheet.

[5] Damadoran Website:Betas by Sector, data as of January 2008, line "Utilities". Detailed references are available in the Jirau HPP Investment Analysis Spreadsheet.

[6] JHPP Feasibility Study Report as submitted to the BNDES on 24 June 2008.

[7] Damadoran Website: Corporate Marginal Tax Rates - By country, data for Brazil as of April 2008, available at: http://people.stern.nyu.edu/adamodar/New_Home_Page/datafile/countrytaxrate.htm.

Table 9. CAPM and references for calculating the cost of equity for Brazilian power investments in 2008

The result of 16.05% (real terms/post tax) is a Project Specific Benchmark obtained on the basis of the CAPM for calculating the return on equity for the Brazilian energy generation industry as calculated for the Project Starting Date is specific for the project activity as it takes the specific assumptions for third party financing offered by the BNDES into account. Therefore it is not linked to the specific profitability expectation or risk profile of the investor but represents a general and market based criteria for judging the financial attractiveness of the specific project activity in question. On the other hand, the calculation takes the Brazilian Development Bank's specific policy for the promotion of renewable energies into account. In fact other GHG intensive energy generation technologies are only financed up to a maximum of 50% of the total capital expenditures as will be detailed in Sub-step 2c/Section 2. Such leverage of 50% therefore can be assumed as baseline condition, which also complies with paragraph 18 of the Investment Guidelines which defines that a 50% debt and 50% equity finance structure may be assumed as default value. If this is taken into account to calculate the Standard Benchmark under Baseline Conditions, the Cost of Equity has to be recalculated as follows: Beta adjusted for a 50% debt and 50% equity finance structure is calculated to be 1.05 and consequently the Cost of Equity (Ke) is reduced to 12.46%. Details for the calculation of the project specific benchmark and the benchmark under baseline conditions are available in the Jirau HPP Investment Analysis Spreadsheet. An overview about the values obtained is offered by following Table:

Perspective for calculation of the Cost of Equity	Ke (real terms)
Project Specific Cost of Equity under consideration of the increased leverage as offered by the Brazilian Development Bank (70% debt and 30% equity finance)	**16.05%**

[113] *Same reference as the one previously introduced in the footnote 83, page 22.*

Perspective for calculation of the Cost of Equity	Ke (real terms)
Cost of Equity under baseline conditions with standard financial leverage (50% debt and 50% equity finance)	**12.46%**

Table 10: Cost of Equity (Ke) under project specific and standard assumptions for financial leverage.

In order to further corroborate the validity of the Project Specific Benchmark in of the Jirau HPP project activity it is also of interest to cite the value mentioned by the study "*Environmental Licensing for Hydroelectric Projects in Brazil: A Contribution to the Debate*"[114], which was published by the World Bank on 28 March 2008 in order to assess the regulatory environment and barriers for the implementation of hydropower projects in Brazil. The study was developed in cooperation with relevant Brazilian governmental authorities such as the Ministry of Mines and Energy and the governmental Energy Research Company (*Empresa de Pesquisa Energetica – EPE*). Next to providing a detailed discussion of regulatory risks and costs related to regulation and licensing of hydropower, the study offers a pertinent estimate of the adequate rate of return as necessary to compensate the risks identified for this type of project. According to the main conclusions presented in Chapter IV, paragraph 25:

> *"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%"*[115].

Due to the specific nature of the report, this rate is specific to large hydropower investments in Brazil and its publication date is fully compatible with JHPP's Project Starting Date. Furthermore, the rate is not linked to the subjective profitability expectation or risk appetite of a particular project developer. Considering the specific objective of the study, as well as the prestige and experience of the World Bank and the reference to ANEEL, which is the key regulatory agency of the Brazilian electricity sector, the article fulfils the criteria of being substantiated by an independent (financial) expert and therefore offers a relevant comparator to the result of the CAPM model as developed by the Project Participants.

Now in complement to the Project Specific Benchmark, as well as the Standard Benchmark under Baseline Conditions as calculated above, the Guidance 15 mentioned above also offers to use a default value of 11.75% as equity return as adopted by the CDM Executive Board on the basis of the Information Note[116] submitted by the CDM Meth Panel[117] and as defined for Brazilian Energy Industries in the Appendix to "Guidelines on the Assessment of Investment Analysis" (version 05.0).

Now as can be expected for a generic default benchmark, it has been established on the basis of general and partly global assumptions and premises which do not necessarily apply for the Brazilian context of the specific project activity in question. In fact, when analysing the premises

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[114] Available in Portuguese at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/01/07/000333037_20090107233249/Rendered/PDF/409950v10PORTU1rio1S1NTESE01PUBLIC1.pdf. Last access on 28 August 2012.

[115] A statement from the World Bank confirming that this rate is given in real terms was provided to the DOE.

[116] According to paragraph 28 of the meeting report of EB 62, *"The Board agreed on the revised "Guidelines on the assessment of investment analysis", as contained in annex 5 to this report. The Board also took note that the Meth Panel prepared an information note that outlines the rationale of the default values for the cost of equity that are included in the guidelines, as contained in annex 8 of the report of the fiftieth meeting of the Meth Panel."* Available at http://cdm.unfccc.int/EB/archives/meetings_10.html#62.

[117] The Information Note is available at http://cdm.unfccc.int/Panels/meth/meeting/11/050/mp50_an08.pdf.

that were made by the Meth Panel to define this default value, there are two fundamental reasons which require a more specific approach for the Jirau HPP project activity:

i) **On page 9 the Information Note explains:**
"Studies show that equity returns on utilities sector are historically lower than industrial sector since they are regulated and guaranteed by regulatory body. ***Historically in utility sector there has been no competition and it is a natural monopoly.*** *Only in the developed countries, in recent years, by liberalizing power production and marketing has been made competitive.* ***However in most developing countries, utility sector is still treated as monopoly with a guaranteed return. For these reasons, utility returns are less than industry returns.***

In fact this does not apply for the liberalized Brazilian energy generation business where agents have to compete in a free market and where no minimum returns are being granted by the state or regulator. To the contrary, any cost overrun or delay has to be borne by the generator and energy sales under the regulated or liberalized market have to be honoured on the basis of firm financial guarantees. For this reason the 1% downward adjustment made by the Meth Panel is not justified in the case of energy generation projects in Brazil.

ii) **On page 14 the Information Note explains:**
"To apply the new default equity values, [...] ***cash flow needs to be computed based on 100% equity to ensure consistency."***

This situation does also not apply for the Jirau HPP as the project is financed up to 70% by the BNDES and, due to the high capital requirement, would not make sense from a pure equity perspective. As shown in the PDD, project financing is necessary to make the project viable and the low interest rates offered by the BNDES are necessary to raise the equity return to a level which offers acceptable returns. Though such leverage is clearly beneficial for the projects financial viability, the effect of leverage on the equity investor's risk and therefore expected return has to be taken into account as referenced by standard financial literature, such as Brealey and Meyres (2003), chapter 9, page 229[118].

This evaluation shows that the Project Specific Benchmark as calculated by the Project Participants is effectively more applicable than the default benchmark offered by the Guideline for Investment Analysis, On the other hand the Standard Benchmark under Baseline Conditions as calculated for the default debt / equity financing structure which applies to GHG intensive generation technologies is calculated to be 12.46% and represents an adequate criteria to evaluate the project activity's additionality under baseline conditions. Furthermore this value is broadly in line with the Default Benchmark defined by the Guidelines on Investment Analysis.

Based on these considerations we will use the Standard Benchmark under Baseline Conditions as general criteria for the project activity's additionality and the Default Benchmark as conservative comparator to demonstrate that even when considering this lower benchmark for the return on equity, the project activity requires CDM revenues to be financially feasible.

In conclusion, the Project Specific Benchmark was obtained from the CAPM and defined on the basis of variables that are standard in the market, while taking into account the project specific circumstances and financing conditions. In addition, this project specific benchmark is comparable with the above cited prestigious reference, which was developed and published by the World Bank in cooperation with Brazilian governmental entities and that address specifically the risk and financial cost of hydropower investments in the context of the Brazilian regulatory environment. This Project Specific Benchmark will be used to compare the project activity's IRR under full consideration of CER revenues and all project specific investment incentives offered to the project activity.

[118] BREALEY, R., MYERS, S. "Principles of corporate finance". McGraw-Hill, 2003.

If standard 50% debt and 50% equity financing conditions as applicable to GHG intensive thermal power plants are assumed, which is also in line with the default values defined in Guidance 18 of the Guidelines for Investment Analysis, the Cost of Equity under baseline conditions can be calculated to be 12.46%. This Standard Benchmark under Baseline Conditions will be used for our general additionality discussion.

In addition, the Default Benchmark, as offered as alternative benchmark by the Guidelines on Investment Analysis, is being used for comparison, while taking in mind that the underlying assumptions are not fully applicable for the project activity in question.

Compatibility of the benchmark with the financial indicator calculated

As the equity Internal Rate of Return (IRR) in real terms will be used as a benchmark for the additionality discussion, the financial return of the project will be calculated accordingly, in compliance with the criteria and provisions defined by the "Additionality Tool".

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Options II and Option III)

According to the Additionality Tool, the project participants shall:

- *"Calculate the suitable financial indicator for the proposed CDM project activity.*
- *"Include all relevant costs (including, for example, the investment cost, the operations and maintenance costs), and revenues (excluding CER revenues, but possibly including inter alia subsidies/fiscal incentives, ODA, etc, where applicable).*

For further guidance on the treatment of subsidies/fiscal incentives the Additionality Tool instructs:

- *"See EB guidance on the consideration of national/local/sectoral policies and measures for the baseline setting."*

Following the requirements of the Additionality Tool, the following sections are presented: Section 1 describes the rationale of the investment analysis in a transparent manner, providing all relevant variables and the respective critical techno-economic parameters and assumptions; Section 2 discusses applicable subsidies/fiscal incentives according to the EB guidance on the consideration of national/local/sectoral policies; Section 3 discusses and defines the respective adjustments in the financial model; and Section 4 presents the results of the investment analysis.

The variables and references presented are used in the Jirau HPP Investment Analysis Spreadsheet to calculate the Equity IRR, which is the financial indicator chosen for the discussion of additionality.

Section 1) Assumptions and parameters of the investment analysis:

Even before ESBR was awarded with the effective right to the concession for exploring the hydroelectric potential of Jirau on 22 July 2008, the project participants developed a complete investment summary (*Roteiro de Financiamento do Projeto UHE Jirau*) (hereafter referred to as the JHPP Feasibility Study Report or simply JHPP FSR). This report was submitted to the BNDES on 24 June 2008 as basis for negotiating the terms of the third party financing for the Project Activity. The report describes the Project's investment context as well as all relevant financial variables and assumptions, such as: i) projected revenues from sales of electricity on the free and regulated market; ii) projected capital expenditures (CAPEX) ; iii) projected operational expenditures (OPEX); iv) applicable sector charges; v) applicable taxes, including relevant governmental incentives for investments in Brazil's North region; as well as projected revenues from generation and sales of CERs on the basis of a minimum floor price. In order to have an appropriate base for the investment analysis, and in line with the requirements and operational practices of the BNDES, all

monetary values are defined in real terms as of 30 April 2008, although the references and assumptions were defined between May and 24 June 2008, i.e. before the Project Starting Date. When compared to the project design of 44 turbines and 3,300 MW installed capacity as proposed by the government, the JHPP FSR already considered the possible installation of 46 turbines and therefore an increased total installed capacity of 3,450 MW with an estimated Firm Energy of 2,014.9 MW. This configuration is here referred to as the "Base Case" of the JHPP as the underlying project improvements proposed by ESBR were already considered at the Project Starting Date. In addition, the JHPP FSR clearly describes all relevant project optimisations (i.e: reallocation of the dam to Ilha do Padre) and the resulting economic benefits, including the projected anticipation of the commissioning schedule and thus incremental revenues from electricity sales to the free market. In conclusion, the Jirau HPP FSR is an accurate and reliable reference of the "Base Case" i.e. the optimistic view that the investor had at the Project Starting Date and that was communicated to the BNDES as a basis for negotiating the project financing contract which was finally approved 7 months later, on 18 February 2009[119].

An officially signed copy of the JHPP Feasibility Study Report was provided to the Designated Operational Entity to allow validation of the original investment assumptions. Based on this document, all features and investment assumptions will be explained and referenced in the following Section 1a: Investment Assumptions for the Base Case.

Later, during the construction of the Jirau HPP, ESBR identified further opportunities for capacity additions and initiated the revision of the project engineering and design, as well as their regulatory approval by the responsible entities to seek the implementation of an additional 6 instead of only 2 turbines, i.e. to increase installed capacity to a total of 3,750 MW, based on 50 turbines of 75 MW each. This configuration is referred to as the "Optimised Project". As these optimisation opportunities were not known at the Project Starting Date, they would not have occurred if the Project Participants had not decided to develop the Jirau HPP, in the format and at the location they proposed, in the first place. Consequently, the later implementation of these optimizations depended on the Project implementation itself and as such do not impact the additionality demonstration of the Project, which is to be conducted at the Project Starting Date. Nevertheless, the optimization of the project represents a change in its basic design and in order to show that this change would not have impacted the additionality of the project if it would have been known at the Project Starting Date, the Project Participants follow the principles of Annex 67/EB 48. The Guidelines defines (paragraph 8): "*The re-assessment of additionality shall be based on all original input data, thereby – in case of investment analysis – in principle only modifying the changed key parameters in the original spreadsheet calculations*."

In addition, it is important to recognize that the effective implementation of the Optimized Project, i.e. to invest into an additional 6 turbines and the necessary civil works, took again the CDM revenues into consideration, as was referenced in the beginning of Section B 5 for the discussion of ongoing action to secure the CDM status. Furthermore, the effective implementation was conditional on the sale of part of the incremental Firm Energy to the regulated market under a follow-up auction which took place on 17 August 2011 and was homologated by the regulator on 18 October 2011 by ANEEL[120]. Another part of the incremental Firm Energy still depends on regulatory approval, but the technical maximum has already been calculated by the governmental Energy Research Company EPE[121]. For the purpose of our additionality analysis, the additional Firm Energy sold under the auction, as well as the maximum incremental Firm Energy technically possible, are being considered to project the maximum incremental revenues that result from the optimisation. On the other hand, the incremental investment cost from adding 6 additional turbines

[119] The financing contract was only signed on 29 June 2009, but the approval was granted on 19 February 2009. Available at: http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Sala_de_Imprensa/Noticias/2009/Energia/20090218_jirau.html. Last access on 28 August 2012.

[120] Special Commission on Tendering (Comissão Especial de Licitação – CEL), Process: 48500.000589/2011-01 on homologation of the auction 02/2011

[121] Empresa de Pesquisa Elétrica EPE: *Avaliação Energética das Alternativas de Motorização das usinas do rio Madeira Santo Antônio e Jirau*, Ministério de Minas e Energia, Brasil, 7 November 2011.

is referenced and used as a basis for the calculation of the changes in the economic parameters. Based on these variables, the Optimized Project is presented as an adjustment of the Base Case that considers the Optimized Project configuration as if it would have been known *ab initio*. This means that the incremental Firm Energy and the resulting revenues, as well as the additional capital expenditures strictly related to the optimization[122], are included in the evaluation, while all other parameters are maintained as defined at the project start.

Thus, the expansion will be analysed in the context of the original investment decision in order to demonstrate that the hypothetical knowledge of this opportunity already at project start would not have changed the conclusion of the Project's financial additionality[123].

All applicable features, variables and investment assumptions for the Optimized Project will be explained and referenced in the following Section 1b: Investment Assumptions for the Optimized Project.

Section 1a: Investment assumptions for the Base Case

The equity cash flow analysis of the Jirau HPP was performed in real terms and all underlying references and assumptions were made available to the Designated Operational Entity (DOE) for validation.

All input values and data used in the investment analysis were valid and applicable at the time of the Project Starting Date. The effects of taxing on the cash flow and all applicable generic subsidies and incentives were taken into consideration according to the respective legislation. Bellow an overview of the key assumptions and features of the investment analysis in line with the key criteria, requirements and orientations, as provided by the CDM Executive Board (EB).

General Features of the Investment Analysis and calculation of the Financial Indicator:

The general assumptions are referenced by the JHPP FSR and reflect the expectations and business strategy of ESBR at the Project Starting Date, as well as all improvements identified and proposed by ESBR at that time. As already described, these improvements include: (i) the proposed reallocation of the hydropower plant to Ilha do Padre - which reduced expected total capital expenditures when compared to the original concept – (ii) the anticipation of the generation and sales of energy, as well as (iii) the possibility to increase installed capacity to a total of 3,450 MW. All these preliminary optimisations were fully considered in the capital expenditures, operational cost and revenue projections presented to the BNDES before the Project Starting Date.

In line with the conditions of the concession, the cash flow analysis covers 35 years of construction and operation, after which the project and all installations will revert to the Brazilian Federation, following the concept of Build Operate and Transfer (BOT) adopted by the government[124]. This is also in line with the operational lifetime of the bulb turbines as discussed in section A3 of this PDD[125].

The Financial Model has been developed in real terms and in Brazilian Reais (BRL), which is the local currency, and all values as described below are presented in real terms as of 30 April 2008, which is compatible with the FSR.

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[122] Other cost increases that occurred were not contemplated for this evaluation as they are not related to the optimization, but are consequence of contingencies that were not foreseen at the Project Starting Date and as such are not relevant for determining project additionality at the Project Starting Date.

[123] This procedure is in line with Annex 67 of EB 48, which defined how changes in project design of registered projects shall be treated. Available at http://cdm.unfccc.int/Reference/Guidclarif/iss/iss_guid03.pdf. Last access on 28 August 2012.

[124] This is in line with Article 8 "§ 9 of law 10.848 of 15 March 2004, which defines that concessions for new electricity generation, contracted after the Provisional Decree no 144, of 11 December 2003,will have a duration necessary to amortize the investment, limited to 35 (thirty five) years.

[125] For details please refer to Footnote 34, page 11

- **<u>Revenues from electricity sales :</u>**
  JHPP's only revenues, besides those related to the generation and sales of Certified Emission Reductions, are related to the generation and commercialization of electricity. According to the Brazilian regulation, a generation unit contracted under the regulated and liberalized market can only sell Firm Energy, which is defined by the Brazilian Ministry of Mines and Energy (*Ministério de Minas e Energia - MME*) on basis of a set of technical and hydrological specifications and calculations developed by its Energy Research Company EPE. As the methodology is known, the values can be estimated by investors, but effective sales and remuneration of this Firm Energy is only possible once approved by the MME. For the original project configuration with 44 turbines, the MME had defined a Firm Energy of 1,975.3 MW average (Original Firm Energy), while ESBR had estimated the Firm Energy of its improved project design with 46 turbines located at Ilha do Padre to be 2,014.9 MW[126] average (Base Case Firm Energy).

  According to the applicable rules, 70% of the Original Firm Energy (1,328.71 MW average) shall be sold in the regulated market (referred to as ACR, *Ambiente de Contratação Regulada*) at the price of BRL 71.37/MWh, as defined by the auction. Price is given in real terms as of April 2008 and the PPAs signed on 10 October 2008 define annual adjustment by the general inflation indicator IPCA.

  Another 30% of the Original Firm Energy (592.59 MW average) can be sold through bilateral contracts in the liberalized energy market (referred to as ACL, or *Ambiente de Contratação Livre*). The same was assumed for the possible additional energy related to the anticipation of the plant commissioning and for the incremental capacity of two additional turbines (39.6 MW average). Though the liberalized electricity market is not as transparent as the regulated market and though contracts have a shorter duration, future market prices have been projected on the basis of the supply and demand situation as observed at the time of the Project Starting Date. As referenced by the JHPP FSR, provided to the BNDES on 24 June 2008, an average price of BRL 134 per MWh was assumed for energy sales in the liberalized market.

  In addition to the Firm Energy sold under the ACL and ACR, ESBR estimates that additional revenue is obtained from the sale of Secondary Energy to the electricity spot market. Secondary Energy is not a direct sale of the project, but a *pro rata* compensation for the balance of electricity generation in the context of the Brazilian Energy Reallocation Mechanism (MRE - *Mercado de Realocação de Energia*) where hydropower plants swap and diversify their hydrologic risks according to their Firm Energy. When the entire MRE presents electricity surplus, the resulting revenue from its sales to the spot market is distributed among MRE participants according to the share of their Firm Energy. To the contrary, if the MRE is generating less than its aggregate Firm Capacity, it will purchase the lacking electricity from the Spot Market and equally pass the respective costs to the participants[127].

  In this context, it has been projected that the secondary energy in long term average amounts to approximately 1.5% of the project's Firm Energy and that the average Spot Price is BRL 90/MWh.

  Quantity and price of the Secondary Energy are referenced by the JHPP FSR, provided to the BNDES on 24 June 2008.

[126] As the FSR was submitted to the Brazilian Development Bank to request project financing, this document also complies with the *"Guidelines for the reporting and validation of Plant Load Factors"(Version 01).* This is relevant for the Firm Energy as it, in the context of the Brazilian regulation, implies the Plant Load Factor.

[127] It is important to understand that excess generation of the MRE due to favourable hydrologic conditions imply low electricity Spot Prices and therefore low revenues, while a lack of electricity in the MRE usually implies a high Spot Price and therefore high additional costs.

- **Capital Expenditures:**
  The total projected capital expenditure (total investment) for the Base Case, already including 46 turbines (3,450 MW), was based on a preliminary contract for civil works[128], which accounts for 38% of the total Capex projection, as well as preliminary negotiations and estimates for acquisition of electro-mechanical equipment and other issues and services. The estimations represent the investor's assumption for investment decision as referenced by ESBR's announcement on the Project Starting Date[129] and as had been presented to the BNDES to request financing as referenced by the JHPP FSR. The total estimated amount at that time was 9,000 MBRL[130]. The Capex expenditures are distributed over a construction period of 6 years, starting in 2008, even though generation with the first turbines was projected to start in 2012, the fifth year of construction.

