Photo Credit: Pedro Ivo Simoes

Amazon Dams, Climate Change, and Truly Green Energy: a Brazilian Case Study

Hydroelectric dams are consistently promoted as a "clean" and an inherently "climate-friendly" solution to meeting our growing energy needs. However, scientific studies indicate that large dams, especially in tropical environments like the Amazon, produce significant amounts of the greenhouse gases carbon dioxide, methane and nitrous oxide. In fact, the warming impact of tropical reservoirs can be much higher than even the dirtiest fossil-fuel power plants.

By driving climate change, these large dams also drive a destructive cycle that undermines their own rationale and viability: in 2010 the Amazon basin witnessed a drought of unprecedented proportions.[1] These warming conditions will be exacerbated by the deforestation of more than 5,000 km2 of rainforest from the construction of new dams and resulting greenhouse gas emissions.[2] As these rivers run dry, the water supplies that are destined to fuel hydroelectric turbines grow increasingly precarious.

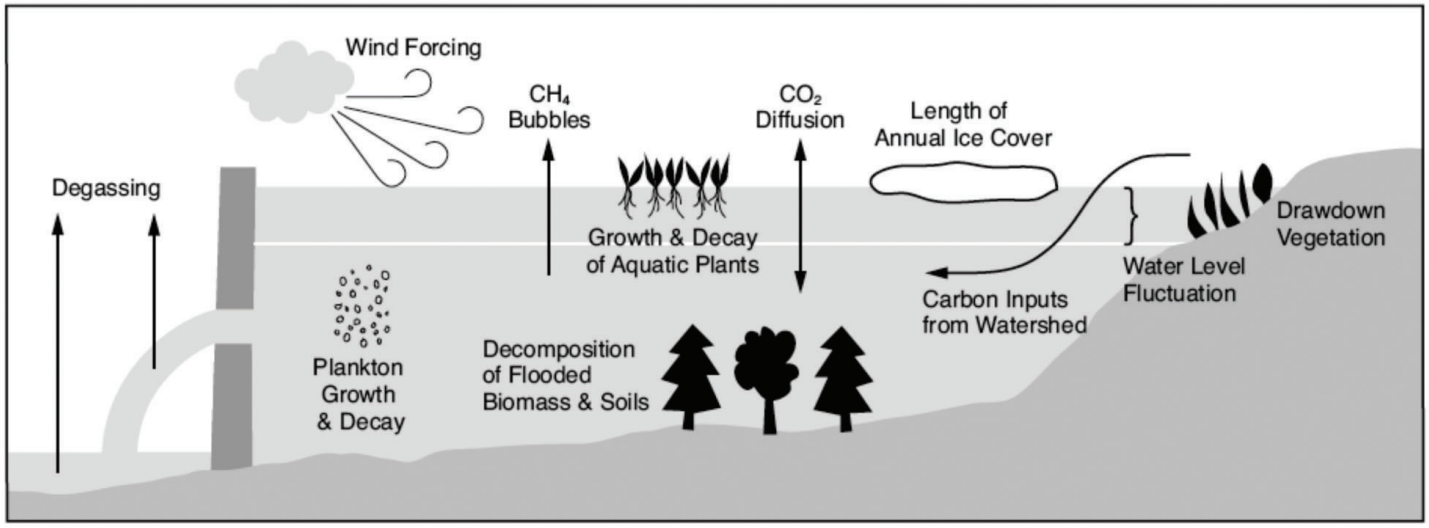
The Brazilian Government intends to build over 60 large dams in the Amazon basin over the next 20 years to supply its national electric grid.[3] In addition to incalculable social impacts of these mega-projects in sensitive regions, large dams in the Amazon threaten the biological integrity of river basin ecosystems with vast artificial reservoirs while intensifying pressures upon surrounding areas with deforestation and other forms of unsustainable resource extraction. Despite this, Brazil is well positioned to forge viable alternatives to this precarious development model by embracing truly clean and renewable alternatives for a sustainable energy future, where the peoples and forests of the Amazon need not be sacrificed for electricity.

Dams in the Amazon and Climate Change

Methane (CH4) is a potent greenhouse gas that has increased as result of human activities related to agriculture, ranching, and natural processes such as decomposition. A molecule of CH4 does as much as 34 times more damage that a single molecule of CO2. It represents 19% of the total greenhouse effect[4] and its present atmospheric levels have been unprecedented in the last 650 years.[5]

The contribution of dams to climate change could even be worse than expected. Scholars such as Philip Fearnside, a leading scientist at the Institute for Research in the Amazon (INPA), have extensively researched dams' greenhouse emissions. According to Fearnside, the lack of water movement increases the amount of organic material in tropical water reservoirs. This "dead material" decomposes and releases methane to the atmosphere.

FIGURE 1: A SCHEMATIC OF KEY FACTORS INFLUENCING RESERVOIR GREENHOUSE GAS EMISSIONS.



