Large scale hydro dams: a false solution to the climate crisis

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Currently hydropower represents 67% of Brazil's installed capacity, which is significantly higher than the international average. Although renewable, this blind bet on a single major source for power generation greatly increases energy insecurity in the country. The predominance of hydroelectric power is susceptible to seasonal droughts, which are becoming more frequent and severe due to climate change.

The Brazilian government intends to build dozens of big hydroelectric dams in the Amazon up to 2023. For the next ten years, there are already 12 new hydro dams in the Brazilian Amazon in the pipeline - awarded contract or in different stages of commissioning - and 9 in the planning stage. That accounts to a total of 29,359 MW, or 92% of the hydro energy planned in Brazil. In the next decade, the Amazon will provide 37% of the new energy in the Brazilian matrix.

The Brazilian development vision for the Amazon seems rooted in the colonial period as the region continues to be seen – and valued – only as a rich stock of untapped energy, raw material and food-basket. Currently, the energy sector is the driving force of the wave of investment in the region. Projects such as Jirau and Santo Antonio (in the state of Rondonia), Belo Monte, Teles Pires and Tapajós dams complex (in the state of Pará) are part of this new cycle of occupation, accelerating a process which has begun during the dictatorship, back in the 70's. The misguided vision of the Amazon as the last energy frontier to be expanded into the forest does not take into account environmental protection or the rights of the forest people.

The impact of hydro dams ranges from deforestation and loss of biodiversity to the displacement of traditional people, land rights conflicts and possible damages to emerging economies. Greenpeace opposes the construction of new hydro dams of any size in the Amazon region and recommends more investments in renewable sources, such as solar, wind and biomass as a means to attend the rising electricity demand. Given the advance of science and power generation technologies, we can gleam an Energy Revolution that is, at the same time, realistic and socially, economically and environmentally responsible. Now the challenge is political.

No dams in the Amazon

The importance of the Amazon is well known. It is the world's largest tropical rainforest, the most biodiverse region in the planet and is home to more than 24 million people, including indigenous groups and traditional communities who depend on the forest for their survival. It is also vital for keeping the climate balance. Despite all its majesty and mystery, one fifth of the Amazon has already gone. Vanished, lost forever. And its deforestation has put Brazil among the world's top climate polluters.

Progressive deforestation and forest degradation are destroying the forest's ability to regulate the climate. Forest destruction threatens not only those who live in the region, but also those who live beyond it. Amazon deforestation influences the rain patterns in other regions of Brazil, such as the South and Southeastern, leading to abrupt and profound changes in the climate of the entire country, as the prolonged and severe drought that is currently plaguing the state of São Paulo. The construction of dams is likely to worsen this scenario, causing additional and irreversible impacts to the rivers and to the fragile ecosystem of the Amazon, thus, affecting its important role of climate regulator. (NOBRE et al, 2014).

Lessons are to be learned

The Southeast region of Brazil is currently facing a historic drought, affecting more than 130 cities and approximately 30 million people. The Southeast and Central West regions. 70% of the Brazilian capacity to generate electricity lies in the Southeast and Central West regions. The recent drought affecting those regions are impacting the water levels in the reservoirs, that reached the lowest level ever recorded – 15% in 2014 in comparison to 20,7% percent in 2001. This increases the risk of an energy shortage (Amato, 2014). It is widely known that extreme climate events such as the drought in São Paulo will increase in intensity and frequency due to global warming.

The relatively plain surface of the Amazon and the absence of high waterfalls disadvantages the construction of dams with big reservoirs. Furthermore, the variance of the river flows between wet and dry seasons increases the intermittency and the performance of run of river projects.
According to Schaeffer et al (2008), climate change will influence hydropower production. The average reduction of flow in the Northeast and South river basins of Brazil is estimated in 2.2%. The study claims that this trend should be stronger in dams that are not operating in full capacity.

The Tapajós Complex

The construction of a dam complex along the Tapajós basin, between the states of Amazonas and Pará in Brazil, has been designed since the 80's. The project includes the construction of five hydroelectric dams – São Luiz de Tapajós, Jatobá, Cachoeira dos Patos, Jamanxim and Cachoeira do Caí. The most significant among these is the São Luiz do Tapajós dam, whose installed capacity is expected to be the biggest after Itaipú, Belo Monte and Tucuruí - 6,133 megawatts (MW) of in a 3,483 meters long dam in the heart of the Amazon.

The Belo Monte Dam

The Belo Monte Dam is a hydroelectric dam complex currently under construction on the Xingu River in the state of Pará, Brazil. Plans for what was called Kararaô also began during Brazil's military dictatorship, in 1975.