  Depreciation of the total immobilized capital for fiscal purpose was estimated on the basis of law 11.196/2005 from 11 November 2005[131], which offers the possibility of accelerated depreciation for fiscal purposes as a general investment incentive and thus does not provide any comparative advantage for GHG reducing technologies or project. According to this fiscal incentive, the PP's assumption for accelerated depreciation for fiscal purpose is 25 years, while the book value is being depreciated during the economic operational lifetime of 30 years.

- **Operational and Maintenance Cost:**
  Costs for Operation and Maintenance, Insurances, General Administrative Expenses and maintenance of Socio-Environmental programs were projected according to best sector practices and are referenced by the JHPP FSR.

- **Transmission Fees:**
  The Transmission Fee (*Taxa de utilização do sistema de transmisão - TUST*) has been defined by the regulator upfront in the Auction Notice on terms of BRL/MWh dispatched to the SIN. Values are specified for the first years and constant as of 2016.

- **Sectoral Charges:**
  For hydropower plants, such as the Project Activity, a series of sectoral charges apply and have been defined according to the applicable regulations. Applicable charges are Inspection Fees; Royalities for the use of hydro resources; Concession Fees and contributions to Research and Development. Where applicable, sectoral charges have been adjusted for inflation by using the respective economic indicator, to reflect the real terms as of 30 April 2008.

- **Taxes (national, state, and municipal) and sector-specific contributions:**
  All applicable taxes have been defined and treated according to the applicable legislation at the Project Starting Date and the effect of accelerated depreciation has been taken into account accordingly. The regulation which allows accelerated depreciation as well as tax subsidies granted for investments in the Amazon region, which are given independently of the GHG intensity of a project or the technology used, has been fully accounted for in the cash flow.

[128] The contract for Civil Works was signed on 8 May 2008 by Suez Energy Latin America and later transferred to ESBR. In any case the contract only came into force on 14 November 2008 when IBAMA issued the provisional installation license. Before that date, according to clause 29.1, the contract did not imply any obligations or costs, but allowed to have a solid cost estimate of the civil works, which is the major and most difficult to estimate item in the total CAPEX estimate.

[129] *Same reference as the one previously introduced in the footnote 83, page 22*

[130] The effective CAPEX (in real terms as of November 2008) as referenced by the final financing agreement is 10,473 MBRL (*same reference as the one previously introduced in the footnote 119, page 39*).

[131] Available at http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2005/lei/l11196.htm, last access on 9 March 2012.

The table below summarizes all the main parameters used in the cash flow according to their value in real terms as of April 2008. All values presented and referenced are used in the Jirau HPP Investment Analysis Spreadsheet.

i. Revenues from electricity sales[132]			
Item	**Description**	**Unit**	**Values**
Firm Energy sold to the regulated market (ACR1)[133]	The Firm Energy sold to the regulated market is defined by the offered concession agreement to be 1,382.71 MW average after full plant commissioning. Multiplication by count of annual hours (8760) results in MWh of firm electricity sold to the ACR per year. To reflect gradual commissioning of the turbines the regulator has defined a specific incremental Firm Energy profile which is referenced by the FSR and in the Jirau HPP Investment Analysis Spreadsheet.	MWh/year	12,112,540
Electricity Price in the Regulated Market (ACR1)[133]	Defined by the auction which took place on 19 March 2008 and was approved on 22 July 2008. The respective PPAs were signed on 10 October 2008.	BRL/MWh	71.37
Firm Energy available for sales to the Free Market (ACL)	The Firm Energy available for the free market is 592.59 MW average. Multiplication by count of annual hours (8760) results in MWh of firm electricity sold to the ACL per year.	MWh/year	5,191,088
Additional Firm Energy projected for sales to the Free Market (ACL)	On the basis of a possible addition of 2 additional turbines, the Project Participants projected that an additional Firm Energy of 39.60 MW average would be available for sales to the Free Market. Multiplication by count of annual hours (8760) results in MWh of additional firm electricity sold to the ACL per year. Furthermore, the Additional Firm Energy from the projected anticipation of the plant commissioning as projected by the FSR was determined in the Investment Analysis by comparing the ESBR implementation timeline with the official timeline as defined by the regulator.	MWh/year	346,896
Electricity Price in the Free Market (ACL)	Estimated based on evaluation of the balance of supply and demand in the long term as well as applicable market data and referenced by the JHPP FSR.	BRL/MWh	134.00
Secondary Energy	Estimated based on historic data and referenced by JHPP FSR. Secondary Energy is priced at the Spot Market Price.	% of Firm Energy	1.5%
Electricity Spot Market Price	Estimated to be the long term average and referenced by the JHPP FSR.	BRL/MWh	90
Compensation for System	To compensate for transmission losses in the Integrated National System (SIN), the	% of Firm Energy	2.5%

[132] In line with the determination of the Additionality Tool this does not include revenues from the generation and sales of CERs. No other revenues apply.

[133] ACR 1 refers to the conditions applicable to the Regulated Market at the homologation of the first energy auction for JHPP which took place on 22 July 2012 (*same reference as the one previously introduced in the footnote* 1*, page* 2).

Transmission losses	CCEE defines a specific discount which applies to all generation sources connected to the SIN. This value is estimated on the basis of historic average figures as published by the CCEE and referenced by the FSR		
	ii. Capital Expenditures		
Item	**Description**	**Unit**	**Values**
Investment (CAPEX)	Initial projection for the Base Case[134] as announced[135] and applicable for the Project Starting Date and referenced by the JHPP FSR. The estimation of the expenditure profile considered construction start in September 2008 and conclusion in 2013.	BBRL	9,000
	iii. Operational costs		
Item	**Description**	**Unit**	**Values**
Variable O&M costs	Variable costs for operation and maintenance were estimated based on the investor's sector experience and are referenced by the JHPP FSR.	BRL/MWh	2.05
SG&A	Costs for Insurances, General Administrative Costs and maintenance of socio-environmental programs are referenced by the JHPP FSR.	MBRL/year	27.44
	iv. Transmission fee		
Item	**Description**	**Unit**	**Values**
TUST	Transmission fees for the Jirau HPP project were defined by the Auction Notice[136] in financial terms of June 2007 and were adjusted by the applicable inflation rate IGPM to reflect values of 30 April 2008.	BRL / MWh x year	2012 – 14.582 2013 – 14.122 2014 – 13.201 2015 – 12.281 As of 2016 – 11.821
	v. Sectoral Charges		
Item	**Description**	**Unit**	**Values[137]**
TFSEE	Inspection Fee of Electric Energy Services according to Law N° 9427/1996[138] is defined to be BRL 316.48/kW[139] for 0.5% of the Project's installed capacity.	MBRL/year	Calculated
Royalties	Royalties for the use of hydropower	MBRL/year	Calculated

[134] Including 46 turbines (equivalent to 3,450 MW), the anticipation of the official generation timeline and the construction of the dam at Ilha do Padre (Source: JHPP FSR as submitted to the BNDES on 24 June 2008).

[135] *Same reference as the one previously introduced in the footnote 83, page 22*

[136] As referenced by Annex XII of the Jirau Auction Notice: Series for the definition of the Transmission Fee for the Jirau HPP project in terms of June 2007. To make the values compatible with the financial model as developed in real terms of 30 April 2008, they have been adjusted with the General Market Price Index (IGPM) which was 9.01% in the period from 1 June 2007 and 30 April 2008 as referenced by the Inflation Calculator "Cálculo Exato".

[137] Where applicable, values that are defined in terms of 31 December 2007 have been adjusted to reflect real terms of 30 April 2008 by using the variation of 4.18% as applicable for the General Market Price Index (IGPM) in the period. Inflation Indicator have been obtained from the database "Cálculo Exato", available at http://www.calculoexato.com.br/parprima.aspx?codMenu=FinanVariacaoIndice.

[138] Available at: http://www.planalto.gov.br/ccivil_03/leis/L9427compilada.htm Last access on 30 August 2012.

[139] The value of BRL 303.78/kW as defined for December 2007 was adjusted for the applicable General Market Price Index (IGPM) of 4.18% in the period from 31 December 2007 and 30 April 2008.

	resources are defined to be BRL 62.55/MWh [140] on 6.75% of the Firm Energy of a hydropower project.		
CCEE	This fee shall cover the operational costs of the Brazilian Electric Power Commercialization Chamber - *Câmara de Comercialização de Energia Elétrica* – CCEE and was estimated according to the applicable procedures and on the basis of Jirau's projected energy generation.	BRL/MWh	0.0833
Concession Fee	The payment of the Concession Fee (*Uso do Bem Publico - UBP*) is due as from the commissioning of the first generation unit until the end of the concession. It was defined by the Auction Notice of April 2008 and is not adjusted for inflation.	MBRL / year	7.873
R&D Fee	The payment of this fee is defined to be 1% of the project's revenue, net of PIS/COFINS.	%	Calculated

vi. Taxes			
Item	**Description**	**Unit**	**Values**
PIS/COFINS	Calculated according to Brazilian law[141].	9.25 % of Gross Revenue	Calculated
Income Tax	Calculated according to Brazilian law.	25 % of Profit	Calculated
Tax Incentive	As the Jirau HPP is located in an area of federal tax incentive, the Income Tax is reduced by 75% during the first 10 years of operation[142].	75 % Income Tax reduction in year 1-10	Calculated
Social contribution	Calculated according to Brazilian law.	9% of Profit	Calculated

Table 11. Financial Inputs used in Investment Analysis of the Base Case

Section 1b: Investment Assumptions for the Optimized Project.

After having concluded the necessary engineering studies for the expansion and optimisation of the Jirau HPP, which were approved by ANEEL on 29 July 2011[143], ESBR initiated the preparation to arrange the sale of the additional Firm Energy related to all 6 additional turbines on the basis of an A3 Electricity Purchase Tender which was planned for the second half of 2011. In response to this initiative, on 1 August 2011[144], the Ministry of Mines and Energy *(Ministério de Minas e Energia - MME)*, established that the additional Firm Energy for the Jirau HPP for sale under the A3 auction is 209.3 MW average and this quantity of firm energy was effectively auctioned on 17 August 2011 and the result of the auction was declared valid on 18 October 2011[145].

[140] The value of 60.04 BRL/MWh as defined for December 2007 was adjusted for the applicable General Market Price Index (IGPM) of 4.18% in the period from 31 December 2007 and 30 April 2008.

[141] Laws 10.637/02, article 2 (available at: http://www.receita.fazenda.gov.br/legislacao/leis/2002/lei10637.htm) and 10.833/03, article 2 (http://www.receita.fazenda.gov.br/legislacao/leis/2003/lei10833.htm) define the percentage to be paid for PIS and Cofins, respectively.

[142] Federal Law 11.196, Article 32, from 22 November 2005. Available at: http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2005/lei/l11196.htm.

[143] The respective engineering design was approved by ANEEL on 29 July 2011 by publication of Dispatch Nº 3.104/2011 (*same reference as the one previously introduced in the footnote 101, page 26*).

[144] Portaria SPDE 26/2011 (*same reference as the one previously introduced in the footnote 101, page 26*).

[145] As referenced by http://www.aneel.gov.br/cedoc/alel2011002hom.pdf, last access on 9 March 2012.

Following that, on 7 November 2011, and in response to its attribution to identify the optimal energy use of the Madeira hydropower developments, EPE published a study to analyse the Firm Energy which could be obtained from JHPP's configuration with 50 Turbines under different assumptions to subsidize the regulator's decision. Though this discussion is not yet concluded, the results obtained by EPE show that the technical maximum for the current configuration and according to the specifications of the concession is a total of 2,279.4 MW[146] average[147]. This quantity corresponds to a total potential of 94.8 MW average of additional Firm Energy for the Free Market, i.e. 55.2 MW average more than under the Base Case assumptions. Though this has not yet been awarded and might not be fully recognized, the full maximum value has been taken into account for a conservative view of the impact which the hypothetical knowledge about maximum optimisation opportunities could have had on the project's additionality at the project starting date.

In addition to the quantification of the maximal possible Firm Energy of this configuration, the inscription in the energy sales tender implied the definition of the incremental CAPEX. This was defined and approved by EPE[148] on 13 July 2011 to be MBRL 1,514.277 for the 6 additional turbines, which corresponds to MBRL 1,009.518 for the 4 incremental turbines that were added to the JHPPs Base Case. This adjustment is necessary as the Base Case already included the total CAPEX for 46 machines. Consequently, this figure represents all applicable incremental costs for the additional 4 turbines that were added to the Base Case to reach the Optimized Project, including electro-mechanical equipment, additional civil works and other costs related to the expansion, but no costs or expenses related to other items such as unforeseen cost increases of the Base Case.

As the value is given in real terms of August 2011 while we have to assess additionality in the context of the original investment analysis which is, in line with the FSR, based on real terms as of April 2008[149], this value has to be discounted with the applicable inflation rate projection of 4.5% per year as defined by the Brazilian Central Bank in Resolution 3.463 of 26 June 2007 as this was the latest reference available at the Project Starting Date[150]. This simple exercise allows defining the impacts on the incremental CAPEX and revenues in relation to the Project Starting Date in order to assess if the hypothetical knowledge about the possibility of an Optimized Project at the time and in the context of the Project Starting Date would have altered the conclusion about the Project's additionality. A summary of the respective assumptions is provided in the table below:

[146] This calculation considers the maximum operational quota of 90 meters as well as the operational rule defined for the operation of the Jirau reservoir as referenced in Table 2 of this PDD. Furthermore, it considers the rivers specific hydrology since 1967 and an operational quota of 70 m of the Santo Antonio Power Plant, which is under discussion and might increase and thus reduce the Jirau HPPs Firm Energy generation potential. The study also calculates Jirau HPP's Firm energy for increased operational level's of the Santo Antonio Poser Plant, but as the values are lower their use would not be conservative.

[147] Though EPE is the Brazilian government's Energy Research Company and therefore independent, and not contracted by the Project Participant, its study conceptually complies with the requirements of the *"Guidelines for the reporting and validation of Plant Load Factors" (Version 01)*. Any uncertainty about the regulators final decision is mitigated by the fact that the maximum value among different results has been considered, which represents a conservative approach.

[148] EPE – Technical Data – JHPP Expansion. The document is available to the validation auditor.

[149] Just for clarification we remind that the Project Starting Date is 22 June 2008 and that the reference date of the Investment Analysis was defined to allow a coherent evaluation of the project in real terms of that date. Such a date necessarily must be shortly before the Project Starting Date.

[150] An overview about Brazil's the historic inflation target is available on the Central Bank's website. Available at: http://www.bcb.gov.br/Pec/metas/TabelaMetaseResultados.pdf.

i. Incremental revenues from electricity sales for the Optimized Project[151]			
Item	**Description**	**Unit**	**Values**
Incremental Firm Energy sold to the Regulated Market (ACR2)[152]	The Incremental Firm Energy for sale at the Auction on 17 August 2011 was defined by the regulator to be 209.3 MW average. Multiplication by count of annual hours (8760) results in MWh of firm electricity per year.	MWh/year	1,833,468
Electricity Price in the Regulated Market (ACR2)[152]	A price of 102 BRL/MWh was defined by the auction of 17 August 2011 and granted on 18 October 2011. As the price is defined in terms of August 2011 was discounted by the inflation target as applicable at the Project Starting Date, to April 2008, which is the base date of our investment analysis.	BRL/MWh	88.08[153]
Maximum incremental Firm Energy for sales to the Free Market (ACL)	As a consequence of the Project Optimisation, the additional energy available to the free market also increases from the original 632.2 MW average, as referenced above, to 687.4 MW, i.e. by an additional 55.2 MW average. Multiplication by count of annual hours (8760) results in MWh of the incremental firm electricity sold to the ACL per year.	MWh/year	483,552
Electricity Price in the Free Market (ACL)	Same assumption and price as applicable at Project Starting Date, i.e. sales of the Incremental Firm Energy with the conditions and price projected to the liberalized market.	BRL/MWh	134.00
Secondary Energy	Same assumption as applicable at Project Starting Date, i.e. 1.5% of Incremental Firm Energy.	1.5 % of Firm Energy	Calculated
Electricity Spot Market Price	Same price assumption as applicable at Project Starting Date.	BRL/MWh	90
ii. Incremental Capital Expenditures			
Item	**Description**	**Unit**	**Values**
Incremental Investment (CAPEX)	Incremental Capital expenditures are derived from EPEs approved additional CAPEX for 6 turbines as published in August 2011 and then adjusted for 4 turbines and discounted to April 2008, which is the base date of our investment analysis[154]. The assumptions for the expenditure	MBRL	871.6[155]

[151] In line with the determination of the Additionality Tool this does not include revenues from the generation and sales of CERs. No other revenues apply.

[152] ACR 2 refers to the conditions applicable to the regulated market during the second energy auction for JHPP which took place on 17 August 2011.

[153] The value is obtained by discounting BRL 102 at the applicable inflation target of 4.5% for the period between April 2008 and August 2011, i.e. for 40/12 years.

[154] *Same reference as the one previously introduced in the footnote 148, page 46.*

[155] The value is obtained by multiplication of 1,514 MBRL as defined by EPE for six (6) turbines by the factor 4/6 to obtain the value of four (4) turbines and then adjusting the result with the applicable inflation target of 4.5% for the period between April 2008 and August 2011, i.e. for 40/12 years.

	profile have been maintained, i.e. it reflects the hypothetical situation that the incremental Capex would have been part of the original projection.		

Table 12: Financial Inputs used in Investment Analysis of the Optimized Project

The assumptions and values assumed for operational costs, sector charges, financial leverage and taxes remain unchanged, being the same as assumed on Project Starting Date. This approach is in line with the principles of Annex 67/EB 48 and allow the re-assessment of additionality based on the original context. Thus, only the changed key parameters for incremental generation capacity, revenues and CAPEX are changed in the original spreadsheet calculations.

Though this is in line with the applicable CDM rules to illustrate that a hypothetical knowledge of the possibility to expand the project at the Project Starting Date would not have altered the conclusion about its additionality, it is important to mention that this approach represents an unrealistic and excessively conservative representation as it neglects other negative evolutions, such as delays in project implementation as well as cost overruns not related to the expansion (that have not been considered in our evaluation), which had also occurred after the project starting date as referenced by a company press information from February[156]. To only evaluate the impact of positive evolutions on additionality, while neglecting other negative impacts therefore yields a hypothetical and unrealistic result which can only be used to reconfirm the general conclusion about the additionality of the project activity.

Section 2) Sectoral policies that give comparative advantage to less emission intensive technologies and the applicable adjustments for the investment analysis:

In its twenty second meeting and referring to its decisions from EB 16, the CDM Executive Board reaffirmed that national and/or sectoral policies and circumstances are to be taken into account for the establishment of a baseline scenario, without creating perverse incentives that may impact host Parties' contributions to the ultimate objective of the Convention. Accordingly, the Board agreed to define E- policy as:

> *"National and/or sectoral policies or regulations that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (e.g. public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs)"*

Further, the Board agreed that such policies should be addressed as follows:

> E- Policies *"that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) need not be taken into account in developing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place).*

According to the abovementioned information, the additionality tool includes a footnote to the calculation of financial indicators in investment analysis, confirming that the inclusion of *inter alia* subsidies/fiscal incentives in investment analysis is subject to the guidance on such policies.

The importance of this concept has been reinforced by the Conference of the Members of the Protocol, CMP 5 in Copenhagen who provided, as part of the decision 2/CMP.5 on *"Further guidance relating to the clean development mechanism"* the following guidance[157]:

[156] "*Investment budgets of the Jirau HPP is revised to 15.1 Billion Reais", published on 8 February 2012, available at* http://www.jornaldaenergia.com.br/ler_noticia.php?id_noticia=9006.

[157] Available at http://unfccc.int/resource/docs/2009/cmp5/eng/21a01.pdf#page=4, last access on 9 March 2012.

> *10. Affirms that it is the prerogative of the host country to decide on the design and implementation of policies to promote or give competitive advantage to low greenhouse gas emitting fuels or technologies;*
>
> *11. Requests the Executive Board to ensure that its rules and guidelines related to the introduction or implementation of the policies referred to in paragraph 10 above promote the achievement of the ultimate objective of the Convention and do not create perverse incentives for emission reduction efforts;*

According to the summary provided in sub-step 1.b, the current Brazilian energy regulations effectively offer a set of regulatory and economic incentives that aim at promoting renewable electricity sources to satisfy the country's growing energy demand with renewable technologies.

The focus on the development of structuring hydropower projects as well as complementary renewable energy project as a basis for a clean expansion of the Brazilian electricity generation matrix and the special relevance of the Jirau HPP was widely discussed and referenced by governmental sources such as the National Energy Plan 2030 (*Plano Nacional de Energia* - PNE 2030) and the Energy Expansion Plan 2007-2016 (Plano Decenal de Expansão de Energia - PDE 2007–2016)[158], as well as different official declarations at that time. In addition, and as already referenced, the government declared that the Jirau HPP is of strategic interest and a priority project for Brazil. At the same time, the BNDES initiated a process of differentiating its loan conditions for large hydropower plants as referenced by presentations given in August 2007 and March 2008[159], as well as on 24 April 2008[160] when the indicative loan conditions for the Jirau HPP were published.

In parallel to these evolutions, the government initiated its discussions about the establishment of the National Climate Change Mitigation Policy (Política Nacional sobre Mudança do Clima - PNMC), with a first draft submitted to the Brazilian President on June 2008[161], as well as the National Climate Change Mitigation Plan (Plano Nacional sobre Mudança do Clima) which was published for public consultation in September 2008[162] and finally approved in December 2008[163]. Both documents clearly refer to the fact that preferential financing conditions offered by private and public banks, in conjunction with the CDM, are policy tools for the promotion of renewable energy projects and green house gas reduction activities. In addition, the National Climate Change Mitigation Plan makes explicit reference to the BNDES and to the financing line FINEM[164] as a basic tool to promote GHG mitigation activities.

