



International Sustainability Observatory



**BRAZIL: CURRENT ENVIRONMENTAL, SOCIAL
AND POLITICAL CHALLENGES**

**Clean or Dirty Energy?
Challenges and Risks Associated to
Belo Monte Hydroelectric Dam
Complex on Xingu River Basin in the
Amazon, Brazil**

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Increase in electricity consumption in Brazil and projections for next years

Brazil is the **tenth** largest consumer of electricity (IEA, 2012).

Since **2001**, electricity consumption in the country increased by almost **38%** above the world average, which was **30%** in the period.

Around **85%** of the total energy produced in Brazil originates from renewable sources, while the **average among rich countries of the OECD** (Organization for Economic Cooperation and Development) is only **8%**.



Increase in electricity consumption in Brazil and projections for next years



Until **2035** the demand for primary energy in Brazil is expected to grow by **78%** (IEA, 2012).

Installed capacity in Brazil today equals **125 GW**. This is expected to grow to about **200 GW** by late **2023**.

On average, **7.1 GW** of new electrical power generating capacity is expected to be put in place **annually** over the next decade.

Increase in electricity consumption in Brazil and projections for next years

Hydropower accounts for about **75%** of existing power generation capacity in **Brazil**, and is expected to **grow at a rate of 3.3 GW/year** over the next ten years.



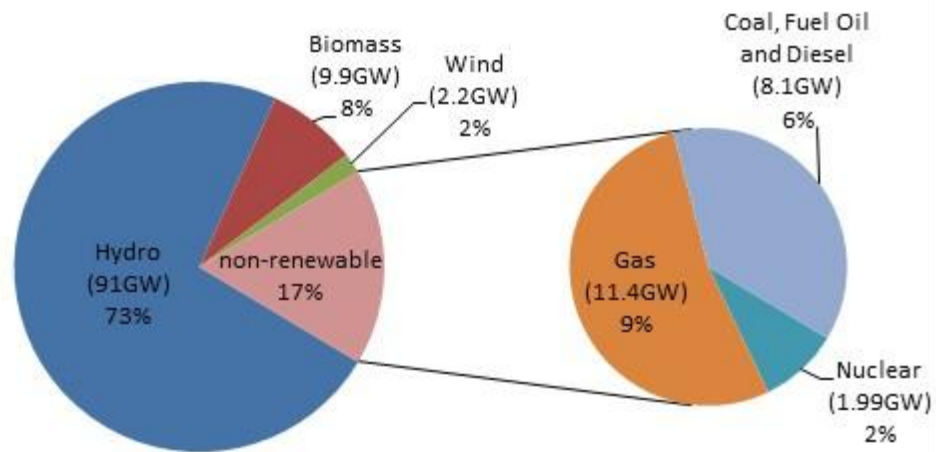
The country will put new hydro capacity in place until the end of 2023 with large plants in the north of Brazil.

Special attention is being given to the **Belo Monte hydropower plant** (11 GW installed capacity). Belo Monte is expected to start operating by 2016.

A number of other **smaller hydro power** plants, of installed capacity varying **from 50 to 8,000 MW**, also are scheduled to enter service **before 2023**.

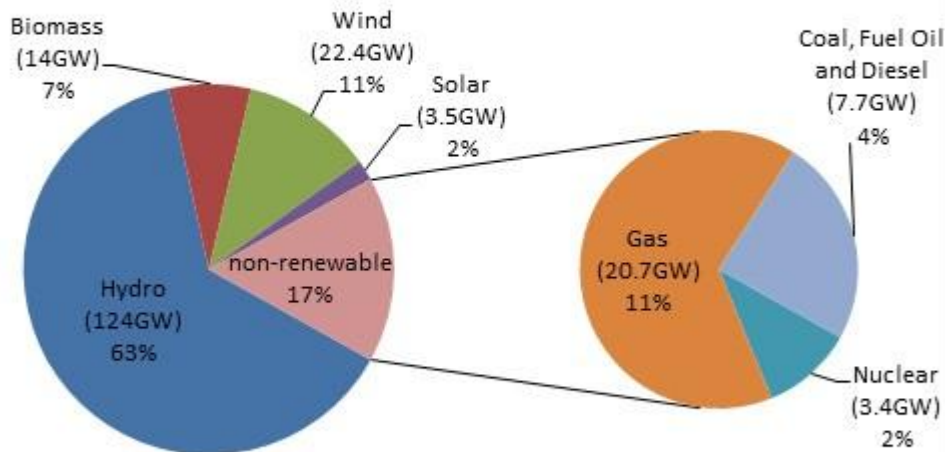
Increase in electricity consumption in Brazil and projections for next years

Existing Power Generation Capacity (125 GW - December 2013)