Belo Monte will be the third largest dam in the world in terms of size, but it will be one of the lowest in terms of load factor – it should produce, on average, 39% (4,420 MW) of its 11,233 MW total capacity, due to the dynamics of the Xingu river that drastically changes in its flow throughout the year. The average yearly production is around 4,400 MW, ranging from 10,688 MWa during 6 months to only 200 MW in the two driest months (ELETRONORTE apud Hernandez et al, 2009), due to the natural reduction of the river flow. This seasonality is likely to worsen in the climate change context.

Impacts on Climate Change

Apart from the great variability of hydro generation between the wet and the dry season, peak demands in the summer means there is an intrinsic need for complementary power generation.
The current setup of the Brazilian electricity matrix prioritizes thermal plants as the main choice during the dry months of the year. The increase of droughts in the past five years has led to a growth in thermal participation in Brazil's electric mix from 7.1 to 23.1% (O Globo, 2014b). As a consequence, emissions in the power sector increased fivefold in the last two years (Observatório do Clima, 2014). The current drought, aggravated by the bad sector planning, has caused the

constant use of thermal power plants, increasing CO2 emissions in 500% between 2009 and 2013.

Regarding direct GHG emissions, forest areas flooded by reservoirs emit methane in the anaerobic decomposition of trees, vegetation and biomass submerged by the dam during its operation. Thus, emissions can be as high as in fossil thermal plants - in some cases, matching those of coal plants, as in the Balbina Hydro dam in the Brazilian Amazon (Santos, 2000; Rosa *et al*, 2004). Although the number greatly varies according to the location and size of the dam, it is clear that tropical and subtropical areas tend to release much more carbon given its characteristics in terms of water temperature, hydrological cycles and biomass stock (Santos, 2008).

According to Rosa (2004), the average hydro dams emission of CO2 equivalent (accounting a total of 23,518 MW distributed in nine projects, such as Itaipu, Tucuruí and Xingu) ranges between 19 and 20,5 percent those of emissions from fossil fuel plants (considering coal, oil and gas). The worst case is the Balbina Dam which emits as much as a coal powered plant.

Environmental impacts

Both the construction and operation of hydro dams represent a substantial social and environmental impact that is not, by any account, comprehensively evaluated in the pre-construction phase. Historically, compensatory measures, usually underestimated in such projects, are not properly delivered. Around 10 percent of the total cost of Belo Monte dam, under construction in the Xingu river, will be used for mitigation and compensatory measures, which amounts to over US$ 1.2 billion (Instituto Socioambiental, 2014b). While the project is well into construction, with high impacts to the local community, almost a quarter of the compensatory measures are still to be implemented. (Instituto Socioambiental, 2014). This figure only comprises the impacts evaluated in the official environmental licensing; independent reports list further impacts not taken into account in this process (Hernandez et al., 2009).

- *Deforestation*

The deforestation caused by hydroelectricity projects includes direct and indirect impacts. Direct impacts are those caused by the installation of reservoirs and building infrastructure; and the indirect impact are considered the results of migration of workers and stimulation of local economic activities. The projected additional deforestation rate in the Belo Monte dam until 2031 is expected to vary between 800 and 5.316 square km (Barreto et al., 2011).

In the Tapajós complex, the expected indirect deforestation rate associated to the 12 hydro dams might reach an additional 950.9 square km in the next twenty years, due to the migration of 63,000 people during this period (Barreto et al., 2014). The dams planned would also induce about 11,000 square km of indirect deforestation and endanger 44 of the 53 protected areas in the basin, including some indigenous lands. These current studies on large hydroelectric plants in the Amazon show that more than one million hectares (10,000 km²) of primary forest were submerged since the construction of the Tucuruí dam. It is estimated that around 2,600 square km will be submerged by the reservoirs of the planned plants, a small fraction of the problem, when considering the impacts caused by indirect deforestation. It is worthy emphasizing that the Environmental Impact Assessment has never considered this scenario. Based on Prodes, the Brazilian Forest Monitoring System and field research analysis point out that the Belo Monte dam would induce indirect deforestation of 5,000 square km in the region in the next twenty years.

The government's determination to carry the plan to build the Tapajós dams may impose an unprecedented environmental cost in the history of the country – an impact even heavier than Belo Monte and similar to the huge damage caused by the construction of the Itaipú dam during the Military dictatorship regime. If approved, it will flood 1,368 km^2 of virgin forests, an area almost the size of the city of São Paulo and equivalent to two and a half times the flooding that will be caused by the Belo Monte dam.

- *Biodiversity*

The Tapajós dam is planned to be 39 meters high, equivalent to a 13-floor building and will be placed inside one of the most protected areas of the region: the Amazon National Park, the first Conservation Unit demarcated in the Legal Amazon. Together with other 11 protected areas, they form the largest mosaic of biodiversity of the planet.

Over 390 species of birds and 400 other fish have been catalogued in the park. Mammal species include endangered animals such as the jaguar, the red jaguar, giant anteaters and ocelots. In the area planned for the construction of São Luiz dam, there is one of those many rock formations that during the dry season – which reaches its peak in September – turned itself into an immense ecological corridor for animals crossing from one side of the Tapajós river to the other.