The existence of these incentives requires their adequate treatment in the additionality assessment and specifically in the investment analysis. For this purpose, the following paragraphs identify and discuss the relevant regulations and define their treatment according to the rules and principles defined by EB 22.

In order to allow such an adequate treatment, the Project Participants pursue the following steps (i) and (ii), as described below:

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[158] *Same reference as the one previously introduced in the footnote 64, page 18.*

[159] Copies were made available to the DOE.

[160] *Same reference as the one previously introduced in the footnote 60, page 18.*

[161] *Same reference as the one previously introduced in the footnote 61, page 18.*

[162] Available at: http://www.mma.gov.br/estruturas/169/_arquivos/169_29092008073244.pdf.

[163] *Same reference as the one previously introduced in the footnote 54, page 17.*

[164] FINEM is the specific credit line for large projects with an investment volume of minimum 10 Mio BRL and a strong focus on infrastructure. One of its most important lines is dedicated to the energy sector and generation activities. Further information is available at:

http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Produtos/FINEM/linhas_finem.html.

i. Identification of an E- policy:

The BNDES has historically played a fundamental role in the implementation of the governmental policies for economic development by providing long-term financing for private sector investments in general infrastructure and specifically in the national electricity sector. According to *Lage de Sousa* (BNDES) and *Ottaviano* (Bolonha University)[165]:

> "*Credit constraints for long-term projects are considered among the most important market failures in the Brazilian economy as they hamper the entrepreneurial efforts of local firms. That is why the Brazilian government provides long-term loans through the Banco Nacional de Desenvolvimento Econômico e Social (henceforth, BNDES), a development bank whose main statutory goal is to improve Brazilian economic competitiveness without neglecting broader social aspects. BNDES invests in several areas including research and development, infrastructures, export support, regional and urban development. "Overall, the importance of BNDES in the Brazilian economy is quite sizeable: in 2005 its disbursements reached the value of US$ 20.1 billion, representing 12.3% of aggregate investment."*

The citation shows that the BNDES function is not only to compensate the inability of the private capital markets to provide long term financing at reasonable terms, but also to foster the implementation of governmental policies.

In the years after the privatization of the electric sector and especially after the launch of the new regulatory model in 2005, the BNDES' key priority was financing the expansion of energy supply to allow economic growth and social development. During this period, apart from its specific role in the PROINFA program, the bank did not have a general policy to offer different financing conditions for any kind of electricity source. Now as from 2007 and in light of the increasing participation of fossil fuelled thermal power plants, and the context of the development of the National Policy and Plan for Climate Change Mitigation, the BNDES started to define financing conditions with a clear objective to promote renewable and low GHG intensive energies when compared to coal and oil fired thermal power plants.

The fact that BNDES is an instrument of the Brazilian policy and, specifically, of the National Climate Change Mitigation Policy[166] is referenced by the National Climate Change Mitigation Plan and by the Climate Change National Policy Law. The specific activity in the electricity sector is further referenced by the Energy Research Company (EPE), institution related to the Brazilian Ministry of Mines and Energy, which has issued the policy paper "*Abatement of GHG emissions due to the production and use of energy in Brazil up to 2020*"[167]. The publication clearly describes the importance of the BNDES to implement the Brazilian mitigation policies and to pursue a clean expansion trajectory in the energy sector.

In order to analyze the evolution of the operational policies which define the financing conditions offered by the BNDES, it is necessary to understand the individual items which compose the financial conditions offered by the bank:

Total interest rate = Financing Cost + Basic Spread + Credit Risk Spread

Where:

[165] Lage de Sousa (BNDES) and Ottaviano (Bolonha University): *The effects of BNDES loans on the productivity of Brazilian manufacturing firms*, July 2009, available at http://virtualbib.fgv.br/ocs/index.php/sbe/EBE09/paper/view/1023/354, last accessed on 6 March 2010.

[166] This plan cited directly in the page 115 a summary financing lines, found and BNDES financing instruments related the climate changes combat. The PNMC is available at: http://www.dialogue4s.de/_media/Brazil_National_Climate_Change_Plan.pdf. Accessed on 05 March 2012.

[167] "Abatimento das Emissões relacionadas à produção e ao uso da energia no Brasil até 2020 Versão 2.03 Preliminar, 25/10/2010" ("Abatement of GHG emissions related to production and use of energy in Brazil up to 2020, version 2.03, dated 25 October 2010")..

- Financing Cost - corresponds to the actual cost of BNDES financing, in other words, it is the interest actually paid by the bank to obtain funds necessary to its operations. This cost is primarily defined by the remuneration of the long-term interest rate (TJLP) released by the Brazilian Ministry of Finance. For the purpose of the Financial Analysis of the Jirau HPP, the TJLP has been determined in real terms from the historic inflation[168] and TJLP interest rates[169] between January 2005 and May 2008. Calculations and references are available in the Jirau HPP Investment Analysis Spreadsheet. The result of 2.9% reflect the stable economic period and constant inflation target in the period and therefore represent and adequate basis for the Investment Analysis.

- BNDES Basic Spread – represents the standard return required by BNDES to finance investments. It is the main political tool for financing since it allows the bank to fix remuneration according to the government's priorities and strategies.

- Credit Risk Spread – represents the risk spread required to remunerate the bank for incurring the credit risk of a certain project. As such, it reflects the perception of the creditor's (investors) insolvency risk on the basis of the evaluation of the project's cash flow and the capability to provide additional guarantees. Consequently, this is a project specific variable defined on the basis of technical terms and not subject to any specific policy. For the case of Jirau it was defined[170] that half of the credit will be granted by the BNDES and half by intermediating Banks. For the BNDES' share Credit Risk Spread was defined to be in the range between 0.46% and 2.54%. For the purpose of the Financial Analysis of the Jirau HPP, the Credit Risk Spread was assumed to be in the middle of the two limits, i.e. 1.5% per annum. For the case of the Intermediating Banks, a slightly higher Risk Spread of 1.65% has been assumed. Furthermore BNDES charges an intermediation Spread of 0.5% which applies only for the 50% of the loan which are being intermediated by the Banks. In addition to the credit risk spread, the intermediating banks charge an arrangement and consulting fee which was estimated at project start to be 23.8 MBRL.

For all variables presented above, the BNDES applied, in 2006 and before, identical conditions and criteria for all energy sources and there was no preference for fossil fuel fired thermal sources, neither for renewable sources. This means that Financing Cost, Basic Spread and the criteria for the definition of the Credit Risk Spread as well as the period for amortization and maximum participation from banks were identical for all type of energy sources, regardless of their GHG intensity.

Then, in 2007, BNDES started to improve financing conditions for the renewable energy sector, first for large hydropower and subsequently for all renewable energy sources. As a result, the bank reduced the basic spread for large hydropower projects above 2,000 MW to 0.5%, while the spread for other sources with low GHG intensity, such as wind power plants and small and medium-sized hydroelectric plants was defined to be to 0.9% versus a rate of 1.8% used for coal and oil fuelled generation units.

In addition, BNDES defined a financial cost of funding of 100% TJLP for GHG efficient energy and renewable sources, while coal and oil fuelled power plants are financed on the basis of a mix of

[168] The inflation data is regularly published by the Brazilian Central Bank and the latest report available before the Project Starting Date provides inflation Data until 31 March 2008.

[169] Historic TJLP rates for the period from January 2005 to May 2008 are available from the National Institute for Applied Economics.

[170] The relevant conditions have been defined by the BNDES when the support conditions for the Jirau HPP were announced as already referenced in footnote 60, page 18.

50% TJLP and 50% TJ-462[171]. According to data provided by the BNDES' website, the TJ-462 is equal to TJLP + 1%[172], resulting in a slightly higher financing cost.

On the other hand, there is no difference in Credit Risk Rates between the different types of technologies. These rates vary depending on the specific project and are not directly related to the incentive policy of the bank.

As described above, the BNDES is the main source of capital for energy generation assets through Project Finance, which is adequate to finance capital intensive infrastructural projects with long term maturity. In the specific case of the energy sector, BNDES has defined the objective and conditions to promote the supply of energy with security, reliability, moderate cost and to increase participation of renewable energies. A consequence of this policy is the fact that BNDES applies differentiated financing conditions for energy generation assets other than GHG intensive coal or oil fuelled thermal power plants. These conditions are provided in the following tables, which were reproduced from BNDES's website[171].

Energy generation	BNDES remuneration (% per year)	Financing Cost	BNDES maximum participation (leverage %)
Electricity generation (except coal and fuel oil power plants)	0.9	TJLP	70%
Electricity generation from coal and fuel oil power plants	1.8	50%TJLP 50% TJ-462	50%

Table 13. BNDES financing conditions from different types of energy generation.

Energy generation	Maximum amortization period
Hydro with install capacity above 1,000 MW	20 years
Hydro with install capacity below1,000 MW	16 years
Electricity generation by coal and fuel oil power plants	14 years

Table 14. BNDES maximum amortization period for different types of energy generation.

In addition to these benefits and due to the high relevance of the JHPP for the Interconnected Grid System, the significant capital expenditures and long maturity of this type of investment, the loan conditions for JHPP were further improved by reducing the spread from BNDES of 0.9% to 0.5%[173].

The comparison shows that the financing conditions offered provide a comparative advantage for less GHG emission intensive technologies when compared to GHG emission intensive coal and fuel oil fired thermal power plants.

Consequently, according to the E- provision of the CDM, it is shown that the financing conditions that the BNDES offers to energy generation assets *"give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies"* and they can be classified as direct investment subsidies.

[171] Source: http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Produtos/FINEM/energia_eletrica_geracao.html. Accessed on 16 April 2012.

[172] Source: http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Custos_Financeiros/Composicao/. Accessed on 28 June 2011.

[173] *Same reference as the one previously introduced in the footnote 60, page 18.*

ii. <u>Was the E- policy adopted after 11 November 2001?</u>

A press release from BNDES on 26 September 2006[174] clearly announces the financing conditions for the electricity sector, applicable as of that date. The revised conditions offered are identical for all new generation assets without any differentiation between the various technologies.

This is also confirmed by the BNDES statement[175] for clarification of the financial conditions offered in the electricity generation sector:

> *"Until 2006 the financing conditions offered by the BNDES to electricity generation activities have been identical for all sources of electricity. As of 2007, the BNDES initiated a policy of differentiation of the financial conditions between different generation sources, specifically hydroelectricity, renewable and coal and oil fired thermoelectric plants."*
>
> *"On the basis of a differentiation in basic spread, the extension of the financing duration, next to the increased participation in financing, it was possible to reduce the financial cost of hydropower investments to a level which granted them with competitiveness in relation to the financial cost of coal and fuel oil based generation plants"(BNDES, 2012, translation ours).*

Therefore, it can be affirmed that the E- Policy was not yet in place in 2006 or before, clearly indicating that it was *"implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001)".*

Accordingly the CDM requires that such policy "need not be taken into account in developing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place)".

Section 3) Adjustments to the financial model to account for E- policies:

Following the requirements of the additionality tool and the E- regulation defined by the CDM Executive Board, the Project Developer excluded the direct incentive that the BNDES financing provides to less GHG intensive technologies and conducted the financial analysis based on the financing conditions offered to GHG intensive technologies. This adjustment allows ignoring the effect of the comparative advantage that is given by the Brazilian government to projects that contribute to the ultimate objective of the UNFCCC. Further, it is important to highlight that this treatment eliminates the perverse incentive for developing countries to avoid the adoption of similar incentives.

The following table compares the differences of the financing conditions as granted for the Jirau HPP on 18 February 2009 versus those offered to GHG intensive generation technologies.

Item	Investment incentive for GHG reducing technology (JHPP)	Investment conditions for GHG intensive technology (coal and oil fired thermal power plants)
Loan amortisation	20 years	14 years
Maximum Leverage	70%[176]	50%
DSCR	Minimum of 1.2[177]	

[174] Available at: http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Sala_de_Imprensa/Noticias/2006/20060926_not185_06.html.

[175] This statement was provided by the BNDES on 17 Feburary 2012 to clarify the promotional financing conditions for hydropower and other renewable energies. A copy has been provided to the DOE.

[176] On the basis of the DSCR the Project Participants had estimated that a total leverage of 70% at the Project Starting Date is possible as documented by the JHPP Feasibility Study Report. This number considered revenues from sales of CER to assure that the respective DSCR is met.

Item	Investment incentive for GHG reducing technology (JHPP)	Investment conditions for GHG intensive technology (coal and oil fired thermal power plants)
Financing Cost Indicator	TJLP	50% TJLP 50% TJ 462[178] (meaning TJLP + 1%)
Financing Cost (real terms)	2.90%	3.40%
Basic Spread	0.50%	1.8%
Risk Spread BNDES (50% of loan)	50% x 1.50%	
BNDES Fee for loan intermediation (50% of loan)	50% x 0.50%	
Risk Spread Intermediary Banks (50% of loan)	50% x 1.75%	
Total Interest rate (calculated / real terms)	5.275%	7.075%

Table 15. Differences between Jirau HPP financing conditions with those of GHG intensive technologies

The comparison in the table above shows that the BNDES' financing policy promotes the project activity with an interest rate which is reduced by1.8%, with 20% higher leverage and with a loan amortisation period extended by 6 years. These changes represent a comparative advantage for the implementation of the project activity when compared to GHG intensive generation technologies. This comparative advantage is readily eliminated by considering the financing conditions offered to the more GHG intensive technologies as the baseline condition for the evaluation of the financial additionality of our project activity. Under this perspective, the Standard Benchmark for Baseline Conditions of 12.46% applies as additionality criteria as it reflects the standard financial leverage of 50% offered by the BNDES.

Considering these adjustments, as well as considering the exclusion of any CER revenues, the Project Proponent developed an adjusted financial model on the basis of the assumptions and premises that had been presented to the BNDES in order to evaluate the Project's financial attractiveness under the baseline assumptions.

Section 4) Results of the Investment Analysis:

Following the adjustments and the calculation of the Equity IRR in real terms as referenced by the financial model, it is possible to evaluate if, in the absence of the CDM and of Brazil's national GHG mitigation policy, the project is an attractive investment.

The text box below shows a summary comparison between the Project's financial indicator as calculated for the JHPP Base Case and the Standard Benchmark for Baseline Conditions as defined in section B.5 *Sub-step 2b*:

Equity Internal Rate of Return for the Base Case of 6.8% < Benchmark of 12.46%

[177] The Debt Service Coverage Ratio of 1.2 requires that the operational cash flow generated by the project is 20% above expenditures for interest and loan amortisation. In addition a reserve account equivalent to 6 month of interest and amortisation as well as O&M cost must be maintained by the investor. If the DSCR increases to 1.3, the reserve account is reduced to an equivalent of three month.

[178] http://www.abimaq.org.br/ceimaq/meta3/download/finem.pdf, accessed on 26 February 2010.

The investment analysis was conducted according to option III of the *"Tool for the demonstration and assessment of additionality"* and the result shows that project's financial indicator is less favourable than the standard benchmark of 12,46%. Moreover, the calculated equity IRR is also below the conservative equity default benchmark of 11,75% as offered by the Guidelines for Investment Analysis. Consequently, it can be concluded, that the project activity without CDM revenues and national incentives cannot be considered financially attractive.

In addition, and as already explained and defined in Section 1b, the Project Participants conducted an adjusted investment analysis to evaluate if the hypothetical knowledge at the Project Starting Date of the possibility of increasing the installed capacity to 3,750 MW in order to sell incremental Firm Energy to the Regulated Market (ACR2), as well as the possible increase of additional Firm Energy for commercialization in the Free Market (ACL2) as reflected by the Optimized Project would have altered the conclusion about the additionality of the Project. Therefore, and in line with the rules of Annex 67, the IRR of the Optimised Project was calculated by "*only modifying the changed key parameters in the original spreadsheet calculations*" while all other variables remain unchanged to assure that additionality is reassessed in the context of the economic assumptions and circumstances that applied at the Project Starting Date.

The text box below shows a summary comparison between the project's equity IRR in comparison to the Standard Benchmark for Baseline Conditions as calculated for the JHPP Optimized Project:

Equity Internal Rate of Return for the Optimized Project of 7.5% < Benchmark of

As can be observed, the Project Optimisation indeed improved the Project's financial return, but not to a level that would turn the project into an attractive investment without the consideration of the CDM and the national support policies. This conclusion is solid, regardless if the calculated equity IRR is compared to the standard benchmark of 12,46% or to the conservative default benchmark of 11.75%.

For a better understanding of the results, it is important to observe that, in the absence of the investment incentive granted for the Jirau HPP, the equity investor is required to increase its share as the loan has to be repaid in only 14 years, instead of the 20 years, which is a key condition for the viability of capital intensive projects with long construction time and long term maturity. Also, the higher interest payments due for GHG intensive generation plants reduce the project's capacity to contract financing due to the established limit on the Debt Service Coverage Ratio of 1.2, which is also in line with the fact that the BNDES limits is participation to 50% of the total CAPEX.

Therefore the results show that the support conditions established by the BNDES are fundamental to increase the Jirau HPPs competitiveness to a level where it is viable and able to compete with thermal power projects. In fact, its implementation would be completely unfeasible without the investment policy adopted by the BNDES, as well as the other support regulations and measures established by the government as already cited in Section 1.

In addition to this national support policy, the CER revenue is important to generate enough cash flow to service interest and debt and therefore allow sufficient debt financing to turn the project into an attractive equity investment. This is illustrated by the fact that CER revenues are necessary to allow 70% of leverage as stipulated in the FSR for the Base Case, while still meeting the BNDES's Debt Service Coverage Ratio of 1,2. In addition, part of the BNDES financing is explicitly related to the CDM and allows anticipating part of the projected CER cash flow for the financing of the construction[179].

[179] A copy of the respective supplement to the financing contract has been provided to the DOE.

Now in order to show that this finding is solid also for reasonable variations of the investment assumptions, the next section offers a sensitivity analysis to confirm this finding. The results are offered for the Base Case, as well as for the Optimized Project.

Sub-step 2d. Sensitivity analysis:

The following sensitivity analysis was performed for the project:

i. Variation of Operational Expenditures (OPEX);
ii. Variation of the investments or the total Capital Expenditures (CAPEX);
iii. Variation of the revenues due to changes of electricity prices (ACL & Spot);
iv. Variation of the revenues due to changes in the volume of electricity sales / change in the Firm Energy;
v. Variation of interest rates.

The impact on the IRR is presented in the table below.

Sensitivity Analysis		Equity IRR (%)	
Scenario	**Variation**	**Base case**	**Optimized Project**
Base case	0%	6.8%	7.5%
Operational Expenses	+ 10%	5.6%	6.4%
	- 10%	8.1%	8.7%
Capital Expenditures	+ 10%	4.1%	4.7%
	- 10%	10.5%	11.1%
Change in ACL and Spot Tariff	+ 10%	8.4%	9.0%
	- 10%	5.4%	6.1%
Change in Firm Energy	+ 10%	9.9%	10.4%
	- 10%	3.2%	4.2%
Change in BNDES Interest Rate	+ 1%	6.2%	6.9%
	- 1%	7.5%	8.1%

Table 16. Sensitivity analysis

In order to better understand the results of the sensitivity analysis the following considerations are of interest.

i. <u>Variation of the Operational Expenses (OPEX):</u>

The operational expenditures are related to i) the payment of the transmission fee TUST, which is the main cost item, ii) other sectoral fees and contributions and iii) costs for Operation and Maintenance (O&M) as well as expenses for insurances and general administration (SG&A). Sector fees as well as O&M and SG&A are only of reduced relevance for the profitability of a hydropower project as their economic performance is much more conditioned by the high initial investment. On the other hand, the expenditures for TUST as defined by the regulator are significant in the case of the Jirau HPP and therefore any changes could have an impact on the projects profitability. To take this possibility into account, sensitivity for all operational costs (OPEX) including the transmission fee has been calculated. As one can see from the results, under the Base Case assumption, the reduction of OPEX by 10% would raise the project's equity IRR to 8,1%, which is not enough to turn the project financially attractive. To reach the Standard benchmark of 12.46%, the Opex would have to decrease by 49% in the Base Case and 47% in for the Optimized Project. If the more conservative Default Benchmark is considered, O&M cost would have to be reduced by 43% to meet the stipulated rate for the Base Case or 40% for the Optimized Project. Given the fact that the TUST is defined by the regulator and that O&M, SG&A and other sector fees and expenses are of minor relevance, it

is evident that such a significant a reduction in the operational costs is unlikely to raise the project's IRR to a level which would turn the project into an attractive investment.

ii. Variation of the Capital Expenditures (CAPEX):

Capital Expenditures at the Project Starting Date as referenced by the JHPP FSR were estimated on the basis of initial contracts for civil works as well as on the basis of initial proposals and negotiations. Though such discussions and estimations are conducted with rigueur in order to allow a reasonable structuring of the investment, as well as a solid basis for the negotiations of the third party financing, there is some uncertainty with regards to the final investment cost. In fact this uncertainty is a key disadvantage of hydropower plants when compared to thermal generation units which are not subject to the frequent cost overruns, geological problems and construction delays as it is the case for hydropower plants[180]. Regardless of that, the investors experience allowed to develop an initial minimum budget for the investment, which was estimated to be 9,000 MBRL immediately before the Project Starting Date, as communicated to the BNDES on 24 June 2008 and announced to the public on 22 July 2008[181]. The main expenditures are related to the civil works contract with Camargo Corrêa that came into force on 14 November 2008 and to the purchase contracts for the turbines and generators that were signed in December 2008. These contracts represent more than 50% of the total capital expenditures and most of the projected contracts were signed shortly after, during January and February 2009. Finally, on 18 February 2009, the BNDES financing was granted on the basis of a final projected Capital Expenditure of 10,473 MBRL, which is higher than the initial preliminary estimate used in our investment analysis. Given that initial minimum Capital Expenditures were carefully estimated on the basis of initial contracts and negotiations, a reduction of 10% in the total Capex is unlikely. Now in order to achieve the Standard Benchmark under Baseline Conditions of 12.46%, Capex would have to be reduced by as much as 15% under the Base Case assumption or 13% for the Optimized Project assumptions. If the Default Benchmark of 11.75% is considered, reduction would still have to be 13% for the Base Case or 12% for the Optimized Case. Such material reductions are certainly not a credible possibility. On the contrary, an increase in capital expenditures due to unforeseen contingencies, events of force majeure not covered in the contracts and other costs or delays are quite common in similar projects and represent a material risk to the investors. The fact that this risk is relevant is demonstrated in the financing agreement approved with the BNDES (of 10.473 Billion BRL) and thus, 15% higher than the early estimates that apply for the Base Case at the Project Starting Date. Likewise, the total Capex for the Optimized Project increased to a total of 15.1 Billion, mainly due to costs not related to the addition of the four additional turbines[182].

iii. Variation of the Revenues due to changes of electricity prices (ACL & Spot):

Next to variation in electricity sales volume as discussed below, project revenues can vary due to variations in electricity sales prices. Now to understand the nature of this variable it is important to take into account that the sales price for the major part of the electricity volume was already defined for the whole concession period at the Project Starting Date and no variations are possible. Consequently, only the prices in the ACL and Spot market may vary from the BRL 134 /MWh, respectively BRL 90 /MWh assumed in the investment analysis. If assuming a price 10% higher for the energy negotiated in ACL (i.e. 147 BRL/MWh) and the Secondary Energy sales revenues from in the Spot Market (i.e. 99 BRL/MWh), this would increase the Equity IRR of the Base Case to 8.4%, which is still much lower than the Standard or the Default Benchmark. To reach the Standard Benchmark, both prices would have to increase by 36% on an ongoing basis, while meeting the Default Benchmark would still require an increase of 32%.