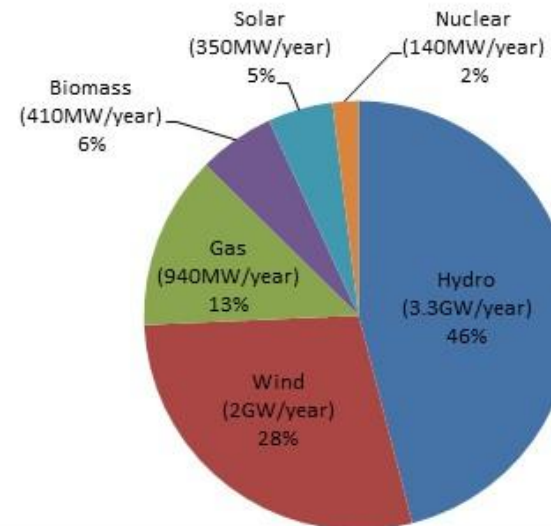


Increase in electricity consumption in Brazil and projections for next years

**Predicted Power Generation Capacity
(196 GW - December 2023)**



**Expected 2014-2023 Power Generation
Capacity Increase Rate (7.1 GW/year)**



It is expected that by 2023 energy consumption in Brazil will increase by about 5% per year.

Alternatives to enhance energy security to the population in Brazil in the next decades

In **November 2014** new granting contracts (20-year energy supply contracts) were issued by Brazil's energy regulator(Aneel) for the construction of **31 solar parks**.

Companies will invest **1.67 billion USD** and will start to feed the national grid in **2017**.

The 31 solar parks, the first large-scale solar projects to be constructed in Brazil, will have a **combined installed capacity of 1,048 megawatts (MW)**.

Wind energy has experienced exponential growth in Brazil. **Between 2009 and 2012**, wind projects participated in six energy auctions, securing contracts to supply **7GW of power**. **Installed wind capacity in Brazil** will reach over **8.4GW by 2017**, **3.5 times the levels in 2013** – attracting investment of over **8 million USD**.

At present **Brazil invests just \$5.42bn in wind power** despite having a total estimated potential of **300 gigawatts (GW)**. However, spending on hydropower projects, which have a **smaller total energy potential of 260GW**, has topped **\$150bn**.

Hydropower plants in the North region of Brazil

In the Amazon is expected to be built 92 dams in the coming years mostly along the Xingu river which is 2000 km long. Over the next six years, the region will receive investments of about 45 billion USD in energy generation.



The Belo Monte Hydroelectric Dam Complex on Xingu river basin, Amazon, Brazil

Quick facts about Belo Monte hydroelectric dam complex:

- ☀ Investment of \$ 26 billion to reach an installed capacity of 11,233 MW, but due to the rainy and dry regime, the average over the year will be only 4,571 MW. This amounts to just over 10% of the electricity consumed in Brazil.
- ☀ Removal of 13 million cubic meters of rocks from Belo Monte construction site (180 million m³ considering sand too - the equivalent of 70 pyramids of Cheops in Egypt).
- ☀ The dam will be 30m deep and 150m high equivalent to a 50-story building. It will consume more than 6 million tons of concrete.



The Belo Monte Hydroelectric Dam Complex on Xingu river basin, Amazon, Brazil

Quick facts about Belo Monte hydroelectric dam complex:

☀ The plant is in the Volta Grande do Xingu region, a point where the river Xingu makes a long curve. The dam is being built near the city of Altamira.

☀ This dam shall come forth a 20km concrete channel length and 210m wide and 40m deep (greater even than the Panama Canal).

☀ When ready, 14 million litres of water will pass through the channel per second. It will divert the water by the end of the Volta Grande in a fall of 90m high. There the intermediate reservoir will be formed to move 18 vertical turbines, responsible for most of the electricity generation plant.



The Belo Monte Hydroelectric Dam Complex on Xingu river basin, Amazon, Brazil

Quick facts about Belo Monte hydroelectric dam complex:

- ☀ The channel will drive virtually the entire flow of the Xingu river to the lake of Belo Monte - the main reservoir and also the largest generation unit consisting of 18 turbines.
- ☀ Together during periods of peak flow of the river, they will produce enough energy to supply a market of 22 million consumers, equivalent to the entire state of Minas Gerais or 3x the population of Pará, but this will only happen during periods of rain .
- ☀ 6 other less efficient horizontal turbines (233 MW, enough to power a city of 1 million inhabitants) will be installed in the dam to maintain the course of the river in a complementary manner. In total the flooded area will be 503km².



The Belo Monte Hydroelectric Dam Complex on Xingu river basin, Amazon, Brazil

Quick facts about Belo Monte hydroelectric dam complex:

☀ According to the plan established and authorized by the government, the minimum flow during the dry season will be 600m^3 per second. This level does not drastically change the Xingu river because the historical average for the period is $700\text{m}^3/\text{s}$.

☀ Most significant change comes during the rainy season when the established minimum flow is $8000\text{m}^3/\text{s}$, a sharp decline since the historic winter average is more than triple ($25,000\text{m}^3/\text{s}$).