Source: International Rivers

The turbines that produce the electricity also generate methane. Turbines saturate water and change its chemical composition. The process is akin to how a soda machine carbonates water. When the pressure suddenly drops as turbines release water, methane is released. (See figure 1)

According to Brazil's National Institute for Space Research (INPE), the world's 52,000 large dams contribute to more than 4% of the total warming impact of human activities.[6] INPE also found that dam reservoirs are the largest single source of human-caused methane emissions. Fearnside also found that greenhouse emissions from the hydroelectric production of the Curu-Una Dam in Para, Brazil were 3.5 times higher than if the electricity had been produced by its fossil fuel burning counterparts.[7]

Critics of hydropower projects have stated that drying conditions and changes in precipitation will affect the Amazon River Basin, making hydropower a less viable energy source. During the 2005 drought, the Madeira river water levels fell to one-tenth of rainy season levels, limiting navigation and potential for electricity production. A recent forecast for 2070 by Brazil's CREAS Project stated that an increase of 4 C in temperature will be translated to as much as 15-20% reduction of rainfall levels.[8] These drought conditions in Northern Brazil are expected to worsen due to the construction of 60 new dams in the region.

True Green Energy and Viable Solutions

There are many alternatives for meeting Brazil's energy needs without compromising environmental sustainability. By prioritizing the development of truly clean energy alternatives, Brazil could eliminate the need for large dams in the Amazon. Rather than invest in large, inefficient dams, Brazil has the potential to be a global leader in energy efficiency and renewable forms of energy such as wind and solar power, conserving the Amazon ecosystem and drastically cutting greenhouse gas emissions.

Brazil has the capacity to produce up to 280,000 megawatts (MW) from renewable sources.[9] This quantity is equivalent to the electricity produced by the Itaipu Dam, the world's second largest. Energy efficiency and conservation could be achieved by reducing the startling amount of energy lost during transmission, replacing energy-inefficient household products, and updating old and failing generators. Brazil has a wealth of clean and renewable energy options, such as wind power, solar energy, and updating old and inefficient energy infrastructure.

Wind Power: Wind power is produced by high towers with propellers, similar to mills. These can be up to 120 metres tall. The towers are equipped with a generator that transforms wind into electricity. Due to Brazil's landscape, wind energy represents a viable option that can be used to satisfy up to 20% of its energy

demand. The current installed capacity of wind power in Brazil is close to 800 MW; this quantity is expected to surpass 5,000 MW in 2012 as result of Brazil's Alternative Energy Fund's incentives.[10]

Solar Power: Photovoltaic panels are often installed on top of houses and buildings to capture sunlight and convert it into electricity. The panel uses rechargeable batteries that store energy. Solar energy can be generated at homes and commercial buildings, located in both urban centres and isolated communities. Solar energy fields are also a feasible option for sun-rich Northern Brazil. Brazil's average annual global radiation is nearly 23,000 kilowatts per square metre.[11] If 5% of this energy were harnessed, all of Brazil's energy demands could be met. A more practical use of solar power water heaters, however, by 2007, only 1.5% of Brazil's residences had this technology installed.[12]

Energy Efficiency: Brazil could cut its expected demand for electricity by 40% by 2020 by investing in energy efficiency. The power saved would be equivalent to 14 Belo Monte hydroelectric plants and would result in national electricity savings of up to R$33 billion (US$19 billion).[13] Sustainable energy development goes hand in hand with the smart use of already installed energy capacity, by "producing" more energy by incorporating efficient solutions in the existing infrastructure. By 2050, 26% of Brazil's energy demand could be reduced with the implementation of energy efficiency alternatives.[14] Examples of these alternatives are: bioclimatic architecture to enhance ventilation, installation of florescent lamps and thermal insulation of roofs to reduce loss of cold and heat. In the long run, increasing energy efficiency is more cost-effective than the development of new energy infrastructure such as hydroelectric dams.

Retrofitting Existing Power Plants: Retrofitting Brazil's existing hydroelectric infrastructure would add thousands of megawatts to the energy grid without needing to dam another river. Scholars have suggested that retrofitting larger hydroelectric plants in the Amazon could improve the country's supply by 15,000 MW,[15] which is more than the full generating capacity of the planned Belo Monte dam. Some studies indicate a potential of up to 32,000 MW for a low cost of US$ 135-300 for each additional kilowatt.[16]

A new vision for energy security paired with environmental sanity

In the context of the increasing volatility of our global climate, and the growing alarm that the Amazon rainforest is threatened by a tipping point from which it cannot recover, the Brazilian Government's reckless energy plans for the basin's rivers are particularly disturbing. This situation urgently calls for a reassessment of the country's ambitious development plans for the Amazon within a new vision of environmental sustainability. If the Government of Brazil chooses to incorporate cleaner energy alternatives and invest in efficiency, it has the potential of developing a 93% clean matrix by 2050.[17] The clean matrix will help consolidate Brazil's commitment to reduce 39% of green carbon emissions by 2020. With the right policies from the government and the electric sector, Brazil has the potential to be a global leader in energy efficiency, creating millions of jobs while conserving the Amazon ecosystem.

Photos courtesy of Amazon Watch, International Rivers and the Rainforest Foundation UK

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