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[180] World Bank Discussion Paper No. 420, "*Financing of Private Hydropower Projects*", July 2000; Section 8, Page 65, 2nd paragraph. Available: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2000/08/19/000094946_00081906365947/Rendered/PDF/multi_page.pdf.

[181] As already referenced in footnote *83, page 22*

[182] As already referenced by footnote 156, page 48

For the Optimized Project the results are basically equivalent and do not change the conclusion.

iv. Variation of the Revenues from volume of electricity sales / change in the Firm Energy:

The volume of energy sold by the JHPP is fixed by the Firm Energy as defined by the Ministry of Energy and Mines. This Firm Energy represents the firm generation capacity which is remunerated under the PPAs signed in the regulated or liberalized markets and not the effective generation of the plant which depends on dispatching decisions of the Electric System National Operator (Operador Nacional do Sistema – ONS). In other words, once the Firm Energy of a plant is defined, its sales volume is also defined, irrespective of the effective amount of electricity generated by the plant. For the Base Case, the Firm Energy of the JHPP was estimated in the FSR to be 2,014.9 MW and as this number is calculated on the basis of an established methodology and the river's specific historic hydrology, which is a given figure, no relevant changes are to be expected under the Base Case configuration. In addition, for the Optimized Project with 50 turbines, the maximal technical potential as defined by EPE has been considered[183]. As a conclusion, under the configuration of 46 or 50 turbines, the maximum possible firm energy volume, in both cases above the respective regulatory approvals at that moment, have been considered for the investment analysis and therefore further increases are not an appropriate assumption. In spite of this technical limitation, the Project Participants have modelled the hypothetical situation that the project would be awarded with more Firm Energy, i.e. that the Jirau HPP would have a higher plant load factor than calculated with the standard methodology. As the results show, a hypothetical standard variation of plus 10% would raise the return for the Base Case to 9.9% and for the Optimized Case to 10.4% and thus in both cases the return would remain below the Standard or the Default Benchmark. To reach the benchmarks under the Base Case assumption, Firm Energy would have to increase by 20% to meet the Standard Benchmark, or 17% to meet the Default Benchmark. For the Optimized Project, which had its Firm Energy already estimated at the technical maximum, results are basically an increase of 18% to meet the Standard Benchmark or an increase of 15% to meet the Default benchmark, which is not a realistic assumption. In addition to that it is important to recognize that this financial model assumes that all additional Firm Energy would be sold at the higher price of the free Market, which is another unrealistic assumption.

v. Variation of the interest rate:

The interest rate under the baseline scenario is composed by predefined variables such as the Basic Spread for GHG intensive generation assets, as well as the intermediary fees and a detailed overview is available in Table 15, which also calculates the total interest rate to be 7.075% per annum. Now as already explained, the Risk Spread for the BNDES and the intermediating Banks were not known at the Project Starting Date and thus the final value could be different from the expectation. In addition, the TJLP and the inflation are uncertain and thus it is also reasonable to take these changes into account for the sensitivity Analysis. For this purpose, this exercise adjusts (+/-) the payable interest rate by 1% point, which is equivalent to a variation of about 14%. Now as the results of the sensibility analysis shows, this has no significant impact. A reduction of 1% point of the total payable interest rate increases the Equity IRR under Base Case and baseline assumptions from 6.8% to 7.5%. As demonstrated under the E- assumption, a more significant reduction of 1.8% point in interest rate in combination with an extended payback period of 20 years and a higher leverage of 69% are necessary to bring the equity IRR up to 9.7%. Now in the absence of these measures and the CDM, the interest rate would have to be negative to achieve the Standard Benchmark, as well as the Default Benchmark, which is not a reasonable assumption.

The investment and sensitivity analysis, elaborated according to the CDM rules shows that there are no realistic assumptions that could make the project financially feasible under the baseline conditions and without CDM. On the contrary, the discussion of the sensitivity analysis shows that

[183] The Role of EPE and the assumptions and parameters of this study have been explained in footnote 146, page 46.

there are significant risks for the projects' profitability and that the financial model for the Base Case already includes numerous optimisations and favourable assumptions made by the project proponent prior to Project Starting Date, which were all documented in the FSR and communicated to the BNDES as a basis for the negotiation of the project's financing. It can be concluded that the IRR for the project under baseline assumptions and without CDM revenues is lower than the benchmark for a realistic range of assumptions for the input parameters of the sensitivity analysis, and therefore that the JHPP project activity, in the absence of direct governmental policies and investment incentives and the CDM revenues "is not financially/economically attractive", as defined by the additionality tool.

Given the obvious relevance of the investment subsidy provided by BNDES, it is of interest to evaluate the impact that it has on the financial performance of the project. If all benefits of the E-regulation are taken into account, the Equity IRR for the base case reaches 9.7%, while the equity IRR under the assumptions that characterize the Optimized Project reach a return of 10.9%. Now as these financing conditions define an increased leverage of 70% for renewable energies, it is also necessary to confront these results with the Project Specific benchmark, which has been calculated to be 16.05%, as a result of the increased risk exposure of the equity investor due to high financial leverage. This comparison shows that even if all investment incentives adopted by the Brazilian Development Bank to promote the Jirau HPP project activity and thus the comparative advantage offered to the implementation of the project activity are fully considered for investment analysis, the equity return for the Base Case and the Optimized Project without CERs is below the applicable Project Specific benchmark of 16.05%, and continues to be below the Standard Benchmark, as well as the Default Benchmark.

Now if CER revenues are taken into account according to the numbers projected by the project developers at the Project Starting Date, JHPP's Equity IRR for the Base Case reaches 16.7%, which is above the Project Specific benchmark and thus the project turns into a rational investment.

The results for the Optimized Project are equivalent, though we have to take in mind that they have been calculated on the basis of a hypothetical perspective of the project starting date and therefore do not reflect other evolutions, such as delays or cost overruns. In any case the results show that the conclusion for additionality of the project activity is solid also under the hypothetical assumption that all optimisations would have been known at project starting date.

The following table gives an overview about the Equity IRR projected, after including the effects of the E- regulation and the CER revenues, and the results demonstrate how beneficial a harmonized coexistence of incentives by the international carbon market and by national governments can be for assuring effective and long-term GHG mitigation in developing countries.

JHPP	Equity IRR Base Case	Equity IRR Optimized Project
With E- policy and without CERs	9.7%	10.9%
With E- policy and CERs	16.6%	17.2%

Table 17. Equity IRR projected, after including the effects of the E- regulation and the CER revenues as projected on the Project Starting Date

As it is clearly demonstrated, the project is deemed additional as it was only financially viable on the basis of governmental incentives as well as on the basis of the consideration of CER revenues.

Step 3: Barrier analysis

It is broadly recognized by reputed sources, such as the World Bank (2000)[184] and the IPCC (2011)[185], that hydropower plants face important barriers, among them lack of access to financing due to high capital demand, long construction time and risk of delays and capital overruns. Another important difficulty is high cost for interests during construction, as loans have to be remunerated during the period of project implementation. In recognition of the fact that such barriers exist, the Additionality Tool allows to identify credible and realistic investment barrier when

> *"No private capital is available from domestic or international capital markets due to real or perceived risk associated with investment in the country where the proposed CDM project activity is to be implemented".*

On the other hand, the "Guidelines for objective demonstration and assessment of barriers" (Version 1) defines that:

> *"Barriers that can be mitigated by additional financial means can be quantified and represented as costs and should not be identified as a barrier for implementation of project while conducting the barrier analysis, but rather should be considered in the framework of investment analysis.*

In consideration of this guidance the PPs opted not to implement a Barrier Analysis as the financial barrier has been illustrated in the framework of the investment analysis where we could show that the financial conditions offered by the Brazilian Development Bank to overcome the lack of access to financing from private capital markets contributed to the project's financial viability. The importance of such a policy is illustrated by the World Bank (2000), which recommends *"the availability of longer-term finance at low cost",* to make hydropower projects feasible.

That this was the intention and policy of the Brazilian Development Bank can be understood from a statement[186] provided to clarify the background of its policy:

> *"On the basis of a differentiation in basic spread, the extension of the financing duration, next to the increased participation in financing, it was possible to reduce the financial cost of hydropower investments to a level which granted them with competitiveness in relation to the financial cost of coal and fuel oil based generation plants".*

Now in this context, the CER revenues also played a decisive role by increasing the project's revenues and thus the projects capability to service debt, which allowed increasing the Brazilian Development Bank's loan investment. This illustrated that the CDM was not only necessary to improve the project's financial attractiveness, but that its effect in synergy with national support policies was important to overcoming the financial barriers of the hydropower investment. This is readily illustrated by the financial analysis and thus Barrier Analysis would be redundant.

Step 4. Common practice analysis

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

According to the Additionality Tool, the project participants shall provide an analysis of any other activities that are operational and that are similar to the proposed project activity. "*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."*

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[184] Same reference as already introduced in footnote 180, page 57.

[185] Same reference as already introduced in footnote 11, page 4.

[186] Same reference as already introduced in footnote 175, page 53.

To facilitate and structure the discussion, paragraph 47 of the Additionality Tool (version 06.0.0) has defined a stepwise approach to define and calculate the share of plants which are similar to the proposed project activity as a basis for the demonstration that the project activity is not common practice. The applicable Steps are being followed and discussed below:

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

The proposed project activity was conceived as a run-of-the river hydropower plant with an installed capacity of 3,450 MW. Later, as consequence of optimisations identified by ESBR, the installed capacity was increased to 3,750 MW. Based on these inferior and superior limits, the output range for this project activity to be considered in the common practice analysis is between 1,725 MW and 5,625 MW.

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}.

As the JHPP will be connected to the SIN, the applicable geographical are to identify possibly similar projects is the Brazilian territory. By using the applicable output range calculated in Step 1 from the additionality tool to filter the total of 2,567 power plants in operation before the start date of the project in the entire national territory of Brazil[187], only 4 power plants have been identified to be in this range, being all of them large hydro power plants. There are no wind power plants, solar power plants, fossil-fuelled thermal power plants, biomass or other hydropower plants with an installed capacity within the established range. Therefore, N_{all} is equal to 4. The list of the identified power plants is presented below.

Power Plant	Installed Capacity (MW)	Owner	Power Plant Type	Commissioning Date
Ilha Solteira[188]	3,444	100% Companhia Energética de São Paulo	Hydro	1973
Paulo Afonso IV[189]	2,462.4	100% Companhia Hidro Elétrica do São Francisco (Chesf)	Hydro	1979
Itumbiara[190]	2,080.5	100% Furnas Centrais Elétricas S/A.	Hydro	1980

[187] Source: ANEEL (Brazilian Electricity Regulatory Agency), "Capacidade Geração Brasil" (Brazilian Generation Database), available at: http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp, accessed on 3 February 2012. The information provided in this link is constantly updated by ANEEL to add new plants. The information provided in this PDD has been accessed on 3 February 2012 and new plants with later commissioning dates will be added in the future.

[188] Ilha Solteira HPP is located at the Paraná River between the states of São Paulo and Mato Grosso do Sul and was built by the São Paulo state owned utility CESP and commissioned in 1973. The plant's reservoir has a surface of 1,195 km² and a useful reservoir volume of 5.52 km³ and has an important role for flood control and water regulation. The plant uses a total head of 41.5 m and operates 20 Francis Turbines with capacities between 175 and 181 MW. Details available under: http://www.cesp.com.br/portalCesp/portal.nsf/V03.02/Empresa_UsinaIlha?OpenDocument.

[189] Paulo Afonso IV HPP is part of a hydroelectric complex (Paulo Afonso I, II, III as well as the plant Apolônio Salles) located at the São Francisco river, which was built by the federal utility Chesf in the period between 1955 and 1983. The plant is connected to the reservoir Moxotó, uses a total head of 102.5 m and operates six Francis Turbines of 410 MW each, which were commissioned between 1979 and 1983. Details available at: http://www.chesf.gov.br/portal/page/portal/chesf_portal/paginas/sistema_chesf/sistema_chesf_geracao/conteiner_geracao?p_name=8A2EEABD3BF8D002E0430A803301D002.

[190] Itumbiara HPP is located at the Paranaibá River between the states of Goiás and Minas Gerais and was built by the federal utility Furnas between 1971 and 1981. The plant's reservoir has a surface of 778 km² and a useful reservoir volume of 12.45 km³. The plant uses a variable head which allows effective energy storage and operates six Francis Turbines with capacities of 347 MW each. Details available under: http://www.furnas.com.br/hotsites/sistemafurnas/usina_hidr_itumbiara.asp.

Power Plant	Installed Capacity (MW)	Owner	Power Plant Type	Commissioning Date
Xingó[191]	3,162	100% Companhia Hidro Elétrica do São Francisco (Chesf)	Hydro	1994

Table 18. List of the plants within the range of +/-50% compared to the Project's installed capacity

As a matter of fact these 4 large hydro power plants are all fully owned and are being operated by federal or state owned governmental utilities. In addition, they all have been developed, financed, build and commissioned by these governmental utilities under the State Owned Model as explained under Step 1b and thus before the establishment of the Free Market Model (1995 – 2003) and the New Model which was established in 2004 and which is applicable for the development and implementation of the present project activity.

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 paragraph 9 of the Additionality Tool Different, Technologies in the context of the common practice are technologies that deliver the same output and differ by at least one of several listed criteria, among them the following:

(d) Investment climate in the date of the investment decision, inter alia:
- *(i) Access to technology;*
- *(ii) Subsidies or other financial flows;*
- *(iii) Promotional policies;*
- *(iv) Legal regulations;*

As demonstrated in the table above, four hydro power plants with installed capacity between 1,725 MW and 5,625 MW and that have started commercial operation before the Project Starting Date of the project activity were identified.

Now according to the Step 3 from paragraph 47 and as per the definition of paragraph 9 of the Additionality Tool, different technologies are those implemented in a different investment climate as characterized by different legal regulations. Based on this definition, all four hydropower plants are clearly to be considered different from the presented project activity as they have been developed in a completely different regulatory context by governmental state utilities which underlie completely different investment criteria and which could rely on state budget financing as explained in Step 1b.

Under the applicable regulation, the energy sector was not only dominated by state-owned utilities, but also fully verticalzed and the same companies acted the segments of generation, transmission and distribution. Investments in hydro generation projects were driven by national infra-structure programs defined on the basis of strategic priorities and carried out by federal companies such as Eletrobras, Furnas, and CHESF or state owned utilities such as CESP. Under this model Brazil's largest hydropower plants have been built, including the 4 hydropower plants listed above.

It is needless to say that this regulatory framework did not allow the control of investments by the private sector and that the investment criteria and access to financing as well as the risk profile and

[191] Xingó HPP is located at the São Francisco River, 65 km below the Paulo Afonso complex and the same federal utility Chesf initiated its construction in 1987, but due to financial problems already cited under Step 1b, construction progress was slow and the plant was only commissioned in 1994. The plant uses a total head of 117.9 m and operates six Francis Turbines of 527 MW each.. Details are available under http://siscom.ibama.gov.br/licenciamento_ambiental/UHE%20PCH/UHE%20Xing%c3%b3/EIA_RIMA/UHE-%20XING%c3%93-%20RIMA.pdf and http://www.chesf.gov.br/portal/page/portal/chesf_portal/paginas/sistema_chesf/sistema_chesf_geracao/conteiner_geracao?p_name=8A2EEABD3BFAD002E0430A803301D002.

exposure of state and federal utilities is not comparable to those that apply for the development of the project activity under the new regulatory framework by a private sector company such as ESBR.

Therefore, it is possible to conclude that the 4 identified power plants previously mentioned have to be considered as plants with different technologies once they were built under a different investment climate, conditions and circumstances.

Hence, it is possible to demonstrate and to conclude that $N_{diff} = 4$.

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.

According the Additionality Tool, the proposed project activity is not "common practice" in the Brazilian Electricity Sector as the share of Plants $F = 1 – N_{diff} / N_{all}$ using a technology similar to the technology used in the proposed project activity is Zero and thus below the defined threshold of 0.2. Also the criteria (b) N_{all}-N_{diff}, which calculates the total number of plants that are similar to the proposed project activity yields a value of Zero and thus is also below the defined threshold of 3. The table below shows both conditions are fulfilled and thus that at the time of the Project Starting Date there was no similar operational plant in Brazil.

Parameters	Values/Results
N_{all}	4
N_{diff}	4
$F = 1 - (N_{diff} / N_{all})$	0.00
N_{all}-N_{diff}	0.00

Table 19 - Parameters and values applied in the common practice analysis

Thus, the proposed project activity is not common practice within the identified sector in Brazil.

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

As sub-step 4a has concluded that there are no projects that are similar to the presented project activity no discussion of any such similar options is possible or required and thus, Sub-step 4b is not applicable.

According to the methodology ACM0002 (version 13.0.0), if Sub-steps 4a and 4b are satisfied, (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

According to methodology ACM0002 (version 13.0.0), the emission reductions (ER_y) are calculated as follows:

$ER_y = BE_y – PE_y$

Where:

ER_y = Emission reductions in year *y* (tCO_2e);
BE_y = Baseline emissions in year *y* (tCO_2);

PE_y = Project emissions in year *y* (tCO_2e).

Project Emissions

As per the methodology ACM0002 (version 13.0.0), for most renewable energy project activities, the project emissions are zero ($PE_y = 0$). However, for hydro power plants that result in new reservoir (the JHPP case), project proponents shall account for project emissions, assessed as follows:

The project emissions shall be calculated as follows:

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

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).

The project emissions from fossil fuel consumption ($PE_{FF,y}$) is applicable for geothermal and solar thermal projects only and, according to the methodology ACM0002 (version 13.0.0), any use of fossil fuels for the back up or emergency purposes (e.g. diesel generators) at hydropower plants can be neglected. Therefore, this variable is not applicable for Jirau Hydro Power Plant.

The project emissions from the operation of geothermal power plants due to the release of non-condensable gases ($PE_{GP,y}$) is specific to geothermal project activities only and, therefore, also not applicable for Jirau Hydro Power Plant.

Consequently, $PE_y = PE_{HP,y}$.

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

For hydro power project activities that result in new single or multiple reservoirs and hydro power project activities that result in the increase of single or multiple existing reservoirs, project proponents shall account for CH_4 and CO_2 emissions from the reservoir, estimated as follows:

(a) If the power density of the single or multiple reservoirs (PD) of power plant is greater than 4 W/m^2 and less than or equal to 10 W/m^2:

$$PE_{HP,y} = \frac{EF_{Res} \cdot TEG_y}{1000}$$

Where:

$PE_{HP,y}$	= Project emissions from water reservoirs (tCO_2e/yr);
EF_{Res}	= Default emission factor for emissions from reservoirs of hydro power plants ($kgCO_2e/MWh$);
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).

(b) If the power density (PD) of the power plant is greater than 10 W/m^2:

$PE_y = 0$

The power density of the project activity is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

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 rule to calculate the Power Density as a basis for the definition of Project Emissions was established in EB 23 and defined in Annex 5[192] of the meeting. The decision defines Power Density as "*installed power generation capacity divided by the flooded surface area*". The fact that the surface of the natural river is not to be considered "*flooded surface area*" was later reinforced by the response to the request for clarification AM_CLA_0049[193] which makes reference to the definition of "*flooded surface area*" and requests to know if it is equivalent to the reservoir area without the original river surface. The answer to this request was clear by defining that the real issue to be considered is "*whether or not new areas are flooded because of the implementation of the project hydro power plant".* Based on this principle the response to the request for clarification was clear by determining that the calculation of the Power Density should be calculated on the basis of the: "*increased flooded area measured in the water surface*".

Based on this concept, the Project Participants understand that the Reservoir Area for the calculation of the Power Density should be net of the original river bed as this does not represent "*flooded surface area*". In fact this interpretation is of special relevance to projects which were developed with the specific objective to minimize the additional flooded area by generating electricity with low head directly in the river bed. This arrangement avoids diversion of the river and does not alter flow volumes and the additional flooded area is minimal as most of the run-of-river reservoir is contained to the original river bed. In addition to these general features of low head run-of river hydropower plants, the Jirau HPP adopts an innovative operational rule with variable quota in order to mimic the rivers' original hydrology with high floods in January to March and lower level during the rest of the year. Therefore, an accurate calculation of the reservoir area created by the project would take into account the variation of the reservoir according to the specific season in comparison to the average natural river surface. As shown in Table 2 of this PDD, the reservoir in the dry season is only marginally bigger than the natural river bed and even in the wet season, when the natural river would anyway flood large areas, the increased flooded area is comparable in surface to the average natural river surface.

