

## Water shortage and simulations of economic effects

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**The risk of water rationing and its impacts on the economy should be closely monitored.** Low rainfall in the Southeast is the main factor behind this risk. Our simulations indicate that in November, at the end of the dry season, reservoir levels could fall to 10% – a critical, but still operable level. In the absence of rain, or if water reserves are unable to recover, thermally generated energy dispatches will remain high throughout 2022. While our base-case scenario remains of reduced risk of energy rationing, this risk increases over time if rainfall remains below average. In other words, the rainy season will be crucial to assess the risk of rationing in 2022.

**Rain forecasts for the next few months suggest lower risks in the short term, but the chance of La Niña weather event during the rainy season is an important risk.** Despite the difficulty in predicting rainfall so far in advance, for now, Inmet's forecasts point to more rain throughout the country, mitigating the risks. In addition, the institution confirmed the forecast of a La Niña later this month. Until then, the La Niña will not be as intense, which also mitigates the impact on lower rainfall in south-central Brazil. In any case, we are keeping a close eye on how these forecasts develop, given the current water situation.

**We summarized some information of the electricity system to create a risk indicator** (Chart 1) The following factors were considered in the indicator, with different weights: increase in load; affluent natural energy (NAE) as a ratio of the historical average; reservoir levels; thermal generation capacity utilization and the temperature of Pacific waters. The higher the indicator, the greater the risk of water shortages. However, since our observations only date back to 2006 to create the indicator and no water rationing has been declared since then, there is no threshold after which the indicator signals a major risk of electricity rationing. At least we can establish that numbers below 25 (highest score recorded between 2006 and 2021) indicate that there is no significant risk of rationing. In addition, the risk is higher at the end of the dry season, but we chose not to seasonal adjust the indicator. The indicator is a simplification of the water scenario and additional analyses are important to estimate the probability of adverse scenarios. However, the indicator proved to be able to point out the risks in recent years (2014-15, 2020), serving as a warning.

**Rainfall is critical to the indicator.** Rainfall and the increase in Southern reservoir levels were sufficient to mitigate risks of rationing in the National Interconnected System (SIN), which had been rising throughout the year. However, considering information from the Southeast/Midwest subsystem, where rainfall shortage has been more intense, the risk continued to grow in recent weeks. The indicator also showed a higher risk in late 2020 and early 2021. At that point, the red flag tariff was imposed and thermal plants were commissioned, indicating water shortage. The NAE rose from around 60-65% to 75-80% of the LTA (long-term average) between November and March – period during which rainfall is seasonally higher. This allowed some recomposition of the levels of reservoirs in the Southeast/Midwest subsystem, mitigating the risk of compromising the electricity system. Even with a less risky scenario, the choice to keep thermal plants operating was justifiable to overcome the dry season, where less rain was expected. That is exactly what happened: in short, low rainfall reduced the level of reservoirs, even for the dry season.

**Chart 1: Rationing risk indicator\* (7-day average)**



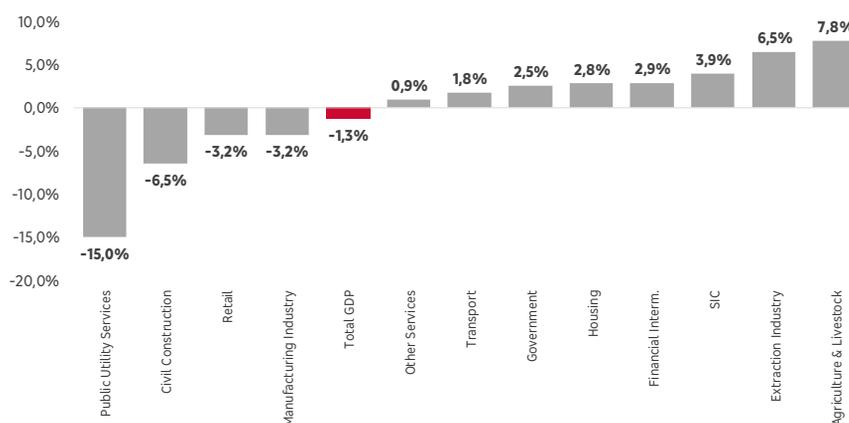
(\* ) Considering reservoir levels, affluent natural energy, operation of thermal plants, energy load and temperature of Pacific waters.

Source: ONS, NOAA, Bradesco

**Even with the recent increase, there is no major risk of electricity rationing, but it is important to underline some relevant considerations regarding its impact in the economy.** Nowadays, the electricity system is better prepared to withstand draught periods compared to 2001, when rationing was implemented due to water shortage. In another more recent episode, in 2014-15, the water crisis led to an increase in capacity utilization of thermal plants. The energy matrix is more diversified and the hydroelectric generation lost share in total output (from 83% in 2000 to 62% currently), while the participation of thermal plants in the system rose significantly (14% to 26% in the same period). In addition, transmission lines more than doubled in the period, making the domestic grid more interconnected and increasing the possibility of energy exchange between regions.

**In the 2001 episode, electricity rationing shaved about 1.5 p.p from headline GDP growth.** The effective GDP result was a 1.3% drop between the first and fourth quarters of 2001 (Chart 2). In addition to the industrial utilities component of GDP, the most significantly affected sectors were construction, retail and manufacturing.

