8
Water Sustainability and Power Generation in BRAZIL

8.1 Water challenges

Brazil is a prime example of a region where water pressures and resulting financial risks are not solely a consequence of chronic water shortages or prolonged droughts, but also unsustainable water management and agricultural or industrial pollution of water resources.

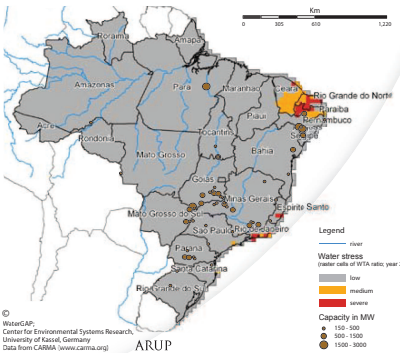
8.1.1 Water availability

Brazil has abundant water resources with approximately 12% of the world's available freshwater resources. Important sources of water include the Amazon River basin, Tocantins-Araguaia river basin and the São Francisco river basin.

While the average availability of water across the country is high, the North-eastern region has an arid climate with only 3% of the country's water resources, but almost 30% of the population. In this area river basins that are classified as water stressed are illustrated in **Figure 9**. Water stressed regions also exist in the south where much of Brazil's urban population is found. Competing uses in the area, further enforced by poorly maintained and managed water supply systems, have led to water conflicts.

Figure 9:

Overview of the water withdrawal-to-availability ratio calculated by WaterGAP. This shows low, medium and severe water stress in river basins across Brazil. The location of selected power stations (>150 MW) is also indicated.



8.1.2 Climate change impacts

A detailed assessment of different climate change scenarios and their impact on water resources and agriculture is beyond the scope of this briefing, however key issues are worth highlighting. For example, the potential consequence of changing rainfall patterns which may cause decreases in water availability and erratic rainfall patterns. In the semi arid north-eastern region, model simulations suggest that by the middle of the 21st century, annual average river runoff and water availability will decrease. An outlook on how water availability is expected to change (shown in **Figure 3**) is provided by the University of Kassel.[69] These changes to water availability will have direct consequences for the electricity power sector.

See PI-TP 6

8.1.3 Institutional/regulatory context

The *National Water Resources Policy* (Law 9.433/97) provides guidance on water sustainability issues. It introduced the following fundamental premises for water management in Brazil: (i) water as a public good; (ii) water as a limited resource, with economic value; (iii) priority for human consumption and watering livestock; (iv) use of water by several sectors (challenge of preventing conflicts on water use); (v) river basins should be the planning and management unit; and (vi) participative management.

The regulation of water use in Brazil is based on a framework that promotes the "user pays" and "polluter pays" principle. For São Paulo state for example, law n°12.183/05 entitled "Disposition on charges for water use in São Paulo State" and its implementation decree n°50.667 of March 2006 provides regulation. **In light of sharpening federal regulation on water, financial institutions should encourage clients to comply with emerging regulation in Brazil before it becomes mandatory.**

See PI-TP 7 & 8

Watershed and basin committees have recently formed and have introduced voluntary water-user fees. In general, fees are collected by the local water management agency to redistribute a proportion to local watershed management committees. Similar schemes, based on payments for ecosystems services are increasingly common.[70]

See PI-TP 10

8.2 The electricity power sector in Brazil

Brazil's energy mix is characterised by renewable sources.[71] Hydropower plants represented the vast majority (77%) of Brazil's internal electricity production in 2007. The reminder of the national electricity mix consisted of thermal power (14.5%) and imported energy (8.5%).[72]

The largest hydropower station in operation is Itaipu, on the border with Paraguay at the Parana River. Itaipu, although not the world's largest hydropower plant, does generate the most electricity and has an installed capacity of 14 GW, with 20 generating units of 700 MW each. Other hydropower plants are concentrated in central-southern Brazil which is the most developed part of the country.

With regard to thermal power plants, their contribution to the electricity mix has increased over recent years. Thermal power stations have played an important role in providing electricity during peak demand periods and droughts when water levels in reservoirs are low. They also supply towns and communities that are not connected to the national electrical grid.[73] Thermal power plants are fired by biomass, natural gas, petrol derivates, nuclear and mineral coal. These sources of energy accounted for 4.1%, 3.3%, 2.8%, 2.6% and 1.6% respectively within the Brazilian electricity mix of 2007.[74]

8.2.1 Expansion

Brazil's hydroelectric potential is immense (more than 100,000 MW), yet estimates vary.[75] This potential includes small, medium, and large size dams. Brazilian's regulations define small dams

as less than 30 MW, medium dams as less than 500 MW, and large above this limit. Approximately, 40% of the potential is located in the north of the country.[76]

Various dams are currently being assessed, funded or built and there are prospects for many others to be realised in near future.[77] However, a key requirement for new reservoirs and schemes under Brazilian Legislation is an Environmental and Social Impact Assessment.

Financial institutions have the ability to influence the approaches used to realise the country's electricity generation capacity. Besides requirements of the statutory process, wider sustainability frameworks can help to assess the sustainability issues at stake.

See PI-TP 1 to 22

Expansion of gas-fired thermal electric power is hampered by the limited pipeline network (availability of gas), in addition to the high cost of this fuel source.[78]

8.2.2 Renewable energy (biomass)

The use of biomass as a source of electrical energy has increased in Brazil, notably in co-generation systems belonging to the industrial and agricultural sectors. The term "biomass" includes many types of industrial and agricultural residues, such as sugar cane bagasse, black liquor (cellulosic pulp residue), wood waste, rice husk and biogas. Generally, few power plants with installed power capacity up to 60 MW use biomass as a fuel. . These are located close to industrial users, and are scattered across the agricultural hotspots.[79]

8.2.3 Other

Petrol derivates such as diesel, residual fuel oil, ultra-viscous oils or refinery gas are used to fuel thermal power stations.

Water permitting and water sustainability of a new Thermal Power Plant in Brazil

The coal-fired plant President Medici (UTPM) in the State of Rio Grande do Sul is looking at an expansion scheme (Candiota III, new phase C) to deliver an additional capacity of 335 MW. The Brazilian environmental agencies have granted a Water Usage Permit (outorga) and the Installation License. On the basis of studies on water availability and water demand the outorga was granted for the Arroio Candiota River Basin. It outlines a maximum withdrawal rate of 292 L/s, operating 24 h/day, 365 days per year. According to the National Water Agency this rate will ensure a minimum flow of 187 L/s downstream of the dam supplying water to the power plant.

See PI-TP 10

No water user fee is established in the river basin where UTPM operates and the region is not classified as water stressed according to the WaterGAP analysis. (see Figure 4). The project plans the adoption of a semi-dry desulphurization system for coal, which is characterized by low water consumption and does not generate liquid effluent. The cooling system of the thermal engines is semi-open (evaporative cooling tower).

See PI-TP 2 & 7

Sources: [80,81]