In this context, abandoning the original principle of calculating Power Density on the basis of the "increased flooded area" provides an undue distortion for projects which were optimized to generate electricity with low head and thus lower installed capacity and energy yield in order to minimize the additional flooded area when the original riverbed itself already corresponds to most of the reservoir surface.

[192] Available at http://cdm.unfccc.int/EB/023/eb23_repan5.pdf

[193] Available at: http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_T74PW4LBX5ZQRSRV57CR6RIKBALHHE.

In spite of this view, the Project Participants decided to calculate the minimum possible Power Density on the basis of the full reservoir surface, including the surface of the original river, at the maximum quota of 90 m.a.s.l. as defined by the operational rules. The data for this calculation were elaborated by Topocart, an independent consulting company, specialized in this field, on the basis of topographic studies[194].

In addition, ESBR will continuously monitor and report the reservoir quota (water level in the reservoir) and the corresponding reservoir surface during the projects operational lifetime, according to the Brazilian regulatory requirements. The results will be continuously reported to the Electric System National Operator (Operador Nacional do Sistema – ONS). In addition, the methodology will be annually revised according to the requirements of the National Water Resources Agency (Agência Nacional de Águas – ANA). This methodology will allow a continuous monitoring of the project activities' Power Density on the basis of the measurement of the reservoir quota and the corresponding reservoir surface on the basis of an official and annually revised methodology.

Based on this concept, the minimal Power Density (PD) has been calculated as follows:

Cap_{PJ} =	3,750,030,000 W
Cap_{BL} =	0 (zero) W
A_{PJ} =	361,600,000 m^2
A_{BL} =	0 (zero) m^2

Thus:

$$PD = \frac{3,750,030,000 - 0}{361,600,000 - 0} = 10.37\ W/m^2.$$

Consequently, as the power density (PD) of the power plant is greater than 10 W/m^2, then, the project emissions are zero (*PEy = 0)*, which is in line with option (b) above. As a result, the equation presented in option (a) above is not applicable.

Nevertheless, as a precautionary measure, the Project Participants will continuously monitor the Reservoir Quota and Area and the Power Density as well as the variables $PE_{HP,y}$, EF_{Res} and TEG_y to allow calculation and discounting of Project Emissions in line with equation available in option (a) above, if, during any period of time, Power Density should temporarily fall below the threshold of 10 W/m^2.

To allow this continuous monitoring all relevant variables are being measured on a daily or hourly basis in order to detect and determine any period of Power Density below the threshold and to allow the pertinent calculation of Project Emissions on the basis of TEG_y as observed during the period in question.
However, as the minimum Power Density calculated at the maximum reservoir surface measure for the maximal operational quota is above the threshold of 10 W/m^2 project emissions are not expected to occur, and PE_y is deemed zero for the purposes of emission reductions estimates.

In case during any period of time during the project operation and monitoring period Power Density is verified to be below 10 W/m^2, Project Emissions (PE_y), will be contemplated for the calculation of the Projects Emission Reduction (ER_y).

As a result, the project's emission reductions (ER_y) will be the baseline emissions (BE_y) minus any applicable Project Emissions (PE_y) as calculated during periods of reduced Power Density below 10 W/m^2. Therefore, $ER_y = BE_y – PE_y$.

[194] Sources: Planilha Informações da Usina_ANEEL_24_out_2011 and topographic study prepared by Topocart (received by ESBR on 3 July 2012).

Baseline emissions

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 ACM0002 (version 13.0.0) 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:

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

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).

JHPP is a Greenfield project, thus, as per the methodology ACM0002 (version 13.0.0), the calculation of $EG_{PJ,y}$ for (a) Greenfield plants is described below:

(a) Greenfield renewable energy power plants

$$EG_{PJ,y} = EG_{facility,y}$$

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).

Leakage

As per the methodology ACM0002 (version 13.0.0), 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 reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y – PE_y$$

Where:

ER_y = Emission reductions in year y (tCO_2e/yr);

BE_y = Baseline emissions in year y (tCO_2e/yr);

PE_y = Project emissions in year y (tCO_2/yr).

The emission factor for the displacement of electricity ($EF_{electricity}$) corresponds to the grid emission factor ($EF_{electricity,y} = EF_{grid,y}$) and the calculation of $EF_{grid,y}$ is done following the procedures established in the “Tool to calculate the emission factor for an electricity system”.

Step 1. Identify the relevant electric power system

As per the "Tool to calculate the emission factor for an electricity system" (version 02.2.1), for the purpose of determining the electricity emission factors, it is necessary to identify the relevant project electricity system. Similarly, it is necessary to identify any connected electricity systems.

If a connected electricity system is located partially or totally in Annex-I countries, then the emission factor of that connected electricity system should be considered zero. This is not applicable for Brazil, where the project activity is located, as Brazil is a non Annex-I country and its connected electricity system is not located partially or totally in Annex-I countries.

According to the "*Tool to calculate the emission factor for an electricity system*" (version 02.2.1), if the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used.

This is applicable for Brazil, where the project activity is located, as the Brazilian DNA published an official delineation of the project electricity system in Brazil, considering a national interconnected system[195].

Therefore, the National Interconnected System (SIN) is defined as the relevant grid to the project activity.

Step 2. Choose whether to include off-grid power plants in the project electricity systems

As per the "Tool to calculate the emission factor for an electricity system" (version 02.2.1), project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.
Option II: Both grid power plants and off-grid power plants are included in the calculation.

The option I was chosen for the project activity, once the operation margin and build margin emission factors calculated by the Brazilian DNA or alternatively calculated by the project developer are based on the data of plants connected to the grid.

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

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods, which are described under Step 4:

a) Simple OM, or
b) Simple adjusted OM, or
c) Dispatch data analysis OM, or
d) Average OM.

The Brazilian DNA is responsible for calculating the OM and BM emission factors in Brazil. For the purposes of calculating the OM emission factor, the Brazilian DNA uses the method c) Dispatch data analysis OM.

For the dispatch data analysis OM ($EF_{grid,OM-DD,y}$), it is necessary to use the year in which the project activity displaces grid electricity and to update the emission factor annually during monitoring.

[195] Brazilian DNA Resolution n.8, dated 26 May 2008, available at http://www.mct.gov.br/upd_blob/0024/24833.pdf, accessed on 15 February 2012.

For emission reductions estimates purposes only, the OM emission factor in Brazil for the year 2010 has been used for the validation process. However, for the verification purposes, the OM emission factor will be annually updated.

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

The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the power units that are actually dispatched at the margin during each hour *h* where the project is displacing grid electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of $EF_{grid,OM-DD,y}$.

The emission factor is calculated as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_{h} EG_{PJ,m} \times EF_{EL,DD,h}}{EG_{PJ,y}}$$

Where:

$EF_{grid,OM-DD,y}$	=	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);
$EF_{EL,DD,h}$	=	CO_2 emission factor for 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;

As previously stated, the emission factor OM ($EF_{grid,OM-DD,y}$) calculation based on the dispatch data analysis method is currently conducted by the Brazilian DNA, in accordance with the dispatch data provided by the National Interconnected Power System Operator (ONS).

In order to estimate the emission reductions for the first crediting period the average $EF_{grid,OM-DD,2010}$ has been used.

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

The Brazilian DNA is responsible for calculating the BM emission factor in Brazil[196].

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: For the first crediting period, 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. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor should be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin

[196] Available at: http://www.mct.gov.br/index.php/content/view/307492.html, accessed on 15 February 2012.

factor shall be calculated ex-ante, as described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

The *Option 1* was chosen for the proposed project.

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 electricity generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

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 electricity generation data is available

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) should be determined as per the guidance in step 4 (a) for the simple OM using options A1, A2 or A3, using for *y* the most recent historical year for which electricity generation data is available, and using for *m* the power units included in the build margin.

The build margin emission factor is calculated by the Brazilian DNA[197] and in case the Brazilian DNA discontinues the publication of these data during the monitoring period, the required data will be calculated by the project participants.

Build Margin emission factor for 2010, as published by the Brazilian DNA, will be used for an ***ex-ante*** estimation of CERs that will be generated as a result of project's implementation. Therefore, the BM is fixed for the first crediting period. The 2010 data vintage was adopted for build margin calculation as it is the latest data available until the beginning of the validation process.

Step 6. Calculate the combined margin (CM) emissions factor

As per the "Tool to calculate the emission factor for an electricity system" (version 02.2.1), the calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following methods:

(a) Weighted Average Combined Margin; or
(b) Simplified Combined Margin.

JHPP Project Activity used option (a) to calculate the combined margin emission factor.

The combined margin emission factor is calculated according to the following equation:

$$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y}$$

Where:
$EF_{grid,BM,y}$ = Build 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);

[197] Available at: http://www.mct.gov.br/index.php/content/view/327813.html#ancora, accessed on 15 February 2012.

W_{OM} = Weighting of operating margin emissions factor (%);
W_{BM} = Weighting of build margin emissions factor (%).

The "*Tool to calculate the emission factor for an electricity system"* recommends that the following default values should be used for W_{OM} and W_{BM}:

- Wind and Solar power generation project activities: W_{OM} = 0.75 and W_{BM} = 0.25 for the first crediting period and for subsequent crediting periods;
- All other projects: W_{OM} = 0.5 and W_{BM} = 0.5 for the first crediting period, and W_{OM} = 0.25 and W_{BM} = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.

This way, for Jirau Hydro Power Plant, it was adopted the following weights: W_{OM} = 0.50 and W_{BM} = 0.50.

Therefore, for emission reductions estimates purposes only, the following values have been considered:

W_{OM} = 0.50;
W_{BM} = 0.50;
$EF_{grid,OM,\ 2010}$ = 0.4787 tCO_2e/MWh[198]; and
$EF_{grid,BM,\ 2010}$ = 0.1404 tCO_2e/MWh[197].

Hence:
$EF_{grid,CM,2010} = w_{OM} * EF_{grid,OM,\ 2010} + w_{BM} * EF_{grid,BM,\ 2010}$
$EF_{grid,CM,2010} = 0.5 * 0.4787 + 0.5 * 0.1404 = 0.3095\ tCO_2/MWh$

NOTE: This is an estimated number with the purpose of calculating the emission reductions estimates for the project activity. Although the Build Margin (BM) is determined as fixed (ex ante) for the first crediting period, the Operating Margin (OM) and the resulting Combined Margin (CM) are to be yearly updated based on data and calculations provided by the Brazilian DNA[199].

B.6.2. Data and parameters fixed ex ante

All the tables below are in accordance with the table template provided in the "Guidelines for completing the project design document form" (version 01.0), EB 66, Annex 8.

Data / Parameter	$EF_{grid,BM,2010}$
Unit	tCO_2 / MWh
Description	Build margin emission factor of the Brazilian Interconnected Grid System (SIN).
Source of data	Brazilian DNA.
Value(s) applied	0.1404[200]

[198] *Same reference as the one previously introduced in the footnote 197, page 70.*
[199] *Same reference as the one previously introduced in the footnote 196, page 69.*
[200] *Same reference as the one previously introduced in the footnote 197, page 70.*

Choice of data or Measurement methods and procedures	The build margin emission factor of the Brazilian electricity grid system is calculated by the Brazilian DNA by applying all steps, data and variables required by the latest version of the "Tool to calculate the emission factor for an electricity system". This data will be archived electronically and according to internal procedures, until 2 years after the end of the crediting period.
Purpose of data	To define the Build Margin emission factor as ex-ante. This data/information will be used for the emission reductions calculation.
Additional comment	This value shall be used for the first crediting period. The build margin emission factor is based on data from the year 2010 and it has been defined as *ex-ante* by the project participants. For more details, see Annex 3.

Data / Parameter	**EF_{Res}**
Unit	$kgCO_2/MWh$
Description	Default emission factor for emissions from reservoir.
Source of data	Decision by EB23.
Value(s) applied	90 $kgCO_2/MWh$
Choice of data or Measurement methods and procedures	This is a default value to be applied in the project emissions' equation to be used only if at any time the power density should fall below the minimum level of 10 W/m^2. Then, the appropriate calculation and consideration of Project Emissions will be taken into account.
Purpose of data	This is a default value to be applied in the project emissions' equation for calculating the emission from the reservoir of the hydro power plant ($PE_{HP,y}$).
Additional comment	Project emissions are not expected to occur. However, in case those unexpected project emissions occur, these will be continuously monitored, actively considered in the monitoring plan and appropriately discounted from the project's emission reductions for the respective period in days that the power density could be lower than 10 W/m^2. For the avoidance of doubt, in case it could be identified that the power density (PD) is in between 10 W/m^2 and 4 W/m^2 during one or more days within a monitoring period, then, project participants will calculate and deduct the project emissions corresponding to the number of days within the correspondent monitoring period (example: if 10 $W/m^2 \geq PD \geq$ 4 W/m^2 for 3 days in 365 days, then, project emissions related to these 3 days will be applied and discounted from the total 365 days).

Data / Parameter	**CAP_{BL}**
Unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity.
Source of data	Project site.
Value(s) applied	0
Choice of data or Measurement methods and procedures	-

Purpose of data	To confirm the installed capacity prior to the project implementation. As this is a Greenfield project and no generation equipment was installed before, CAP_{BL} is zero. This data/information will be used in the power density calculation.
Additional comment	As per ACM0002 (version 13.0.0), for new hydro power plants, this value is 0, which is the case of JHPP.

Data / Parameter	A_{BL}
Unit	m^2
Description	Area of the single or multiple reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full.
Source of data	Project site.
Value(s) applied	0 (zero)
Choice of data or Measurement methods and procedures	As per ACM0002 (version 13.0.0), for new hydro power plants, this value is 0.
Purpose of data	To confirm the surface area of the single or multiple reservoir(s) measured prior to the project implementation. This data/information will be used in the power density calculation.
Additional comment	Although the methodology ACM0002 (version 13.0.0) states that for new reservoirs, this value is supposed to be zero, in accordance with the Clarification from the Meth Panel AM_CLA_0049 [201], submitted on 7 June 2007, *"the correct equation will be the increased power capacity divided by the increased flooded area measured in the water surface".* However, in order to swiftly conclude the validation process, the Project Participants accepted to adopt the area of the river surface (A_{BL}) as 0 (zero).

B.6.3. Ex ante calculation of emission reductions

Project Emissions

As per the methodology ACM0002 (version 13.0.0), for most renewable energy project activities, the project emissions are zero ($PE_y = 0$). However, for hydro power plants that result in new reservoir (the JHPP case), project proponents shall account for project emissions depending on the Power Density (PD), estimated as follows:

Cap_{PJ} =	3,750,030,000 W
Cap_{BL} =	0 (zero) W
A_{PJ} =	361,600,000 m^2
A_{BL} =	0 (zero) m^2

Thus:

$$PD = \frac{3{,}750{,}030{,}000 - 0}{361{,}600{,}000 - 0} = 10.37 \text{ W/m}^2.$$

Consequently, $PE_y = 0$.

[201] *Same reference as the one previously introduced in the footnote 193, page 65.*

Baseline emissions

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity, calculated as follows for the period when the project is fully operational:

$BE_y = (19,967,544) \times 0.3095$

$BE_y = 6,180,620\ tCO_2/year$

Where:

BE_y	= Baseline emissions in year y tCO_2/yr;
$EG_{PJ,y}$	= 19,967,544 MWh[202];
$EF_{grid,CM,y}$	= 0.3095 tCO_2/MWh.

Leakage

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, fuel handling (extraction, processing, and transport), and land inundation (for hydroelectric projects – see above). Project participants do not need to consider these emission sources as leakage in applying this methodology. Project activities using this baseline methodology shall not claim any credit for the project on account of reducing these emissions below the level of the baseline scenario.

Emission reductions

Emission reductions are calculated as follows:

$ER_y = BE_y - PE_y$
$ER_y = 6,180,620 - 0$
$ER_y = 6,180,620\ tCO_2$

As per the formulas presented in section B.6.1., the emission factor key values are presented below:

$EF_{grid,BM,2010} =$ 0.1404 tCO_2/MWh
$EF_{grid,OM-DD,2010} =$ 0.4787 tCO_2/MWh.

The default weights are as follows: w_{OM} = 0.5 and w_{BM} = 0.5, fixed for the first crediting period. That gives:

$EF_{grid,\ CM,\ 2010} =$ 0.5 * 0.4787+ 0.5 * 0.1404 = 0.3095 tCO_2/MWh

NOTE: This is an estimated number with the purpose of calculating the emission reductions estimates for the project activity. Although the Build Margin (BM) is determined as fixed (ex ante) for the first crediting period, the Operating Margin (OM) and the resulting Combined Margin (CM) are to be yearly updated based on data and calculations provided by the Brazilian DNA[203].

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[202] The quantity of net electricity generation projected to be supplied by the project plant/unit to the grid by year corresponds to the Firm Energy of 2,279.4 MW, as defined by EPE (*same reference as the one previously introduced in the footnote 20, page 8*), multiplied by 8,760 hours per year (24 hours/day x 365 days/year), which results in 19,967,544 MWh. Therefore, the Plant Load Factor (PLF) can be obtained by dividing the Firm Energy of 2,279.4 MW by the nominal installed capacity of 3,750 MW, resulting in a PLF = 60.78% (*same reference as the one previously introduced in the footnote 21, page 8*). This rationale is in line with paragraph 3(b) of the "Guidelines for the reporting and validation of plant load factors" (version 01).

[203] *Same reference as the one previously introduced in the footnote 196, page 69*.

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

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e) [204]
From 01/07/14 to 31/12/14	3,090,310	0	0	3,090,310
2015	6,180,620	0	0	6,180,620
2016	6,180,620	0	0	6,180,620
2017	6,180,620	0	0	6,180,620
2018	6,180,620	0	0	6,180,620
2019	6,180,620	0	0	6,180,620
2020	6,180,620	0	0	6,180,620
From 01/01/21 to 30/06/21	3,090,310	0	0	3,090,310
Total	**43,264,343**	**0**	**0**	**43,264,343**
Total number of crediting years	**7**			
Annual average over the crediting period	**6,180,620**	**0**	**0**	**6,180,620**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

All the tables below are in accordance with the table template provided in the "Guidelines for completing the project design document form" (version 01.0), EB 66, Annex 8.

Data / Parameter	$\mathbf{EG_{facility,y}}$ = $EG_{PJ,y}$
Unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y*.
Source of data	Electricity meter(s).
Value(s) applied	9,983,772 MWh for the first calendar year (from 01 July to 31 December 2013) 19,967,544 MWh for the subsequent years.

[204] The combined margin emission factor used for this estimation was calculated using the 2010 operating margin emission factor and the 2010 build margin emission factor (the 2011 build margin emission factor was not available until the date in which the PDD has been published for the global stakeholders' consultation process). These emission factors are made available by the Brazilian DNA through this link http://www.mct.gov.br/index.php/content/view/333695.html#ancora.

Measurement methods and procedures	The following parameters shall be measured: (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. The electricity meters to be installed in the project activity will be "bi-directional" type, therefore, being able to continuously and automatically measure both electricity supplied by the project plant/unit to the grid and the electricity delivered to the project plant/unit from the grid. Moreover, it is expected to occur that the "bi-directional" power meters would directly deliver data already considering the net amount of electricity supplied by the project plant/unit to the grid and without distinction between (i) and (ii) as described above, i.e. by automatically discounting eventual electricity consumptions from the grid from the amount of electricity dispatched to the grid. Further details about measurement methods and procedures are available in section B.7.3 below.
Monitoring frequency	Continuous measurement and at least monthly recording.
QA/QC procedures	Electricity supplied by the project activity to the grid. The quantity of net electricity generation supplied by the project plant/unit to the grid needs to be checked through the CCEE (Electric Power Commercialization Chamber) database, which is the official and the most credible source of information for this purpose. Sales receipts for sold electricity cannot be used for cross-checking purposes as the sales receipts will only indicate the monetary amount to be paid and not the amount of electricity sold to the grid. Nevertheless, this will not affect the monitoring of this parameter or compromise the quality of data, as the purpose of CCEE is to carry out the wholesale transactions and commercialization of electric power within the National Interconnected System, for both Regulated and Free Contracting Environments and for the spot market. In addition, CCEE is in charge of financial settlement for the spot market transactions. These activities form the Energy Accounting and Financial Settlement Process, which is entirely audited by outside auditors, pursuant ANEEL's Normative Resolution nº 109, dated 26 October 2004 (Electric Power Commercialization Convention). The Commercialization Rules and Procedures that govern the activities performed by CCEE are defined and approved by ANEEL[205].
Purpose of data	To quantify the net amount of renewable electricity dispatched to the grid by the project activity. This data/information will be used for the emission reductions calculation.
Additional comment	-

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	3,750,030,000 W, implemented according to the Table 3 schedule.

[205] Information available at: http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=92f6a5c1de88a010VgnVCM100000aa01a8c0RCRD, accessed on 15/02/2012.

