THE IMPACTS OF CLIMATE CHANGE ON THE GENERATION OF HYDROELECTRIC ENERGY AND ITS EFFECTS ON THE BRAZILIAN ECONOMY BETWEEN 2020 AND 2050

Abstract

The processes of global warming and climate change will have significant consequences for the national energy system, with direct and indirect impacts on renewable and non-renewable energy sources. The phenomenon, reflected more clearly in changes in precipitation and temperature levels, could negatively impact the hydrological cycles and consequently the hydroelectric generation capacity in Brazil with significant effects on the Brazilian economy.

The possible reduction in the supply of hydroelectric power could be offset by other renewable and non-renewable energy sources. Renewable sources of electricity, such as wind, for example, while being an important alternative to climate change adaptation and mitigation, are also not immune to the effects of climate change. On the other hand, non-renewable sources, such as thermoelectric, present as a negative factor in global warming, since they are emitters of greenhouse gases.

The Brazilian national energy system is interconnected and comprises the hydroelectric, thermoelectric, and wind power sources. The system allows the generation of energy by one region and use by another. The installed capacity of electric generation in Brazil was 150.3 GW in 2016, being generated mainly by hydroelectric plants (64.5%) and thermoelectric (27.4%).

Since about 65% of the country's electricity supply comes from hydroelectric plants, it is necessary to evaluate how the drop in supply of this type of energy will impact the economy, in addition to, verifying how the energy loss will be compensated for between the other sources, in the face of increased demand for energy. In this sense, the objective of this study is to evaluate the economic impacts of the hydroelectric energy supply reduction induced from the process of climate change in Brazil between 2020 and 2050, as well as to evaluate the effects of using other sources to compensate the power supply.

The methodology starts from projections in a Computable General Equilibrium model called BeGreen, capable of capture changes in the Brazilian electrical matrix and its effects on the economy. The model also captures how the restriction of hydroelectric energy can be compensated for by the generation in thermoelectric plants and wind farms. Projections for the drop in hydroelectric energy supply resulting from IPCC climate change scenarios were taken from Lucena (2010).

Two scenarios were simulated, the first allowing the supply of energy electricity from thermoelectric and wind farms to increase to compensate for the restriction imposed on hydroelectric plants, and a second, in which the increase of these sources would follow the 2016 National Energy Plan (NEP).

The results indicate that the production of electric power by thermoelectric and wind farms should increase by 25% by 2050 in order to compensate for the drop in the energy supply of the hydroelectric dams, projected by the climatic scenarios. This is a

magnitude beyond the growth predicted by the National Energy Plan (NEP). Taking into consideration that the greenhouse gas emissions from the thermoelectric plants contribute to the global warming process, proper planning by policy makers relating to clean and renewable sources becomes advisable.

The results suggest a drop in the main macroeconomic indicators, albeit marginally until 2050. In terms of the effects on GDP, there is a fall in both scenarios for the year 2050. In Scenario 1, where thermoelectric and wind farms increase production to offset the power supply constraint of hydroelectric plants, the drop is 0.14%. In Scenario 2, analyzing the pure effect of the hydroelectric energy restriction, in which the other sources do not compensate it, the GDP retraction is of the order of 0.38%. The decline in GDP is associated with a drop in hydroelectric power generation and a consequent drop in the activity level of other sectors that use energy as an input for production, which leads to a reduction in exports and also implies a reduction in household consumption, due to observed increase in the price level.

However, imposing a restriction on the supply of electricity makes this input more expensive with cost impacts across other sectors of the economy, raising the overall price index. The consumer price index in scenarios 1 and 2 increased by 13% and 40% respectively. This generalized price increase would discourage investment, employment, and activity in the economy.