Evaluating regulatory strategies for mitigating hydrological risk in Brazil through diversification of its electricity mix

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1. Hydroelectricity: the backbone of the nation’s electricity generation

2. Hydrological risk

3. The nexus approach: challenges and opportunities for the electricity mix strategies in Brazil
Brazilian electricity mix

Figura 16. Matriz de capacidade instalada de geração de energia elétrica do Brasil sem importação contratada.

Fonte dos dados: ANEEL e MME

‘Boletim Mensal de Monitoramento do Sistema Elétrico Brasileiro’, Brazilian Ministry of Mining and Energy
Hydropower Global Capacity: Brazil 2nd place in the rank

Hydropower Global Capacity, Shares of Top 10 Countries and Rest of World, 2017

- 28% China
- 9% Brazil
- 7% Canada
- 7% United States
- 31% Rest of World

Next 6 countries:
- Russian Federation 4.3%
- India 4.0%
- Norway 2.7%
- Turkey 2.5%
- Japan 2.0%
- France 1.7%
Brazilian hydroelectric plants by basin

SIGEL/ANEEL. Sistema de Informações Geográficas do Setor Elétrico, 2016
Recent Water Crisis

The Amazon effect: how deforestation is starving São Paulo of water, The Guardian, 28 November 2017
Recent Water Crisis

• When? 2013-2017

• Why?
  • Water management
  • Inefficiency of use
  • Consecutive years of reducing precipitation
  • Deforestation in the Amazon for pastureland? Debatable
“We should not transform the Amazon into pastureland,”
“The Amazon creates a movement of water. If you could follow a molecule of water you would see that most of the clouds that are over São Paulo have passed across the Amazon. If the forest is cut, we’ll be in trouble.”

Jefferson Kelman, president of São Paulo water company Sabesp

The Amazon effect: how deforestation is starving São Paulo of water, The Guardian, 28 November 2017

http://riosvoadores.com.br/o-projeto/fenomeno-dos-rios-voadores/
Recent Water Crisis

• Effects

  • Offset by thermal power production, increasing the economic costs and the greenhouse gases emissions

  • Rationing (water supply for approx. 20 million people in the region) and tariff raises

  • Pressures over water uses – competition amongst the users

  • Generator's exposure in the spot market
Hydrological risk: definition

• **Broadly** speaking, issues related to the quantity and quality of the water, either too much or too little, affecting the operation of a hydropower plant or other phases of the project

• More **specifically**, during the operation of a hydropower plant the risk of insufficient amount of water to support the expected levels of electricity generation, with potential physical and financial impacts

(Blomfield and Plummer, 2014)
Hydrological risk: Brazilian policy

- **Energy Reallocation Mechanism (MRE):** a compulsory hedge for the total production of all the interconnected grid hydropower plants during dry periods (Law No. 13.203/2015)

- **Objective:** optimal use of the water resources to manage hydrological risk in times of insufficient water (takes into account different patterns of energy production throughout the year) and avoid high financial exposures of the generators in the spot market.

- The MRE scheme consists of the assignment of credits that consider the proportion between, on the one hand, the sum of all the energy produced within the MRE and, on the other hand, each participant’s assured certificates of physical guarantee based on the amount of energy equivalent to the plant’s installed capacity. This calculation of the MRE adjustment factor is known as the **Generation Scaling Factor (GSF).**
Hydrological risk: Brazilian policy

Scenario 1: Generation > Physical Guarantee

- Surplus
- Physical Guarantee
- Generated Energy

Scenario 2: Generation < Physical Guarantee

- Deficit
- Physical Guarantee
- Generated Energy

Credit in the Spot Market

MRE adjustment factor = Generation Scaling Factor (GSF) = Exposed in the Spot Market
Hydrological risk: Brazilian policy

The problem: 'systemic risk' caused by serious drought, overall production is collectively below expected and contracted levels

Consequence: the hydropower generators were forced to purchase short-term energy at higher prices in the spot market to comply with their contractual obligations, creating a large financial deficit with billions of Brazilian reais at stake (negotiations on the debts and lawsuits)
Hydrological risk: under de Nexus approach

**Challenges**

- Limit the solution to the financial impacts in the generators’ pocket
- Overdependency in hydroelectricity in times of water scarcity

**Opportunities**

- Discuss the causes from and the effects to natural resources involved in the process (forest clearance for farms causes impacts on the water cycle, floods of forest for dams)
Hydrological risk: under de Nexus lenses

**Challenges**
- Energy security and sustainability
- Regulatory fragmentation
- Power asymmetries
- Competition for water resources

**Opportunities**
- Diversification of the electricity mix (analysis using Integrated Assessment Modelling – IAM tools to explore future macroeconomics scenarios for Brazil in the global context)
- Brazilian NDC's: **reduce** GHG emissions by 37% below 2005 levels in 2025, and **increase** by 43% below 2005 levels in 2030 renewables (other than hydropower) in the power supply to at least 23% by 2030.
Many thanks for your attention!

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Variation in electricity prices by scenario (w/r to baseline)

- Baseline
- Carbon Tax
- Subs.
- FiT
- FF Cap
- Hydro Cap
- Mix
- Mix + Bio Cap

Change with respect to baseline

Year

2018
2022
2026
2030

-5%
0%
10%
20%