Measurement methods and procedures	Visual inspection of the power generation equipments (turbines) installed at the project facility as well as their technical specification available at the nameplates.
Monitoring frequency	Yearly monitored.
QA/QC procedures	Can be cross-checked through the inspection of the technical specification documents or manuals of the power units at the project site.
Purpose of data	To confirm that the installed capacity at the project location is the same as the installed capacity of the project described in the PDD. This data/information will be used in the power density calculation.
Additional comment	-

Data / Parameter	A_{PJ}
Unit	m^2
Description	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data	Project site.
Value(s) applied	361,600,000 m^2 [206]
Measurement methods and procedures	Calculated based on a Quota x Area x Volume curve, being the quota directly measured on the reservoir. The water level will be measured by electronic sensors and specific rulers for this purpose.
Monitoring frequency	The monitoring frequency will be at least once a year.
QA/QC procedures	As required by the ANA (the National Water Resources Agency), through its Resolution N° 269 from 27 April 2009 (Art. 6°, VI), the Quote-Area-Volume curve will be annually updated. The monitoring data will be annually reported to ANA, with the objective of fulfilling controlling and compliance supervision of the conditions established in the concession rights for the use of water resources granted to ESBR.
Purpose of data	To confirm the area of the reservoir measured in the surface of the water at the project location, after the implementation of the project activity. This data/information will be used in the power density calculation.
Additional comment	-

Data / Parameter	$EF_{grid,OM-DD,y}$
Unit	tCO_2 / MWh
Description	Operating margin emission factor of the Brazilian grid.
Source of data	Brazilian DNA[207].
Value(s) applied	0.4787
Measurement methods and procedures	The operating margin emission factor of the Brazilian electricity grid system is calculated by the Brazilian DNA by applying all steps, data and variables required by the latest version of the “Tool to calculate the emission factor for an electricity system”.
Monitoring frequency	The emission factor is calculated ex-post, as described in B.6.3.
QA/QC procedures	Apply procedures in the “Tool to calculate the emission factor for an electricity system”.

[206] Largest reservoir surface area according to map prepared by Topocart and received by ESBR on 3 July 2012 indicating the areas of the JHPP’s reservoir for various reservoir water levels.

[207] *Same reference as the one previously introduced in the footnote 196, page 69.*

Purpose of data	The Operating Margin emission factor shall be used as ex-post during the verifications. This data/information will be used for the emission reductions calculation.
Additional comment	All data and parameters to determine the grid electricity emission factor, as required by the "Tool to calculate the emission factor for an electricity system", were included in the monitoring plan. This is an estimated number with the purpose of calculating the emission reductions estimates for the project activity. Although the Build Margin (BM) is determined as fixed (ex ante) for the first crediting period, the Operating Margin (OM) and the resulting Combined Margin (CM) are to be yearly updated based on data and calculations provided by the Brazilian DNA[207]. For more details, see Annex 3.

Data / Parameter	$EF_{grid,CM,y}$
Unit	tCO_2 / MWh
Description	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".
Source of data	Brazilian DNA.
Value(s) applied	0.3095
Measurement methods and procedures	The emission factor is calculated ex-post, as the weighted average of the dispatch data analysis OM (Operating Margin) and the BM (Build margin), as described in B.6.3.
Monitoring frequency	At least once a year.
QA/QC procedures	Apply procedures of "Tool to calculate the emission factor for an electricity system".
Purpose of data	To calculate the emission reductions achieved by the project activity during the monitoring and crediting periods.
Additional comment	All data and parameters to determine the grid electricity emission factor, as required by the "Tool to calculate the emission factor for an electricity system", were included in the monitoring plan. This is an estimated number with the purpose of calculating the emission reductions estimates for the project activity. Although the Build Margin (BM) is determined as fixed (ex ante) for the first crediting period, the Operating Margin (OM) and the resulting Combined Margin (CM) are to be yearly updated based on data and calculations provided by the Brazilian DNA[207]. For more details, see Annex 3.

Data / Parameter	TEG_y
Unit	MWh/yr
Description	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y.
Source of data	Project activity site.
Value(s) applied	No value has been applied as the Power Density is above 10 W/m^2. Therefore, this parameter is not used for the emission reductions calculation.
Measurement methods and procedures	Electricity meters.
Monitoring frequency	Continuous measurement and at least monthly recording.
QA/QC procedures	-

Purpose of data	This value will be applied in the project emissions' equation for calculating the emission from reservoirs of hydro power plant ($PE_{HP,y}$) just in case project emissions occur, i.e. if power density of the project activity (PD) is between 4 W/m^2 and 10 W/m^2.
Additional comment	Applicable to hydro power project activities with a power density of the project activity (PD) greater than 4 W/m^2 and less than or equal to 10 W/m^2.

B.7.2. Sampling plan

Not applicable.

B.7.3. Other elements of monitoring plan

1. Management Structure and Responsibility

Overall responsibility for daily monitoring and reporting lies with the project owner. Before project starts its commercial operation, a staff will be defined within the owner company to carry out operation and monitoring activities. This staff will receive appropriate training, aiming to comply with the relevant procedures defined for a Type I generation unit[208] and with the requirements established by ACM0002 (version 13.0.0) and the Validation and Verification Standard (VVS)[209].

1.1. Management Responsibility

The manager of the proposed project will hold the overall responsibility for the monitoring process, including the follow-up of daily operations, definition of personnel involved with the monitoring work, revision of the monitored results/data, quality assurance of measurements and the process of training operational staff.

1.2. Responsibility of the personnel directly involved

Other relevant CDM monitoring activities will be carried out by project's personnel[210]. These activities comprise:

- Supervise and verify metering and recording: the staff will coordinate internally with other departments to ensure and verify adequate metering and recording of data, including electricity delivered to the grid, in accordance with national procedures defined by ONS (the operator of the Brazilian national electricity grid system);
- Collection of additional data, sales/billing receipts: the staff will collect sales receipts and additional data such as daily operational reports of the hydro power plant containing both generation as reservoir data;
- Calibration: the staff will coordinate internally to ensure that calibration of the metering instruments is carried out in accordance with national regulations and/or equipment supplier specifications;
- Data Archives: the staff will be responsible for keeping all monitoring data, and making it available to the DOE for the verification of the emission reductions.

[208] Type I includes all generation units that have a centralized programme and dispatch.

[209] Validation and Verification Standard (VVS), version 02.0, dated 25 November 2011, available at: http://cdm.unfccc.int/Reference/Standards/accr_stan02.pdf , accessed on 15 February 2012.

[210] Roles and responsibilities will be clearly defined prior to commercial operation date (COD). A Roles and Responsibilities Flow will be available to the DOE during the first verification.

1.3. Support and Third Parties Participation:

The staff will receive support from the CDM consultants / experts (internal and/or external) in its responsibilities through the following actions:

- Provide the staff with a calculation template in electronic form for calculation of annual emission reductions;
- Provide a specific CDM monitoring training to the personnel involved in the project's operation;
- Follow-up of the monitoring plan and continuous advice to the staff;
- Compilation of the monitored data and preparation of the monitoring report;
- Review of monitoring reports;
- Coordination with DOEs for the preparation of periodical verifications.

2. Measurements Recording and Archiving

Measurements of the energy generated and provided to the grid are conducted in accordance with Procedure 12 (also called Measurement System for Invoicing Purposes[211]) defined by ONS. This Procedure 12 provides technical specifications for energy measurements as the basis for defining both the invoicing of energy sales as the overall control of generated energy by the CCEE (the Electric Power Commercialization Chamber) and also the determination of the demand for the grid-connected users by the ONS.

The Measurement System for Invoicing Purposes (MSIP) comprises two meters (the main meter and the backup one), transformers, communication channels between the Project Developer and the CCEE and data collection systems. Minimal standards for the main and backup meters are also defined by the Procedure 12 (Sub-Module 12.2, Annex 1). Data Collection procedures are also defined in Procedure 25 (Sub-Module 25.2). Storage and backup requirements are also defined the same Procedure (Annex 1, paragraphs 1.2.1.5 and 1.2.1.7).

The amount of energy generated by the project activity will be transmitted from the meters to the Project's Supervision Room. Thus, the data will be stored in the project's database service, from where it can be easily accessed by the project staff and extracted in spreadsheet format. As the MSIP was conceived with the clear purpose of assuring high quality and accurate standards for determining the amount of energy produced by the generators connected to the grid, JHPP data can be also obtained by accessing the CCEE database. As determined by the Procedure 12 (Sub-Module 12.1, paragraph 1.7), "data that are stored in the meters are remotely and automatically collected by the "Energy Data Collection System - EDCS" of CCEE, through a direct access to the agent's installed meters or through the "Measurement Collection Unit" used by the agent. The data collected by EDCS are the basis for quantifying and invoicing the energy produced by the project activity.

Therefore, the adoption of Procedure 12 allows for a proper recording and archiving of measured data and assures that all the data generated throughout the crediting period is maintained in at least three databases (project developer's, CCEE and ONS). For the emission reductions calculation purposes, data from CCEE will be used as the main source of information for determining the net amount of electricity dispatched to the grid by the project activity.

This means that the amount of net electricity dispatched by the project activity to the national grid (SIN) will be constantly monitored by the power meters which are monitored online and regularly checked by the CCEE. This is warranted because CCEE has direct and continuous access to the raw / primary data from the monitoring devices (power meters) at the point in which the project activity is connected to the interconnected grid system (SIN) and thus net electricity is dispatched to the national grid (SIN). The raw / primary data obtained from the monitoring devices (power meters) is stored / recorded in CCEE internal database and its access is restricted to the accredited agents of the electricity sector, as for example: electricity suppliers, electricity consumers, utilities, transmission companies, governmental entities, regulators, etc.

[211] "SMF - Sistema de Medição para Faturamento" in Portuguese.

In addition, by accessing the CCEE database, it is possible to obtain different kind of electricity generation reports. However, as these reports will be derived from the same and unique source (CCEE database), the cross-checking practice becomes redundant and useless being, therefore, not possible to be done. On the other hand, the electricity invoices and/or sales receipts are not suitable for cross-checking purposes, as these documents refer to the values established in the electricity supply contracts or PPAs (Power Purchase Agreements), with a fiscal balance or correction that usually happens after the end of each year as a matter of compensate possible divergences or differences between the amount of electricity contracted and the effective amount of electricity delivered. Hence, the electricity invoices and/or sales receipts will not reflect the accurate amount of electricity dispatched to the grid by the project activity.

Nevertheless, this will not affect the monitoring of this parameter or compromise the quality of data, as the purpose of CCEE is to carry out the wholesale transactions and commercialization of electric power within the National Interconnected System, for both Regulated and Free Contracting Environments and for the spot market. In addition, CCEE is in charge of financial settlement for the spot market transactions. These activities form the Energy Accounting and Financial Settlement Process, which is entirely audited by outside auditors, pursuant ANEEL's Normative Resolution nº 109, dated 26 October 2004 (Electric Power Commercialization Convention). The Commercialization Rules and Procedures that govern the activities performed by CCEE are defined and approved by ANEEL.

In addition, measures that accounts for the water level in the reservoir will be undertaken in accordance with national requirements defined by the ANA (the National Water Resources Agency), through its Resolution N° 269 from 27 April 2009, in articulation with ONS (the Electric System National Operator), as established by the "Grid Procedures" (Procedimentos de Rede), Sub-module 10.8 – Hydraulic Operation of Reservoir Systems (Operação Hidráulica dos Sistemas de Reservatórios), approved by ONS on 17 June 2009 and approved by ANEEL on 5 August 2009 through its Normative Resolution N° 372/09. In this regard, the water level in the reservoir will be daily monitored and reported to ONS and annually reported to ANA. The water level in the reservoir will be used in a Quota x Area x Volume curve, which will allow project participants to calculate the area of the reservoir in the surface of the water, after the implementation of the project activity, when the reservoir is full. Every year, these data and results need to be reported to ANA for its approval and for the purposes of controlling and compliance supervision of the conditions established in the concession rights for the use of water resources granted to ESBR, as well as to adjust or update the Quota x Area x Volume curve on a yearly basis. Therefore, the quota (water level in the reservoir) data will be used for calculating the corresponding reservoir surface area, which will be used for determining the power density (PD) during the operation of the project activity over the crediting and monitoring periods. Although it is not expected, if at any time the power density should fall below the minimum level of 10 W/m^2, the appropriate calculation and consideration of Project Emissions ($PE_{HP,y}$) will be taken into account for number of days in which the power density (PD) is in between 10 W/m^2 and 4 W/m^2 within the correspondent monitoring period.

These information will be kept and archived by the project developer and be made available to the DOE. Other physical documents such as paper-based maps, diagrams and environmental assessments will be collected in a central place, together with this monitoring plan. In order to facilitate auditors' reference of relevant literature relating to the project, the project material and monitoring results will be indexed. All paper-based information will be stored by the project owner and all data including calibration records is kept until 2 years after the end of the total credit time of the CDM project.

3. Quality Assurance and Quality Control

Quality Assurance and Quality Control (QA/QC) of the data generated by the project activity will be done in accordance with centralized requirements for energy projects connected to the national

grid. In order to assure high quality standards, procedures for installation of metering equipment, calibration and quality review are foreseen by the project activity.

After the conclusion of the project implementation and starting of operations, the raw data and primary information related to the net electricity dispatched to the grid by Jirau HPP specifically, which will be available in CCEE internal database, can be accessed (read only) by ESBR through a web based dedicated interface by using a specific access code (named “crypto card”). The information available in CCEE internal database is encrypted and, therefore, protected against any kind of data manipulation or tentative of fraud. Thus, there is no risk for loss or impact on data quality. This is why the CCEE database is the official, primary and the most credible source of information for the purpose of effectively monitoring the amount of net electricity to be supplied by the project activity to the grid.

3.1. Installation of Meters

The installation of JHHP metering devices will be undertaken in accordance with Procedure 12 (Sub-Module 12.2). This procedure provides guidelines for the location, commissioning and integration of energy meters to the grid. Technical information on the accepted meters – in order to fulfill national standards for grid-connected projects – are also included in this procedure.

3.2. Calibration and Periodical Maintenance

The metering equipment will be properly configured and installed as defined in Procedure 12 (Sub-Module 12.2). Calibration is carried out based on the relevant national or industrial standard by a testing facility accredited under the Brazilian law for the required type of meters determined by ONS.

According to the “Grid Procedures” (Procedimentos de Rede), Sub-module 12.3 – Maintenance of the measurement system for billing/invoicing (Manutenção do sistema de medição para fatura), Annex 1, revision 1.1, issued on 16 September 2010, the power meter should be calibrated or verified with a frequency or interval of 2 years.

Maintenance procedures are also foreseen by the Brazilian grid regulations. The Project Developer will elaborate annually a Maintenance Plan that will be verified by ONS as foreseen in Procedure 16 (Sub-Module 16.2). This procedure provides guidelines for reporting to ONS the maintenance activities undertaken by the Project Developer for the equipments described in the Annex 1[212].

3.3. Quality Review of Data

As mentioned on Section 2 of this monitoring plan, the quality of data generated (avoidance of erroneous data measuring) by this project will be assured by the implementation of an overarching monitoring system, as required by ONS in the relevant Procedure 12. This system allows for double-checking of the generated data by accessing project’s internal database as well as CCEE’s one. In addition to this efficient measurement system design, the data generated by the project activity will be periodically revised by the project manager before being submitted to the third parties (CDM consultants and other relevant actors involved in the project activity).

Some other complementary procedures may be applied in order to improve the reliability of the electricity data used for emission reductions calculation include cross-check against other installed meters[213] and against monthly sales receipt, or the Electricity Transaction Notes (ETNs).

[212] Annex 1 specifies the equipments whose maintenance activities shall be reported to ONS. For further information, please refer to Procedure 16 (Sub-Module 16.1, Annex 1), available at: http://www.ons.com.br/download/procedimentos/modulos/Modulo_16/Subm%C3%B3dulo%2016.1_Rev_1.0.pdf.

[213] These meters are not required by ONS. They will be installed by the project developers and will only be accessed for CDM purposes if inconsistencies within measured data are verified.

4. Corrective actions

Procedures for corrective actions will be proposed in the aim of the Annual Maintenance Plan. These procedures aim to provide coordinated solutions to any inconsistency detected during JHHP operation and will be made available for the DOE for the first verification.

5. Verification and Monitoring Results

The verification of the monitoring results of the project is a mandatory process required for all CDM projects. The main objective of the verification is to independently verify that the project has achieved the emission reductions as reported and projected in the PDD.

The responsibilities for verification of the projects are as follows:

- Sign a verification service agreement with specific DOE and agree to a time framework for carrying out verification activities while taking into account specific timeframe established by the buyer. The project developer will make the arrangements for the verification and will prepare for the audit and verification process to the best of its abilities;

- The proposed project owner will facilitate the verification through providing the DOE with all required necessary information, before, during and, in the event of queries, after the verification;

- The proposed project owner will fully cooperate with the DOE and instruct its staff and management to be available for interviews and respond honestly to all questions from the DOE.

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

Date of completion of the application of the baseline study and monitoring methodology: 11 March 2012 (GSC version) and 5 September 2012 (latest version prior to the request for registration).

GDF SUEZ Latin America is responsible entity for application of the baseline study and monitoring methodology.

Contact information:
Contact Person: Philipp Hauser
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SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

22 July 2008 – Note on ratification and granting (*Aviso de ajudicação e homologação).*

C.1.2. Expected operational lifetime of project activity

35 years, including construction and operation

C.2. Crediting period of project activity

C.2.1. Type of crediting period

Renewable crediting period.

C.2.2. Start date of crediting period

1 July 2014 or the registration date, whichever occurs later.

Project Participants requested to postpone the original start date of the crediting period from 01/07/13 to 01/07/14, which was approved by the UNFCCC Secretariat on 16/12/15, as referenced by the project's webpage at the UNFCCC website (Project 9226: Jirau Hydro Power Plant).

C.2.3. Length of crediting period

7 years.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

Description of the Environmental Licensing Process on the level of the Brazilian Federation[214]

Environmental Licensing is a mandatory administrative procedure that precedes the installation, expansion and operation of any facility or activity that could possibly generate pollution or any kind of environmental degradation. One of the most notable principles of this process is the consultation and participation of general society and applicable stakeholders in the decision making through public hearings conducted or supervised by *the* Brazilian Institute of Environment and Renewable Natural Resources (*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis* - IBAMA).

The main criteria, requirements and procedures for environmental licensing in Brazil are defined by Law N° 6938/1981, Complementary Law N° 140/2011 and in CONAMA Decision N° 001/1986 and 237/1997.

As first step of the environmental licensing, the regulating agency, which could be at the municipal, state or federal level, establishes the conditions, restrictions, and environmental control measures to be followed throughout the installation and operation of the facility. At the federal level, and in the case of the Jirau HPP, the Brazilian Institute of the Environment and Natural Renewable Resources (IBAMA) is responsible for environmental licensing.

In accordance with current legislation, the environmental licensing process consists of three main stages, which result in the issuance of the following environmental licenses: i) Preliminary License (*Licença Prévia* - LP); ii) Installation License (*Licença de Instalação* - LI); and iii) Operating License (*Licença de Operação* - LO).

[214] Environmental Licensing for projects of minor scale which are limited to the jurisdiction of one state or one municipality may be licensed by the respective environmental organs of the state or municipality.

To apply for each license, the regulatory environmental agency defines the required environmental studies and documents to be presented beforehand by the owner. The studies required for the environmental licensing shall be prepared by legally qualified professionals.

Based on this information, IBAMA establishes the conditions for each environmental licensing stage, which shall be duly met before applying for the next environmental license and so forth. Therefore, it is correct to conclude that environmental licenses can be expedited solely or consecutively, according to the nature, features and phase of the facility or activity.

i) Preliminary License (LP):

The first stage of the environmental licensing, seeks to evaluate and attest the environmental feasibility of the proposed project on the basis of the Environmental Impact Assessment (EIA) and the Environmental Impact Report (RIMA), which contains the most important information of EIA without using technical terms, since it is addressed to all stakeholders. The EIA/RIMA is a fundamental document for the whole licensing process as it identifies and quantifies all applicable Social and Environmental Impacts as well as the principles for their mitigation. The document must be developed by a competent entity with qualified and legally authorized personnel and on the basis of all applicable requirements and rules. Once the EIA/RIMA is submitted to the IBAMA to request the LP, IBAMA will thoroughly evaluate the document and use it as a basis for its stakeholder consultation process and the applicable public hearings. As a consequence of its analysis and the results of the stakeholder consultation IBAMA will define additional requirements such as studies and complementary assessments. Once all requirements are met and the environmental feasibility of the project is attested. IBAMA will issue the Preliminary License. The LP will approve the location and concept of the project and establish the requirements and conditions which must be met during the following installation phase, taking into consideration the different project alternatives and the proposals presented in the EIA and by the stakeholders. A LP is also necessary for offering the project's underlying hydropower concession in the tendering process.

ii) Installation License (LI):

The second stage of the environmental licensing process is responsibility of the investor which has effectively been granted with the rights to the concession, which is also a precondition for initiating the process for requesting the LI. As a basis for requesting the LI, the investor must develop a Environmental Basic Project (Projeto Básico Ambiental - PBA) which satisfies all the requirements that were defined in the LP. Once the PBA is approved, the LI is issued as a basis for the construction start and shall cover the whole project installation period. The LI authorizes the installation of the plant, according to the specifications of the approved plans, programs and projects, including the environmental compensation and mitigation measures and other conditions, which were defined according to the purpose and specifications of the plant of the facility/activity. Following the issuance of the LI, the PBA is a central document for definition, management control of the projects socio-environmental aspects on the basis of the socio-environmental programs defined and it is used as a basis of IBAMAs ongoing and audits.

iii) Operating License (LO):

The third and conclusive stage is the requesting and issuance of the LO which authorizes the effective operation of the plant. The LO is requested on the basis of a Final Report on the Implementation of the Environmental Programs as defined in the PBA, as well as the Reservoir Land Use Plan (PACUERA) in the case of Hydro Power plants, to be developed and submitted to IBAMA in accordance with IBAMA Normative Rule N˚. 065/2005. After IBAMA has been confirmed that all conditions of the LI have been duly fulfilled the LO is issued with a validity of minimum four and maximum ten years. The LO must be revised in accordance with its validity.

Throughout the whole environmental licensing process between LI issuance and the validity of the LO, which covers the whole operational period of the project, IBAMA will conduct periodic inspections to verify compliance with the environmental conditions included in the different environmental licenses as well as any other commitments defined and undertaken by the investor in the PBA. Thus IBAMA is the responsible environmental deregulatory agency to follow-up and

evaluate and approve the results of each measure/program implemented. As a result and consequence of this role, IBAMA prepares regular technical reports and requests clarifications or corrective actions. The compliance with all requirements of each of the different licensing stages according to the criteria and judgment of the IBAMA is a precondition to reach the next level or, in the renovation of the license after its validity period. This model guarantees that the investor and plant operator will always and continuously follow the criteria and conditions defined in its environmental license and the underlying socio-environmental programs.

