ASSESSMENT OF THE ECONOMIC VALUE OF NATURAL UNDERGROUND GAS STORAGE FOR THE BRAZILIAN POWER SECTOR

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Overview

This paper aims at assessing the main obstacles to the development of underground natural gas storage (UGS) in Brazil and at identifying the conditions required for the feasibility of USG projects in the country. In particular, it attempts to estimate the economic value of UGS facilities for the power sector in Brazil, given the specificities of the Brazilian power and gas sectors. This paper shows that, differently from the US gas market, the Brazilian gas market does not have the typical seasonal characteristics associated Winter gas consumption for space heating. Instead, in Brazil, gas demand shows a volatility of a random nature associated with gas demand from the power sector, given that thermal generation is complementary to hydropower generation. Finally, this paper argues that it is essential to seek mechanisms to include the economic value of UGS for the power sector into the design of USG regulation.

Methods

This paper gas estimated the value of OGS for the Brazilian Power Sector through a simulation of the use of a hypothetical UGS project in Brazil between 2006 to 2014. The paper proposes that the Brazilian power sector can use the UGS as a new energy storage capacity similarly to the storage in the hydropower reservoirs. This integration would occur to increase the flexibility in the thermal dispatch to the system while preserving the purchase of a minimum flow of gas by the thermal power plants.

In conceptual terms, in certain occasions it would be economically and technically interesting to divert the volumes of natural gas to be consumed by the inflexible thermal power plants1 to UGS. Some favorable hydrological occasions, the "must run" thermal power plants could be shut down, the gas diverted into UGS, and the hydropower generation increased. Since in the case of the inflexible thermal power plants the cost of this gas is included in the power purchase agreements, it is paid by the power consumers independently if it is consumed or not. Therefore, the gas stored in UGS could be used later in adverse hydrological conditions, by the flexible thermal power plants, avoiding the importation of LNG for this dispatch.

The paper has considered actual data for price of electricity in the spot market and the price of LNG imported to estimate the avoided LNG cost during the period. The paper has simulated the situation where a UGS would have been used to store natural gas during periods of low electricity prices (high rain levels) to be used in periods of high electricity prices (low rain levels). The paper used a cash flow analysis to estimate the attractiveness of the investment in a UGS project, that would be used during the period.

Results

This paper attempted to highlight the economic value that the UGS can provide for the Brazilian power sector. It has presented some relevant specificities related to the gas and power market in Brazil, showing a different role played by the UGS in relation the storage markets in other countries. We have highlighted that the Brazilian natural gas market demand does not have a seasonal characteristic; instead, it shows a random nature associated with the demand from thermal power generation segment, which is complementary to the national hydropower generation.

Due to the specific characteristics of the Brazilian gas and power markets, the paper proposes a market design for gas storage services, based in the value that can be created for the Brazilian power sector. In order to make economic viable investments in UGS projects, it is proposed that the Brazilian power sector hires storage capacity, in order to

[1] These are the thermal power plants under "must run" status. Some thermal power plants are considered inflexible as the gas supply can not be interrupted.

avoid the consumption of natural gas by inflexible power plants, during periods of very low power prices (favorable rain periods).

Based on the pricing assumptions a UGS project would have an internal rate of return of 18% and a NPV of US$ 263.73 million, (considering a cost of capital of 8% p.a.). In order to prove the soundness of the economic results found, a sensitivity analysis regarding the most important variables was carried out, varying the CAPEX and OPEX for the UGS facilities. Therefore, according to the assumptions adopted and based on the sensitivity analysis for both CAPEX and OPEX, the paper proves that there is a great economic value associated with the gas storage at low price of power to be consumed in period of high price of power.

Conclusions

Results of the simulation performed lead to important considerations in energy policy. Firstly, it would be important for the ONS to carry out detailed studies to estimate the economic value for the Brazilian power sector be provided with UGS capacity, by simulating the hydrothermal system, with a stochastic dispatch model for the power system that also represents the UGS as a resource.
The simulation could consist of two steps: i) hydrothermal dispatch of the SIN representing "Take or Pay" as operational inflexibility and without the possibility of storing gas: It represents the current operation performed (optimization of hydropower reservoirs only); ii) hydrothermal dispatch of the SIN allowing "Take or Pay" to be stored in the gas reservoir: representation of how the operation can be performed with the possibility of storing gas (optimization of the hydropower reservoirs together with the gas reservoirs).

As a result, a comparison of the expected operating cost reduction can be made and compared it with the investment in the UGS, in order to obtain the economic benefit of its implementation. The estimated economic benefits can be compared with the costs of building a UGS (Hoelen et al., 2006, Orin, 1995, Barroso et al., 2005 and Bezerra et al., 2010). Finally, upon confirming the economic value for the power sector be provided with this type of facility, the next challenge would be how define a specific economic regulation to allow the implementation of UGS in Brazil, especially in relation to the conditions of the country's energy market.

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