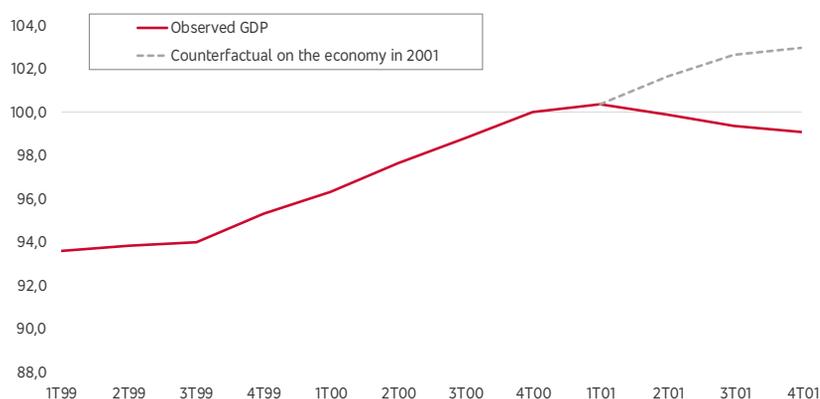
**Chart 2: Effective GDP accumulated between 1Q01 and 4Q01 (in %)**



Source: IBGE, Bradesco

**The energy crisis impacted economic growth forecasts in 2001.** The consensus forecast, as per the Focus survey of the Central Bank, stood at 4.0% at the beginning of the year. After it became clear that Brazil would be forced to ration energy, around April-May, growth expectations revised significantly lower. Based on this information, we prepared a counterfactual growth scenario for 2001, considering effective data from the 1st quarter and, as of the second quarter, we used Focus' expectations (Chart 3). This hypothetical scenario indicates that the GDP should have grown by about 3.7% that year. However, the economy grew only 1.4% in the year. This difference between effective and counterfactual accounts for a total impact of 2.3 p.p<sup>1</sup>. However, it is important to discount two GDP-reducing factors that were relevant at the time: the strong recession in Argentina (Brazil's number-two commercial partner in 2001) and the 9/11 attacks, which worsened financial conditions around the globe. The combination of these two effects, in our estimates, removed 0.8 p.p. from Brazil's growth. Therefore, we believe the energy crisis back then ultimately reduced the country's GDP by 1.5 p.p.

**Chart 3:** Observed and counterfactual GDP for the economy without rationing in 2001  
Index 4Q/00=100



**Source:** IBGE, BCB, Bradesco

**However, the impact of 2001's rationing in the activity shouldn't be flatly extrapolated to the current scenario.** Again, there are mitigating factors, such as the lower reliance on hydropower and greater connectivity between regions. Thus, we can expect a smaller impact than what we saw back in that period, albeit still negative.

**Finally, even without rationing, the operation of thermal plants has some negative impact on growth, although significantly smaller.** The added value generated by thermal plants is lower than other energy sources. According to our calculations, an increase of 10 p.p. in the share of thermoelectric plants in total energy generation reduces the GDP index by approximately 0.2 p.p. per quarter, in the year-on-year comparison. In 2001, this effect was residual (-0.1 p.p.), given the low weight of thermal plants at that time. In this sense, even if a more severe rationing scenario does not play out ahead, the prolonged operation of these plants by itself already has a negative impact on growth. We've had a 14 p.p. increase in the share of thermal plants – the percentage of thermal plants went from 14% to 28% between 3Q20 and the same period of 2021. Therefore, part of this negative impact for the activity is materializing this year. The effect for 2022 will be reduced, seeing as thermal plants are approaching their operational limit.

<sup>1</sup> Difference calculated by GDP level.

**Inflation has already been impacted, and an eventual rationing could put more pressure on prices.**

The energy component in consumer inflation should reach 20.1% this year, reflecting high annual adjustments and changes to tariff flags, including a higher value for water shortage, implemented in September. Our benchmark scenario for 2022, which does not include electricity rationing, considers a deflation of around 4% in energy prices. This is basically a reflection of the removal of the water shortage tariff flag and implementation of the red flag 1. In the event of rationing, we estimate that energy inflation could reach +7.1% (i.e. 0.50 p.p. added to consumer inflation – Table 1). This is a direct impact on energy prices and does not include impact on exchange prices, for example. Another impact to be considered is the greater inertia due to higher general inflation in the event of a water shortage tariff flag implemented throughout the year, which we estimate at +0.1 p.p.

**The currency depreciation in 2001 was not exclusively explained by energy rationing, in our view.**

The country’s external sector fundamentals were substantially more fragile at the time. Also, as mentioned above, the global scenario was more adverse for Brazil and emerging nations in general. Our reading is that the BRL’s depreciation in 2001 was strongly tied to external events, while the contribution of energy rationing is not entirely comparable to the current scenario. In this sense, we did not incorporate exchange rate changes to inflationary impacts.

**Table 1:** Energy inflation (%)

	<b>Energy inflation (%)</b>
<b>2021</b>	20,1%
<b>2022 Base</b>	-4,0%
<b>2022 Rationing</b>	7,1%

**Source:** IBGE, Bradesco

**in short, the effects of an eventual energy rationing are negative for the economy and inflationary.**

In the economy’s case, there are mitigating factors, in 2022, of the impact seen in 2001, judging by the system’s integration and alternative energy sources. It would be unlikely to see the same impact observed that year; perhaps a good estimate is that the impact would be less than half as intense. In the case of inflation, impacts are more direct and do not depend on the parallel with 2001. The rainfall regime is the most important variables for this matter. It can’t be predicted so far in advance; we can only monitor it. For now, our base scenario does not consider energy rationing in 2021 and 2022. Therefore, our GDP and inflation forecasts do not reflect this risk, as of this moment.

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