Environmental Licensing Process for Jirau HPP

In the case of the Jirau Hydroelectric Power Plant (HPP), the studies for the EIA were developed between 2003 and 2005 by Leme Engenharia Ltda., a specialized consulting company in this field, in cooperation with other companies and entities to gather all applicable expertise and specific knowledge as necessary to address local and regional specificities or various technical aspects of social, physical or biotic dimension. The EIA report presents the results of the studies and a detailed analysis of the factual or possible impacts of all phases of the project on the direct and indirect areas of influence of the applicable facilities. In addition to the EIA and in complementation to the applicable legal requirements a Strategic Environmental Assessment (*Avaliação Ambiental Estratégia* - AAE) of the Madeira River Complex was prepared and submitted to IBAMA in order to add a better view and understanding on the economic impacts, benefits and opportunities related to the implementation of the Madeira hydropower plants in the region.

On the basis of the EIA which addressed all complementary requirements defined by the regulator, as well as the results of all stakeholder consultation as described in Section E, IBAMA issued the Preliminary License N° 251/2007 for the Santo Antonio and Jirau HPPs (Madeira River Complex) on 9 July 2007. On the basis of this LP, which attests the Madeira HPPs environmental feasibility and defines all socio-environmental conditions to be met by the respective investors and concessionaries, ANEEL initiated two separate tenders for choosing and approving investors for the Santo Antonio and the Jirau hydropower concessions. The auction to define the most attractive proposal for the Jirau hydropower concession was held on 19 May 2008 and the results were approved on 22 July 2008, granting ESBR with the effective rights to the concession.

Immediately after having been granted with the rights to the concession, ESBR began the process to obtain the LI for the facility in order to initiate construction as soon as possible, which was vital for the effective project implementation and the ambitious commissioning schedule. As first step of this process, ESBR had to seek approval for its conceptual improvements, which implied construction of the plant at the *Ilha do Padre* instead of the original location at the Jirau Waterfall. In order to seek this approval, ESBR prepared a complete report of the applicable technical and environmental information and specifications as requested by the environmental agency. On the basis of this information a comparative analyses on the social-environmental impacts and the main mitigating/compensation measures of the new plant concept at *Ilha do Padre* versus the former concept at the Jirau Waterfall was developed and submitted to IBAMA. The main features of this comparison are presented in the following table and allow concluding that the revised project design was capable to reduce Jirau HPPs environmental impacts as identified in the EIA.

MAIN ASPECTS	JIRAU WATERFALL (Original layout)	ILHA DO PADRE (Revised layout)
General Layout	The plant location at the Jirau Waterfall would require the removal of two elevations on the river banks and thus excavations of about 100 m in depth. This would be necessary to have enough width of about 2 km with a sufficient low head to allow installation of 44 bulb turbines and 21 sluice gates on the spillway.	The implementation at the *Ilha do Padre* is facilitated by natural width of the river at this location, as well as by a cluster of islands and other suitable topographical conditions. This implies need for less excavation, less waste and disposal sites and thus lower costs and construction time, but does not alter operational conditions of the plant.

MAIN ASPECTS	JIRAU WATERFALL (Original layout)	ILHA DO PADRE (Revised layout)
Amount of Excavation	To allow construction, the complete deviation of the Madeira River with artificial canals excavated out of the rock on the right and left banks would be necessary. According to the Feasibility Study the amount of excavation required would be approximately 49 million m^3.	At the Ilha do Padre the Madeira River separates into two branches, which allows to install the plant without artificial canals for river deviations. As a result, the volume of rock excavation is only about 5 million m^3 which is much less when compared to the original project concept.
Disposal areas	Since less than 25% of the excavated material will be used, enormous disposal areas along the banks would be needed. As there is no space on the right bank, the deforestation of 13 km^2 of preserved forests on the left bank would be required to form a 4 m high pile of unused material.	The reduced excavation of this layout allows eliminating external disposal areas as the residual material can be deposited in stagnant areas that exist just below the dam. This measure eliminates risks of accumulation of macrophytes and disease vectors and the attraction of fish fauna predators.
Flooded Area	The stretch between the Jirau and *Ilha do Padre* axes would already be partially flooded by the backwaters of the Santo Antonio HPP.	An additional flooded area will located in a region already impacted by human activities, but is offset by the reduced need to impact preserved forests for waste deposits and access roads as would be necessary for implementing the project at the Jirau Waterfall.
Fish Ladders	At the Jirau Waterfall the natural land is relatively steep, which would require the installation of a very curvy fish transposition canal to overcome the elevation change with a suitable slope.	The *Ilha do Padre* location offers smooth elevation and thus better topographical conditions to install a fish ladder along either of the two river arms. These more favorable conditions are the result of natural thalwegs located downstream on both river banks.
Physical / Biotic Flows	At the Jirau Waterfall, the upstream migration of fish during the construction phase would be inhibited, since the fish would need to swimming through the artificial canal in the rock, which will have a fast current. In addition, the descent of eggs, larva and small fish would be jeopardized during the dry months and natural predators would be attracted to the stagnant water areas where fish fauna would concentrate.	At the *Ilha do Padre*, during the whole construction period, river can be deviated in the natural river bed, which represents much less change and impact for the physical and biotic environment. The reduced flow speeds in the natural canal will allow natural sediment flow and migration of, fish, spawning, larvae and other physical and biotic elements during the construction period of the plant.
Accumulation of Macrophytes and Mosquitoes	In the original project, stagnant water areas would form in the reservoir in front of the spillway when it is not operational, i.e. during nine months of low water levels per year. This would hinder the flow of sediments downstream and facilitate the proliferation of macrophytes and mosquitoes.	With the *Ilha do Padre* layout dead zones are avoided and thus the risk of accumulations of macrophytes and malaria vectors is reduced.

Table 20. Main social-environmental aspects related to the change in project location

Based on this revised project concept and with the objective to initiate project construction as soon as possible, ESBR initiated on 23 July 2008[215], and thus immediately it could do so after having been granted with the rights to the concession, the first step to obtain the Installation License. Initially, ESBR registered the specific Environmental Basic Project for the construction site with IBAMA, in order to obtain a specific LI to prepare and install the construction site for the facility. On

[215] As referenced by footnote 85, page 22.

23 October 2008 after addressing additional requirements made by IBAMA, ESBR registered the Environmental Control Report (RCA) for the initial construction site with the environmental agency. Following that and an intense process of information exchanges, additional public hearing with stakeholders and further revisions, IBAMA issued LI N° 563/2008 on 14 November 2008 in order to authorize the installation of the initial construction site for the Jirau HPP at *Ilha do Padre*[216].

Following that, the complete version of the Environmental Basic Project (PBA) to cover the entire Jirau HPP, was registered with IBAMA on 10 December 2008. The PBA consists of the detailed description of the environmental and social programs regarding Jirau HPP proposed requested by the original EIA, as well as additions developed to address requirements made by IBAMA in the conditions of Preliminary License N° 251/2007, as well as the results and voluntary commitments defined and incurred during the progress of the facility licensing process. The purpose of the environmental and social programs included in the PBA is to define and document the mitigation measures as approved by IBAMA and required to be implemented by ESBR, as well as to allow their ongoing control and audit.

In conclusion, the PBA is the main social and environmental management instrument of the plant and currently includes 22 physical and biotic programs and 11 socio-economic programs. Section D.2 provides a complete overview of all 33 social and environmental programs. It is worth mentioning that the PBA revision registered in 2008 contained 29 programs, and following specific requirements from IBAMA, four additional programs were defined[217]. Approval of the PBA by the environmental agency resulted in the issuance of LI N° 621/2009 for the facility on 3 June 2009, which is valid for four years.

In addition and in parallel to the process of obtaining and fulfilling the conditions outlined in LI, on 1 October 2010, ESBR also requested IBAMAs approval for the changes which configure the Optimized Project which imply the expansion of the installed capacity of the facility from the original 44 to a total of 50 generator units. After intense technical information exchanges between ESBR and the environmental agency, on 19 April 2011 IBAMA issued Directive N° 361/2011/DILIC/IBAMA, which concludes that there are no technical obstacles for the installation of the six additional generator units at the Jirau HPP project as requested by ESBR.

The Operating License (LO) for Jirau HPP shall be obtained before the start of commercial operations, currently estimated for October 2012.

Monitoring the Environmental Licensing Process

Following condition 2.1 of LI N° 621/2009 ESBR shall develop and submit bi-annual follow-up reports on the implementation and evolution of Jirau HPP's socio-environmental programs. To date, five reports have been submitted to IBAMA, covering the status and main results obtained for each of the programs, in addition to compliance status of the conditions outlined in LI. Based on a critical evaluation and assessment of the reports, IBAMA defines additional requirements that seek the continuous improvement in the Social-Environmental Programs, i.e. to further mitigate impacts and maximize benefits of the project and the related programs.

The consolidated report presented to IBAMA on 5 October 2011 (correspondence AJ/TS 1763-2011) is a consolidation of all activities conducted and the results obtained since the issuance of LI

[216] To support the issue of LI for the initial construction site, the following IBAMA technical opinions are available for review: 1) Technical Opinion N°. 61/2008, in reference to the analysis of the documents related to the environmental implications of changing the location of the project from Jirau Waterfall to Padre Island; 2) Technical Opinion N° 63/2008 in reference to the analysis of the Environmental Control Report (RCA) / Environmental Control Plan (PCA) / Recovery Plan for Degraded Areas (PRAD) related to the initial construction site; 3) Technical Opinion N° 93/08/GAB (PFE/IBAMA/ICMBio/Sede) in relation to the analysis regarding the legal aspects involved in the environmental licensing of Jirau HPP.

[217] The programs added were: 30) Program to Monitor and Support Fishing Activities; 31) Program to Manage Submersed and Floating Tree Trunks and Debris; 32) Downstream Action Program; and 33) Monitoring Program for Areas Subject to Instability along the Hillsides and River Banks.

N° 621/2009 on 3 June 2009 and up to May 2011. The scope and the main issues of each of the socio-environmental programs, as listed in the Consolidated Report are presented in Section D.2.

On 9 March 2012, ESBR presented the fifth semestral report to IBAMA (correspondence AJ/TS 465-2012) which included the activities developed from June to November 2011. In addition to the bi-annual reports, IBAMA has made periodic inspections at the Jirau HPP construction site, as well at the urban construction site of the new residential district called Nova Mutum Paraná, which is result of a voluntary program proposed by ESBR, as well as other areas where the social-environmental programs outlined in the PBA are being implemented. These audits verify the progress of the activities and seek to identify any non- conformities or possible improvements.

In addition, as outlined in condition 2.1, periodic technical seminars are held for follow-up of the social-environmental programs. To date, two technical seminars have been held for the biotic community programs, two workshops covering the physical environment programs and one seminar on the socio-economic programs. It is important to note that the development of the technical seminars is complementary to the various work groups and committee created by ESBR for continuous follow-up of the programs and direct involvement of applicable and interested stakeholders. The work groups and Committee, as well as their objectives, are presented in Section E.1 of this PDD.

Voluntary social and environmental programs proposed and implemented by ESBR

As from the beginning of the process ESBR actively seeked to identify actions, programs and activities that were capable to reduce the projects socio-environmental impacts and to maximize its benefits. The most important action in this respect was the redefinition of the project's layout and location at *Ilha do Padre*, which was capable to reduce the Project's environmental impacts. Another key optimization was the expansion of the Project's generation capacity which will offer more energy without any incremental socio-environmental impact. Now in addition to these actions, which have been thoroughly described in the PDD, the following additional voluntary actions have been suggested and defined by ESBR:

a) Sustainable District Nova Mutum Paraná

To assure that the economic impulse that the construction of the Jirau HPP has for the region can be catalyzed into a permanent improvement of the local economy and living standard, ESBR established a novel concept with the creation of the sustainable district Nova Mutum Paraná. This new urban centre was designed to offer attractive housing and economic opportunities as well as all necessary urban infrastructures to assure good quality of live and social integration. One of the objectives of this Project was to offer an attractive alternative to 199 families that had to be resettled from the old Mutum Paraná district as well as other rural dwellings in the region. These families had been living under poor conditions with a low HDI and without access to waste and effluent treatment.

Nova Mutum Paraná is a city with 1600 houses and paved roads on an area of 4,000,000 m^2. The city offers schools for 900 students and centres for training and education of professionals, health centres with medical service, social services, facilities for sport and leisure as well as facilities for waste and effluent treatment. In addition ESBR has contracted Fundação Getulio Vargas to develop and implement an economic study to identify economic activities that are capable to diversify the local economy and offer long term sustainable income to the citizens of Nova Mutum and the region.

The total investment for the project is R$ 256 million, which were financed on the basis of a novel kind of loan agreement with the BNDES who was interested to promote this strategy as an efficient way to induce regional sustainable development on the basis of the education and qualification of the local population and new economic opportunities as well as incentives that encourage activities that promote economic, human, social and cultural development

b) Pilot Project for integrated organic agriculture and fish farming

This is an initiative established by ESBR in partnership with the NGO ProNatura Institute to develop and implement small scale sustainable economic activities for the communities that live around the Jirau HPP reservoir. The program started in 2011 and initially benefits 35 families with the professional capacity needed to autonomously implement and conduce the activity. The program seeks to consolidate these sustainable entrepreneurships in the region and to assure that they turn into a self standing and independent economic activity for the interested population.

c) Program for Healthy Kids, Healthy Future

This health program was initiated in August 2011 on the basis of a partnership between the NGO INMED, ESBR and the Municipality of Porto Velho and seeks to improve the quality of live and nutrition of children that live in vulnerable social groups. The program covers 11 municipal schools in the direct and indirect area of influence of the Jirau HPP and supports 3,000 children with an age between five and twelve years. The program offers treatment for children with parasites and nutritional deficiencies as well as education in basic disease prevention, health care and nutrition for the Municipality's health workers and teachers as well as the population itself. In addition it organizes the establishment of community gardens to produce crops and vegetables that can improve the children's nutrition.

D.2. Environmental impact assessment

The social-environmental impacts identified for Jirau HPP are described in the Environmental Impact Study (EIA), Part C and summarized in the Consolidated Impact Evaluation Matrix herein. The impacts were classified by the phases of the facility, including the phases of (i) planning and design; (ii) construction of the facility; (iii) filling the reservoir / plant operation. The main project impacts are related to phases (ii) and (iii) and were subdivided into social-economic impacts, physical medium impacts and biotic medium impacts. For each of the impacts identified, general mitigation strategies were suggested that were then converted into social-environmental programs within the scope of the PBA. The development of the Social-Environmental Programs for Jirau HPP considered the proposals presented during the public hearings as well as the requirements and recommendation from the environmental agency outlined in LP and LI. The following table presents the main impacts identified in EIA/RIMA and the respective Mitigation Programs for the Construction phase and the Reservoir Filling / Plant Operation phases.

SOCIAL-ENVIRONMENTAL IMPACTS	MITIGATION PLANS
FACILITY ERECTION	
SOCIAL-ECONOMIC IMPACTS	
Alteration in the population's social and political organization	Social Compensation Program Social Communication Program Relocation Program for the Population Affected
Increase in the Incidence of Malaria and Other Diseases	Public Health Program Social Communication Program Social Compensation Program Environmental Education Program
Occupation of New Areas	Relocation Program for the Population Affected Reservoir Land Use Program
Commitment to riparian communities	Relocation Program for the Population Affected Reservoir Land Use Program
Alteration in the population's quality of life	Social Compensation Program Follow-up Program for Mineral Rights and Prospecting Activities Monitoring and Support Program for Fishing Activities Environmental Education Program Relocation Program for the Population Affected
Alteration in the dynamics of vector populations	Public Health Program Social Communication Program Environmental Education Program Social Compensation Program Erection Environmental Program (PAC)
Commitment to the Mutum-Paraná urban center	Relocation Program for the Population Affected Social Compensation Program
Relationship Conflicts between the Local Population and Migrants	Social Compensation Program Social Communication Program
Interference and loss of archeological property and other cultural assets.	Prospecting and Preservation Program for Archeological Property.
Reduced employment and depletion of activities when the workforce is demobilized.	Social Compensation Program Social Communication Program Environmental Education Program
Increased demand for public services.	Social Compensation Program Public Health Program Support Program for Leisure and Tourism Activities
Pressure on Indigent Territories	Support Program for the Indigenous Communities.
Increased housing demand	Erection Environmental Program (PAC) Social Compensation Program
IMPACTS ON THE BIOTIC COMMUNITY	
Loss and/or fleeing of fauna	Follow-up Program for Deforestation and Wildlife Rescue Degraded Area Recovery Program (PRAD) Wildlife Conservation Program Reservoir Land Use Plan
Vegetation Clearing	Reservoir Deforestation Program Degraded Area Recovery Program Flora Conservation Program Erection Environmental Program (PAC) Environmental Compensation Program
Disappearance of specific habitats for bats	Fish Fauna Conservation Program

SOCIAL-ENVIRONMENTAL IMPACTS	MITIGATION PLANS
Depletion of shrub vegetation in Madeira River	Flora Conservation Program Environnemental Compensation Program
Loss of fish fauna due to increased fishing demand	Fish Fauna Conservation Program Fish Fauna Rescue and Preservation Program
Social Conflict regarding fishing activities	Monitoring and Support Program for Fishing Activities
IMPACTS ON THE PHYSICAL ENVIRONMENT	
Interference in research and mineral concession areas.	Follow-up Program for Mineral Rights and Prospecting Activities
Interference in potential paleontological assets	Paleontological Investigation, Monitoring and Preservation Program
RESERVOIR FILLING AND PLANT OPERATION	
SOCIAL-ECONOMIC IMPACTS	
Drop in prospecting employment and income.	Follow-up Program for Mineral Rights and Prospecting Activities
Alteration in the dynamics of the vector population	Public Health Program Social Communication Program Environmental Education Program Social Compensation Program
Possible impacts on the riparian population downstream.	Downstream Action Program
IMPACTS ON THE BIOTIC COMMUNITY	
Loss of specific environments for bird fauna (barriers and reproduction sites)	Wildlife Conservation Program
Introduction of alien fish species caused by the elimination of natural barriers.	Fish Fauna Conservation Program
Interruption and interference in the migratory route of fish, small fish, larva and spawning	Fish Fauna Conservation Program
Local loss of fish biodiversity (losses in the areas of spawning, fish fauna growth and alterations in their composition.)	Fish Fauna Conservation Program Fish Fauna Rescue and Preservation Program
Loss of shrub vegetation in the reservoir flood area.	Flora Conservation Program Environnemental Compensation Program
Possible elimination of natural barriers for the porpoise species in the area.	Wildlife Conservation Program
Loss of reproduction areas (laying eggs) for turtles and alligators	Wildlife Conservation Program
Increased cyanobacteria biomass and aquatic macrophytes.	Aquatic Macrophyte Monitoring and Control Program Liminology Monitoring Program
Proliferation of aquatic disease vectors	Public Health Program Social Communication Program Environmental Education Program Social Compensation Program
Impacts on aquatic and semi-aquatic mammal species	Wildlife Conservation Program Follow-up Program for Deforestation and Wildlife Rescue
Interference in Conservation Units	Environnemental Compensation Program
Fishing Alterations in the Reservoirs	Monitoring and Support Program for Fishing Activities
Concentration of schools of fish downstream	Fish Fauna Conservation Program
Interference in the migratory movements of turtles	Wildlife Conservation Program

SOCIAL-ENVIRONMENTAL IMPACTS	MITIGATION PLANS
IMPACTS ON THE PHYSICAL ENVIRONMENT	
Suspension of Metallic and Non-Metallic Elements deposited in the river bed	Water Biogeochemistry Monitoring Program
Retention of suspended particles	Water Sedimentology Monitoring Program
Lower oxygen levels in the lateral compartments	Liminology Monitoring Program
Increased erosion possibilities and salt solubility downstream	Water Sedimentology Monitoring Program
Alteration in the gold mining deposit	Follow-up Program for Mineral Rights and Prospecting Activities
Lowered oxygen levels due to the incorporation of biomass	Liminology Monitoring Program
Loss of potential agricultural areas	Social Compensation Program Relocation Program for the Population Affected Environmental Education Program
Alteration in the water table level	Water Table Monitoring Program

Table 21. Main impacts identified in EIA/RIMA and the respective Mitigation Programs

The implementation of the 33 social-environmental programs listed in the PBA will be conducted by ESBR with the support of partners and subcontractors. A summary of the 33 social-environmental programs is presented in the table below.