Concerns with fish populations are also great due to the changes in river flow. The region is full of water rapids. The species able to climb the dam ladder to reach the lake will need more oxygen due to stress, but will find backwater with smaller amount of oxygen. The estimative is that 90 percent of fish species disappear.

Social impacts

As Brazil moves into the 21st featured as a growing superpower in the international arena, internally the social and political challenges only seem to multiply by the day.

Development is yet not framed within the changing climate and global warming dynamics nor within a human rights framework; rather, the long term investments on electricity, deep sea oil, transport, urban occupations and agriculture are leading to a clear increase on GHG emissions in the coming decades and severe impacts on already vulnerable communities. While the future is sealed by elected officials funded by private corporations and chained to colonial power structures, the Brazilian public remains ajar of this worrying reality.

The World Commission on Dams states that an unacceptable and often unnecessary price has been paid to secure the benefits of dams, especially in social and environmental terms.

The simple announcement of a dam construction is enough to trigger a mass population migration to the dam's closest city, affecting the entire region. According to the Brazilian government, the hydroelectric dams planned for the Amazon in the next 10 years will permanently impact about 43,000 people (EPE/MME, 2014).

The migration process affects the cities' poor infrastructure systems. Thousands of civil workers arrive to the construction sites. Meanwhile, cases of prostitution, drugs and violence involving women and children start to sky-rocket, changing forever the cities' routine. In Altamira, the nearest city to the Belo Monte dam construction site, cases of sexual violence against children and adolescents tripled compared to previous records registered before the construction of the dam: from 15 to 40 cases of children rights violation per day. Homicides increased 25% with the population explosion.

The impacts of this perverse model of development are not restricted to the cities. It also threatens the forests people, such as the Munduruku who live alongside the Tapajós river. In the indigenous perspective, these dams will bring destruction and death, disrespect and environmental crime. Historically, the construction of mega infrastructure projects in Brazil has been in violation of the rights of indigenous people. The Brazilian Constitution and international treaties, such as the ILO 169 Convention, demands that Indigenous people affected by such projects have the right of free, prior and informed consent. However none of the projects undertaken to date have complied with this premise.

When someone comes to you and says: "no Indigenous will be affected", that person might be hiding behind the different interpretations of the word "affected". Literally one might say that no Indian will be affected because no Indian will be drowned by the full reservoir. Or that the dams are not located inside Indigenous Lands. But in reality, the affected are all those people who will have their way of life dramatically changed due to the installation of the project, even if the area is

not flooded. A Panel of Experts, gathering 40 independent scientists and academics from well-known Brazilian and foreign institutes for an independent analysis of the Belo Monte Environmental Impact Assessment (EIA), point out that there is no guarantee that the Indigenous People mobility will not be affected by decreased river flow nor that the fisheries supply will continue as before. If the Indians have their main source of protein reduced and are isolated in some period of the year, their ancestral land becomes worthless, even without works or flood. Not to mention land invasion that they will need to face due to the workers migration.

The way forward: solar, wind, biomass, energy efficiency

Greenpeace Brazil opposes **the construction of new** hydro dams of any size in fragile ecosystems, such as the Amazon region, and recommends more investments in renewable sources, such as solar, wind and biomass as a means to attend the rising electricity supply. The continued investment in the hydro-thermal model will both increase emissions in the electricity sector and our vulnerability to climate change.

As much as the dry season impacts the overall hydro production, it is the best period for harnessing the wind power, and coincides with the biomass production. The past two years have also proven that the decrease in water precipitation has also reflected in more solar radiation and consequently photovoltaic generation.

Thus, the solution to attend the rising energy demand with a lower social and environmental impact is investing in wind, solar and biomass energy, which could provide around 4 GW of installed capacity per year, or 80% of the demand growth. The remaining 20% can be complemented with voluntary efficiency programs, retrofitting or repowering ageing dams, building small hydro plants and using natural gas thermal plants to attend peak loads. The potential of solar generation in Brazil could supply up to 10 times the national energy needs. Wind power could supply three times the current demand for electricity and has already the second lowest cost of generation from all sources.

According to the Energy Revolution Brazil report, released in 2013, the diversification of the electricity mix in the next decades should reduce the share of hydroelectricity from 78.1% in 2010 to 39.7% in 2050. By then, the share of solar, wind and biomass energy are expected to amount to 51.5% of the generated energy.

Greenpeace is campaigning for a future that will allow our forests to thrive - filled with unique wildlife and able to sustain local people and economies whilst cleaning the air of carbon: a future with no deforestation. We campaign for forest protection because, without healthy, thriving forests, planet Earth cannot sustain life. The only way forward to both reduce emissions, preserve the environment while guaranteeing social justice is through responsible and sustainable renewable energy solutions for all.

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