☀ In addition, the plant is authorized for every other year decrease the flow to $4000\text{m}^3/\text{s}$. This can bring great harm to plants and animals that live in the region, including endangered species.



Criticism to the Belo Monte Hydroelectric Dam Complex

- ☀ The project is strongly criticized by indigenous people and numerous environmental organizations in Brazil plus organizations and individuals around the world.
- ☀ Belo Monte's 668 square kilometres of reservoir will flood 400 square kilometres of forest, about 0.01% of the Amazon forest.
- ☀ Though argued to be a relatively small area for a dam's energy output, this output cannot be fully obtained without the construction of other dams planned within the dam complex.



Criticism to the Belo Monte Hydroelectric Dam Complex



- The planned area of reservoir for the Belo Monte dam and the necessary Altamira dam together will exceed 6500 km² of rainforest.
- The environmental impact assessment written by Eletrobras, Odebrecht, Camargo Corrêa, and Andrade Gutierrez listed the following possible adverse effects:
 - The loss of vegetation and natural spaces, with changes in fauna and flora
 - Changes in the quality and path of the water supply, and fish migration routes
 - Temporary disruption of the water supply in the Xingu riverbed for 7 months.

Criticism to the Belo Monte Hydroelectric Dam Complex

In February Brazilian environmental agency IBAMA granted an environmental license for the construction of the dam despite uproar from within the agency about incomplete information in the Environmental Impact Assessment (EIA).

Among the problems cited within the EIA were the project's uncertain cost, deforestation, generation capacity, greenhouse gas emissions and in particular the omission of consideration for those affected by the river being mostly diverted in the 100 km (62 mi) long "Big Bend" (Volta Grande).



Criticism to the Belo Monte Hydroelectric Dam Complex

Loss of biodiversity

- ☀ The fish fauna of the Xingu river is extremely rich with an estimated 600 fish species and with a high degree of endemism.
- ☀ The area either dried out or drowned by the dam spans the entire known world distribution of a number of species.
- ☀ An independent expert review of the costs of the dam concluded that the proposed flow through the Volta Grande meant the river "will not be capable of maintaining species diversity", risking "extinction of hundreds of species"



Criticism to the Belo Monte Hydroelectric Dam Complex

Greenhouse gas budget

The National Amazon Research Institute (INPA) calculated that during its first 10 years, the Belo Monte-Babaquara dam complex would emit **11.2 million** metric tons of Carbon dioxide equivalent, and an additional **0.783 million metric tons of CO₂ equivalent** would be generated during construction and connection to the national energy grid.

This independent study estimates greenhouse gas emissions of an amount that **would require 41 years** of optimal energy production from the Belo Monte Dam complex in order to reach environmental sustainability over fossil fuel energy.



Furthermore, the forest will be cleared before flooding of the area, so the CO₂ and methane emissions calculated for the flooding of the forested area will be significantly undercut.

Criticism to the Belo Monte Hydroelectric Dam Complex

Social effects

The dam will directly displace over 20,000 people, mainly from the municipalities of Altamira and Vitória do Xingu.

The river diversion canals will reduce river flow by 80% in the area known as the Volta Grande ("Big Bend"), where the territories of the indigenous Juruna and Arara people, as well as those of sixteen other ethnic groups are located.

While these tribes will not be directly impacted by reservoir flooding, and therefore will not be relocated, they may suffer involuntary displacement, as the river diversion negatively affects their fisheries, groundwater, ability to transport on the river and stagnant pools of water offer an environment for water-borne diseases, an issue that is criticized for not being addressed in the Environmental Impact Assessment.

Compensatory measures of the project

- ✦ There is a package of around 2 million USD for compensatory measure but there have been delays in their implementation.
- ✦ According to the plant construction plan, the consortium Norte Energia will have to keep a 500m range around the whole flooded area as a permanent protection area.
- ✦ The consortium had to build three villages to serve as lodging for about 11,000 workers. In addition to the houses containing four workers each, it was necessary to provide a school library, a large recreation area, video game rooms, fitness centres and a large canteen.



Compensatory measures of the project

- ☀ As to relocation, Belo Monte is going to move hundreds of people involved in agriculture and around 2 thousand Altamira families who nowadays live under precarious conditions. Everyone will be indemnified.
- ☀ Farmers will be transferred to agrovilas (organized farm settlements) and city residents will be taken to houses with urban infrastructure and sanitation, in places which will offer public facilities such as schools and leisure areas.
- ☀ According to the approved project plan the indigenous lands close to the enterprise (Paquiçamba, Arara da Volta Grande, Trincheira Bacajá and Juruna) are inhabited by around 240 people are not going to be flooded.



Criticism to the Belo Monte Hydroelectric Dam Complex

Recommended video:

“Belo Monte Announcement of a War - complete movie”

Available on youtube

If you have a smartphone, scan the QR code to access the video on youtube:





THANK YOU FOR YOUR ATTENTION!

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