N˚	ENVIRONMENTAL PROGRAM & DESCRIPTION
1	**Environmental Management System** In order to guarantee the efficient implementation, quality management and monitoring of the 32 environmental programs defined in the PBA during the entire activity cycle, ESBR developed an Environmental Management System (EMS) covering the planning, construction, demobilization and recovery of areas impacted by Jirau HPP. This System will help to identify synergies between the programs, assisting the company to meet the conditions of the environmental licenses/authorizations and the applicable legal requirements. Additionally, in order to facilitate the integration of proposed programs and promote synergies between them, EMS will be supported by the Jirau HPP Geographic Information System (GIS).
2	**Environmental Program for Construction** This program determines the guidelines which shall be followed during the construction activities of Jirau HPP in order to reduce environmental interferences. The activities will be executed during the construction period at the Construction site and the Residential Construction site (Nova Mutum Paraná) including: (i) effluent management and treatment; (ii) emission and water quality monitoring; (iii) energy, water and production input consumption control; (iv) environmental education and prevention of environmental risks; (v) health and workplace safety measures.
3	**Water Table Monitoring Program** This program shall monitor the water table elevation and quality until the Jirau HPP reservoir is stabilized. By implementing this program it will be possible to evaluate the effects on the vegetation, underground water quality and soil use.
4	**Climate Monitoring Program** This program will follow the evolution of climate parameters before, during and after the Jirau HPP reservoir is filled. Through continual meteorological data collection it will be possible to improve the understanding of the climate dynamics in the region and evaluate the correlation with the installation of the Jirau HPP reservoir.
5	**Seismologic Monitoring Program** The purpose of this program is to follow the evolution of the natural and induced seismic activities before, during and after filling the reservoir.
6	**Water Sedimentology Monitoring Program** The purpose of this program is to monitor and evaluate the spatial and temporal evolution of the sediment flow in Madeira River, upstream and downstream of the Jirau HPP reservoir

N°	ENVIRONMENTAL PROGRAM & DESCRIPTION
	before, during and after it is filled. The data collected for this program will enable the control of erosion and sediment deposits in the area of influence.
7	**Water Biogeochemistry Monitoring Program** The purpose of this program is to monitor the different mercury species in the environmental matrices (water, sediment, soil, macrophytes, fish, plankton, aquatic invertebrates and mammals) and humans in the Jirau HPP area of influence.
8	**Follow-up Program for Mineral Rights and Prospecting Activities** The purpose of this program is to implement new rules for the mineral extraction activities in the Jirau HPP area and work with the National Department of Mineral Production (DNPM), the Government regulating agency in charge of mineral assets.
9	**Paleontological Monitoring Program** The main purpose of this program is to record the number of paleontological sites and to preserve animal and vegetable fossil specimens in the Jirau HPP area of influence.
10	**Liminology Monitoring Program** The purpose of this program is to estimate and measure the alterations in the fresh water dynamics resulting from the installation and operation of Jirau HPP which will be used to support the adoption of control measures, in the event that water quality problems are identified.
11	**Aquatic Macrophyte Monitoring and Control Program** The purpose of this program is to follow the dynamics of the aquatic macrophytes in the Jirau HPP area of influence which will be used to support the adoption of control measures in the event macrophyte proliferation problems are identified.
12	**Flora Conservation Program** The purpose of this program is to minimize the impacts on the vegetation through monitoring, rescue and conservation of the vegetable germplasm. This includes measuring the tree types, calculating the ecosystem diversity parameters and determining community involvement in the flora conservation. This programs includes 2 subprograms: (i) flora monitoring subprogram; (ii) germplasm recovery and conservation subprogram.
13	**Degraded Area Recovery Program** The purpose of this program is to recover the areas that suffer interventions for the installation of Jirau HPP, including the Construction site and Residential Construction site (Nova Mutum Paraná) and the future Permanent Preservation Area (PPA).
14	**Reservoir Vegetation Clearing Program** Establishes the guidelines and procedures for deforestation and clearing of the future reservoir area in order to avoid negative effects on the water quality, fauna and flora.
15	**Wildlife Conservation Program** This program includes continuous monitoring of the wildlife before, during and after the reservoir is filled. In addition, qualitative and quantitative studies of the wildlife in the region are conducted. This program is implemented in conjunction with the Wildlife Rescue Program.
16	**Follow-up Program for Deforestation and Wildlife Rescue** The purpose of this program is to rescue the wildlife during the vegetation removal activities.
17	**Fish Fauna Conservation Program** This program evaluates the impact of the installation of Jirau HPP on the fish fauna and supports the mitigation measures used to control and preserve the fish fauna. Two Fish Transposition Systems (STP) will be implemented to allow migratory fishes, such as the large catfish (*Brachyplatatystoma rouxeauxii* and *Brachyplatystoma platynemum*), to access spawning areas located upstream of the project activity[218].
18	**Fish Fauna Rescue Program** This program is complementary to the conservation program and the purpose is to rescue and save the fish fauna on the fish ladders constructed for the installation of Jirau HPP including relocation, release and suitable destinations.
19	**Environmental Compensation Program** The purpose of this program is to mobilize and allocate financial resources for the installation and maintenance of the Conservation Unit (CU). The resources shall be allocated for regularizing land property titles and boundaries, the acquisition of the required assets and services to implement management, monitoring and protection of the CU, among other issues as outlined in the law, in order to guarantee the preservation of the area.
20	**Social Communication Program** The purpose of this program is to create and maintain continual communication channels with

[218] Environmental Basic Project (PBA), Chapter 4.17 – Fish Fauna Conservation Program, page 64.

N°	ENVIRONMENTAL PROGRAM & DESCRIPTION
	the communities in order to inform and clarify the population, government, civil society and construction workers on the Jirau HPP installation activities including environmental program interfaces and the phases of the facility.
21	**Environmental Education Program** The main objectives of this program are: (i) train and qualify monitors to teach environmental education and sustainable development to the local population, while emphasizing "local knowledge"; (ii) expand local participation in the production processes and the spread of knowledge on environmental issues (iii) make environmental education a means of awareness and social transformation.
22	**Public Health Program** Develop actions to extend, improve and qualify the health care of the population in the direct and indirect areas of influence surrounding the HPP. The program also establishes measures that enable disease monitoring and prevention.
23	**Support Program for the Indigenous Communities** The purpose of this program is to support the rational use of indigenous resources through communication instruments, covering the social, cultural, and economic aspects of the fauna and flora. This work will be developed in conjunction with the indigenous populations who will directly participate in all phases of the work.
24	**Prospecting and Preservation Program for Archeological Property.** The purpose of this program is to conduct archeological surveys and preserve the pre-historic archeological sites located in the area of the construction site and future reservoir. The program also includes the preservation of monuments, sites, structures and all elements considered important to the local history and regional culture.
25	**Relocation Program for the Affected Population** The purpose of this program is to relocate the population in the Direct Area of Influence of the Jirau HPP seeking to maintain or improve the quality of life standard and sustainable development of the residents that reside, work, develop activities or survive on the natural resources existing in this area. For this purpose, residents will be actively involved in the relocation options and the indemnification options.
26	**Infrastructure Recovery Program** The purpose of this program is to maintain and recover the access and communication conditions of the population in the areas surrounding Jirau HPP and all other users of the existing infrastructure.
27	**Social Compensation Program** The purpose of this program is to make social investments which will definitely contribute to local and regional social and economic development. The investments proposed in the program include the construction of schools, medical clinics, community training programs, etc.
28	**Reservoir Land Use Program** This program has three main objectives: (i) propose land uses and occupation (zoning) to improve the use of the areas surrounding the Jirau HPP reservoir; (ii) guarantee improved environmental quality in the area surrounding the reservoir; (iii) define suitable areas for the communities that will be relocated, in addition to the allocation of animal species and ecological and economic zoning in the area surrounding the future reservoir.
29	**Support Program for Recreational and Tourism Activities** Through this program, projects in the recreational and tourism sector will be installed with significant participation from the community and government, due to the increased tourism demand as a result of the population influx during the installation and operational phases of the facility.
30	**Monitoring and Support Program for Fishing Activities** The purpose is to identify and monitor the fishing activities in the Jirau HPP area of influence, as well as identifying and monitoring any possible environmental and social affects generated by the installation of the facility on the fishing activities.
31	**Program to Manage Submersed and Floating Tree Trunks and Debris** The purpose of this program is to identify, quantify and define the material transported down Madeira River and supply information to help prepare a management solution for submersed and floating tree trunks and debris.
32	**Downstream Action Program** This program has three main areas: (i) develop an identity for the resident population and the economic activities developed at the location; (ii) follow-up on the alterations in these areas during and after the installation of the facility in order to identify any possible causes of the alterations identified; and (iii) generate employment opportunities and income for the rural

N°	ENVIRONMENTAL PROGRAM & DESCRIPTION
	producers, fishermen and populations living in the riparian communities.
33	**Monitoring Program for Areas Subject to Instability along the Hillsides and River Banks** The purpose of this program is to identify critical areas, monitor and control the erosion on the hillsides and river banks.

Table 22. Summary of the 33 social-environmental programs

The implementation of the social-environmental programs shall be monitored continually by the environmental agency, which is a pre-condition for the issue of the Jirau HPP Operating License (LO), the last licensing phase for the facility. As described in Section D.1, the Jirau HPP Operating License (LO) should be obtained before the start of commercial operation, proposed for October 2012.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

Local Stakeholder Consultations were conducted on three different stages as presented below. First step was related to the presentation and discussion of the EIA/RIMA in 2006 aiming for the conclusion of the Preliminary Licensing. As the relevance of the CDM is clearly mentioned in the EIA/RIMA this concept was already introduced to the stakeholders at this stage.

Later, after ESBR was awarded with the right to the concession and pursued the approval of its revised project concept as a basis for the Installation License, a second round of stakeholder consultations were conducted.

In addition, after the LI was obtained, ESBR established a continuous stakeholder engagement as a basis for the implementation and improvement of part of its environmental programs and in order to obtain constant feedback from the project's key stakeholders. As part of this ongoing process the CDM related local stakeholder consultation initiated already in January 2010, but only in March 2012, as a result of the PDD conclusion in Portuguese and English versions, the official local stakeholder consultation was conducted according to the rules of the Brazilian DNA.

1) Stakeholder Consultations for the presentation and discussion of the EIA/RIMA

In accordance with current environmental legislation (Law no. 6938/1981 and CONAMA Decision N°. 001/1986 and 237/1997), Public Hearings were held to discuss the Environmental Impact Study (EIA) and Environmental Impact Report (RIMA). The EIA/RIMA were made available for public consultation on 25 September 2006 and the invitations to the public hearings to discuss EIA/RIMA for the Santo Antonio and Jirau HPPs were published by the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) in a public notice published on 24 October 2006 and later in the Official Gazette (DOU) on 24 October 2006 and 14 November 2006.

This public notice covered four (04) official and public hearings, held in the districts of Abunã, Mutum-Paraná, Jaci-Paraná and the City of Porto Velho, as described below:

- District of Abunã – held on 29 November 2006 at the Marechal Rondon Municipal Primary Education School, the Abunã Public Hearing was attended by 404 people.
- District of Mutum-Paraná – held on 30 November 2006 at the Nossa Senhora de Nazaré Municipal Primary Education School, the Public Hearing was attended by 669 people.
- District of Jaci-Paraná – held on 10 November 2006 at the Maria Nazaré dos Santos Municipal Primary and Secondary Education School, the Public Hearing was attended by 800 people.
- City of Porto Velho – held on 11 November 2006 at the Aquarius Hotel, Nautilus room, the Public Hearing was attended by 1,100 people.

All the hearings were officially announced by IBAMA in the Official Gazette (DOU) and on the site of the Institute. The companies responsible for preparing the EIA/RIMA promoted the publication campaigns for the hearings beforehand via the distribution of hand outs, posters, banners, radio announcements, newspaper ads, cars travelling through the communities with announcements made over a loudspeaker, invitations to agencies and entities, in addition to 36 collective meetings and debate series at the universities in Porto Velho.

In addition, 36 buses and vans, two (02) boats and two (02) taxis were made available for transportation to the public hearing locations between 8 and 11 November 2006. For the public hearings held on 29 and 30 November 2006, 22 buses and vans were made available for transportation from the communities. All the records and results from the public hearings are available for consultation at IBAMA and will be made available to the auditing team.

2) Stakeholder Consultations for approval of the revised project design

In addition to the public hearings held to discuss the technical and environmental aspects presented in EIA/RIMA, ESBR held an additional Public Hearing to present the proposal of moving the location of the Jirau HPP.
The specific purpose of this hearing was to detail the technical aspects of the revised project and to discuss the change in social-environmental impacts of the new engineering design in comparison to the original design on the basis of the information already presented in the respective Table in section D.1. This Hearing was held in the City of Porto Velho on 15 October 2008 and was attended by approximately 800 participants.

3) Ongoing stakeholder engagement and CDM consultation as regulated by the CIMGC Decision N° 7[219].

After conclusion of the formal stakeholder consultation process as required for the Installation License, ESBR developed processes and programs to establish a continuous communication channels with the local community to promote transparency and to obtain feedback for the continuous improvement of the environmental programs and mitigation activities defined in the PBA or that are being developed in addition to the those required by the formal licensing process. The Social Communication Program (20) is the backbone of this strategy, with the purpose of informing and educating the population as well as the public authorities, civil society and the workers about all socio-environmental aspects of the Jirau HPP, and its installation. The most important tools and communication channels created within the realm of the Social Communication Program are described as follows:

- Suggestion Boxes located in the districts of Abunã, Fortaleza do Abunã, Nova Mutum Paraná and Jaci Paraná;
- Bulletin Boards located in the districts of Abunã, Fortaleza do Abunã, Jaci Paraná, Nova Mutum Paraná, Ramal 31 de Março, construction site (ESBR office, LEME and the Cafeteria);
- Information Center – Community services office located in Nova Mutum Paraná;
- Mobile Information Center – Schools and regional sites (Jaci Paraná, Nova Mutum Paraná, Abunã, Fortaleza do Abunã, PA São Francisco, Ramal 31 de Março Schools) are considered community services offices;
- Jirau Observatory Portal – Joint action of the Environmental Education Program and the Social Communication Program in order to monitor environmental issues, going beyond social, economic and cultural dimensions, with network discussions on a permanent popular research forum, environmental discussions and cultural production, and the promotion of sustainable social-environmental actions[220];

[219] Brazilian DNA: Resolution N° 7 from 5 March 2008 is available at: http://www.mct.gov.br/index.php/content/view/336403.html.

[220] More information on the social organization can be obtained on the site: http://www.observatoriojirau.com.br/.

- Toll free telephone service (0800);
- Home Visits: Conducted with the residents in the Direct Area of Influence (AID) of the Jirau HPP and those with Special Situations (AIISE);
- Visits to the construction site conducted by the (AID and AIISE) communities;
- Meetings with the communities to cover or present specific issues.

In addition a Sustainability Committee has been created with the participation of local NGOs, communities associations, communities representatives, indigenous representatives, municipalities, local environmental agencies, universities, heritage and cultural institutes, representatives of relocated communities, among others which now holds a fundamental role in promoting community participation and involvement in the implementation process of all the social-environmental programs contained in the Basic Environmental Project (PBA) for the Jirau HPP. The Committee helps in the joint development of proposals and adjustments for the activities undertaken, in order to strengthen the discussion and follow-up of the Jiau HPP installation.

The Sustainability Committee structure includes 9 Work Groups (Mineral Activities WG, Indigenous WG, Technical Epidemiology WG, Rural WG, Urban WG, Land Property Title Regularization WG, Environmental WG, Socio-economic WG) with one member elected by the population as their representative for each WG (one or two on average.) Therefore, the respective representatives are invited to every meeting as well as the agencies and other institutions involved. It is worth noting that all the meetings are open to the public.

The Sustainability Committee was also key for the structuring of the local stakeholder consultation process in relation to CDM. Already at the first meeting of the committee, which was held on 7 January 2010, the CDM was introduced in order to discuss the concept of the mechanism, its importance for the Jirau HPP and hydropower projects in general as well as the issue of methane emissions in reservoirs and run-of-river projects like the Jirau HPP. In order to inform a wider range of stakeholders, the meeting was also communicated in ESBRs bulletin.

Later, in March 2012, ESBR then initiated the formal Local Stakeholder consultation process as defined by the Designated National Brazilian Authority (CIMGC - Interministerial Commission on Global Climate Change). According to the provisions of CIMGC Decision N°. 7 ESBR prepared a PDD in Portuguese, as well as a summary and description of the project's contribution to sustainable development (Annex III) and both documents were made available to any interested party on the ESBR site (http://www.energiasustentaveldobrasil.com.br/)[221]. In addition, and in compliance with the compulsory list of stakeholders as defined by Decision 7, ESBR submitted formal letters to inform the following entities and institutions about the project activity and the local stakeholder consultation, as well as to expressly invite their comments:

- Porto Velho City Hall, City Council and Environment Secretary;
- Rural Workers Trade Union of the City of Porto Velho;
- Federal Public Attorney of the State of Rondônia;
- FBOMS - Brazilian forum of NGOs, and Social Movements for the Environment and Development;
- Federal Public Attorney;
- IBAMA;
- SEDAM – Rondônia State Secretary of Environmental Development.

In addition, the start of the official public consultation period was announced in the meeting of the Sustainability Committee and participants were invited and instructed about the procedure to comment on the CDM project. To provide comprehensive information about the process, a detailed presentation about key aspects of climate change mitigation and the role of the CDM for the Jirau

[221] The PDD in Portuguese version was made available at http://www.energiasustentaveldobrasil.com.br/dcp.asp on 28 March 2012.

HPP were presented and discussed with the audience. Following that, the fact and the content of the meeting was again informed in the company's communication bulletin[222].

E.2. Summary of comments received

The comments and questions received during the period of public hearings, carried on in the context of the Environmental Licensing Assessment approval process, can be classified in main thematic issues, such as:

- Employment generation during the construction and operation phases for the local population;
- Impacts on fishing activities after the implementation of the project;
- Resettlement options for riparian communities and urban households located at Mutum-Parana;
- Compensation packages to affected communities (resettled and other affected communities);
- Benefits generated by the project activity in areas such as: health (specially the control of Malaria in the region), education, income and employment generation.

No additional comments have been received during the local Stakeholders consultation process, as implemented according to the requirements of the Brazilian DNA.

E.3. Report on consideration of comments received

All comments and questions made during meetings and public hearings have been orally answered by the consortium of companies responsible for the development of the EIA and the national environmental agency (IBAMA). As required by the Brazilian regulation, all the comments received during this phase have been incorporated to the licensing process into the licensing process of the Santo Antônio and Jirau Hydropower plants (the Madeira Complex), including the Preliminary License (LP) No 251/2007, which attested the environmental viability of these projects. According to the technical opinion nº 14/2007 – COHID/CGENE/DILIC/IBAMA (page 1) issued by IBAMA:

> *"This technical opinion aims to present the results of the environmental impact assessment of the Santo Antonio and Jirau Hydropower plants, as performed by the technical team of IBAMA, based in the analysis of the Environmental Impact Assessment (EIA), Environmental Impact Report (RIMA), Public hearings, technical surveys, technical meetings and other documentation annexed to the process in accordance with the applicable legislation"* (Free translation from Portuguese).

Based on this participatory process, IBAMA issues a conclusive opinion, stating that "*(…) we can affirm that there was an improvement of the project's overall understanding and addressing of identified problems, and, as a conclusion, there is no remaining issue at this Preliminary Licensing stage*" (Free Translation from Portuguese).

During the public meeting held on 15 October 2008 in Porto Velho to present and discuss the proposal to amend project's original engineering design and construct the plant at the Ilha do Padre instead of the original location at the Jirau Waterfall, additional comments have been made by stakeholders. These comments have also been orally answered by ESBR and dully integrated in the Installation Licensing Process. Besides the thematic issues raised in the previous public

[222] Bulletin of the Jirau HPP, issue 132 of 16 April 2012, available to the DOE.

hearings, comments on training of local population for working in the project site and other activities have also been presented by the meeting participants223.

During the local Stakeholders consultation process, implemented according to the requirements of the Brazilian DNA, no comments or concerns have been presented.

SECTION F. Approval and authorization

The Brazilian letter of host country approval will be requested from the Brazilian DNA according to its applicable requirements and before conclusion of the final validation report by the DOE.

[223] All the meetings and public hearings have been entirely registered in audio and video.

Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Energia Sustentável do Brasil S.A.
Street/P.O. Box	Avenida Almirante Barroso, 52 – 2802
Building	-
City	Rio de Janeiro
State/Region	RJ
Postcode	20031-000
Country	Brazil
Telephone	+ 55 21 2277 3800
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E-mail	-
Website	www.energiasustentaveldobrasil.com.br
Contact person	Isac Paulo Teixeira
Title	Operations Director
Salutation	Mr.
Last name	Teixeira
Middle name	Paulo
First name	Isac
Department	Operations
Mobile	-
Direct fax	+55 21 2277 3838
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Personal e-mail	Isac.Teixeira@energiasustentaveldobrasil.com.br

Project participant and/or responsible person/ entity	☒ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	GDF SUEZ Energy Latin America Participações Ltda
Street/P.O. Box	Avenida Almirante Barroso, 52 – 1401
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Contact person	Philipp Hauser
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First name	Philipp
Department	CDM and Carbon Market Management
Mobile	-
Direct fax	+55 21 2215 1312
Direct tel.	+55 21 3974 5443
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Appendix 2. Affirmation regarding public funding

There is no annex 1 public funding in this project.

Appendix 3. Applicability of methodology and standardized baseline

Further details about the applicability of the selected methodology are available in section B.2.

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

BASELINE INFORMATION

Emission Factor (tCO_2/MWh)		
Combined Margin (2010)		
1st Crediting Period		0.3095
Build Margin 2010		**0.1404**
Operating Margin 2010	January	0.2111
	February	0.2798
	March	0.2428
	April	0.2379
	May	0.3405
	June	0.4809
	July	0.4347
	August	0.6848
	September	0.7306
	October	0.7320
	November	0.7341
	December	0.6348
	Average 2010	**0.4787**

Table 23. Information about the Brazilian Interconnected Grid System Emission Factor (base year 2010)[224]

[224] Available at: http://www.mct.gov.br/index.php/content/view/327813.html#ancora, accessed on 12 February 2012.

Appendix 5. Further background information on monitoring plan

Further details about the applicability of the selected methodology are available in sections B.7.2 and B.7.3.

Appendix 6. Summary of post registration changes

Not applicable.

Appendix 7. Further considerations from the Project Participants concerning the PDD

Please note that all internet links used as references in this PDD have been duly accessed during the PDD elaboration as well as during the validation process. In addition, all these internet links used as references in this PDD have been printed by the project participants and made available for the DOE during the validation process. Project participants have no control and cannot be responsible for the access to the internet links used as references in this PDD if those become no longer available or accessible. In case of one or more internet links used as references in this PDD become no longer public available, the original printed information can be accessed upon formal request to project participants through the contact information of project participants made available in Appendix 1 of this PDD.

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Document information

Version	*Date*	*Description*
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revisions to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Editorial improvement.
05.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from *F-CDM-PDD* to *CDM-PDD-FORM;* • Editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b
04.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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