



POTENTIAL IMPLEMENTATION RISKS IN THE PILOT ENERGY EFFICIENCY AUCTION IN RORAIMA

Between 2018 and 2020, the Brazilian Electricity Regulatory Agency (*Agência Nacional de Energia Elétrica* - ANEEL) held public consultations to receive input for the preparation of a request for tenders for the energy efficiency auction. The purpose of the auction is to hire entities to carry out energy efficiency (EE) actions aimed at reducing electricity consumption in the city of Boa Vista in the state of Roraima, Brazil.

This analysis, carried out by researchers from the Climate Policy Initiative/Pontifical Catholic University of Rio de Janeiro (CPI/PUC-Rio), aims to explain the EE auction design and to point out and assess the risks of the proposed model regarding its implementation in Roraima's pilot.

The state of Roraima is the only state in the country that is not a part of the National Interconnected System (*Sistema Interligado Nacional* - SIN), which produces and distributes electricity throughout the country. Between 2001 and 2019, Roraima imported electricity from Venezuela, but such imports have since been discontinued with the onset of Venezuela's political and economic crisis. As a result, the state of Roraima became solely dependent on local power generation, provided by diesel-fueled thermoelectric plants, which, in addition to being expensive, are also highly polluting, inefficient, and sometimes fall short of demand. With insufficient electricity supply, citizens in Roraima are experiencing blackouts while paying some of the highest electricity tariffs in the country.

On the one hand, Roraima is a suitable location for the pilot energy efficiency auction in Brazil considering the state's supply-related challenges. On the other hand, when viewing this auction as a test case for future EE auctions in the country, the current atypical situation of the state may hinder applying the same method in the other states in Brazil.

Other countries have had experiences that can help shape future auctions in Brazil. In the United States, the Bid4Efficiency program was intended for commercial and industrial projects and winners were chosen based on the lowest incentive rates offered per kilowatt-hour. The Swiss ProKilowatt program provides project financing based on the capital to kilowatt-hour savings ratio. These sample projects, however, are based on the submission of bids rather than actual EE auctions, which remain unprecedented. In 2019, Canada initiated a pilot EE auction project where each participant would submit a bid with different price levels for different amounts of energy to be avoided.

Regarding Brazil's energy efficiency auction pilot project, this study's contributions seek to mitigate the risks tied to the winner's curse phenomenon, to the chosen measurement and verification (M&V) methodology, and present the implementation challenges associated to the misalignment between the interests of the electricity distributor and those of the central planner.

BOX 1. POTENTIAL RISKS IN THE PILOT ENERGY EFFICIENCY AUCTION

- Risk concerning the auction design tied to the winner's curse.
- Risk of the chosen measurement and verification (M&V) not working given the impossibility of measuring real reduction of consumption due to the auction.
- Risk of not taking full advantage of the EE measures potential due to M&V's methodology directing the EE actions exclusively to the treatment group.
- Risk of lack of interest on the part of the auction buyers, since the current structure lacks incentives for the energy distributors to provide rational energy consumption.
- Risk of the pilot EE auction not presenting external validity, since Boa Vista differs in many ways from the other cities.

PROPOSED EE AUCTION DESIGN

In preparation for the EE auction, the city of Boa Vista was divided into eight lots, with public lighting counting as a single lot that encompasses all illumination points throughout the city. Each of the remaining seven lots, referred to as broad competition lots, consists of several neighborhoods. Within these lots, EE actions may target the following consumer units (*Unidades Consumidoras* - UCs): normal residential, low-income residential, and normal commercial.

EE actions in the public lighting lot include the replacement of light bulbs and other accessories as needed. In broad competition lots, actions may include the replacement of electronic equipment, improvements to the facilities, installation of distributed generation, installation of storage facilities, and even initiatives to change the behavior of UC occupants in ways that reduce electricity consumption. All these actions will be carried out by the winners of each auction lot and the costs incurred may be shared with the UCs, if so agreed upon by the parties.

Domestic or foreign private companies, either individually or in consortia, may participate as bidders in the auction, and must meet a series of requirements laid out in the tender. Requirements include the receipt of bid bonds in the amount of R\$ 131,400 and pre-registration in the auction for each lot of interest. Thus, eligible bidders will submit - in sealed envelopes - the amount they are willing to receive per megawatt-hour of the energy avoided by EE actions they carry out in the lot. The auction will be held in stages, starting with the public lighting lot and followed by each broad competition lot. Envelopes for the second lot will only be accepted after the auction results for first lot have been announced, and so on successively until the last auctioned lot. For each lot, the bidder who submits the lowest price for the sale of avoided energy will be declared the winner, provided the price is at least 5% lower than the other bids.

The auction winners will have 66 months to execute EE actions: six months for implementing the action and 60 months with the action underway. Winning companies will receive the equivalent of the energy avoided by their actions at the price set in their auction bid. If the winning bidder delivers less than 90% of the contracted avoided energy, it pays a fine; if energy avoided is above the contracted amount, the winning bidder receives a bonus.

MEASUREMENT AND VERIFICATION (M&V) METHODOLOGY

The methodology chosen for measurement and verification (M&V) in the EE auction is Randomized Control Trial (RCT). UCs eligible for the program would be randomly assigned to the treatment group (included in EE actions) or to the control group (not included in EE actions). If the method is well implemented, both groups will be similar both in observable and non-observable characteristics.

The consumption reduction estimate will be calculated using the difference-in-differences methodology. A difference is then taken of the treatment group in the period before and after the EE auction, and the same difference is taken of the control group. These differences are then subtracted to represent the reduction in electricity consumption in the UC as a result of EE actions.

For the public lighting lot, the M&V results will follow option A as described in the International Performance Measurement and Verification Protocol (IPMVP). It provides for field measurements only for key parameters, such as energy consumption of public lighting after the replacement of light bulbs and necessary components.

ANALYSIS OF THE AUCTION DESIGN

The auction uses the “sealed envelope” format and stipulates that bids be submitted with the amount bidders are willing to receive per megawatt-hour of energy avoided by means of EE actions. Estimating this amount requires knowledge of many factors, such as the EE actions that bidders are willing to execute, the potential for the lot to incorporate such actions and the expected profit. In view of all these factors, the complexities involved in assigning a value to avoided energy may give rise to the “winner’s curse”, which is when the bid submitted by the winner is higher in value than the good to be auctioned off - or, as put by Charness, Levin and Schmeidler (2019), it may indicate that the winner is actually worse than the other bidders.¹

In the case of the EE auction, a difference in valuation will lead to significant losses both for bidders (whose profit will be lower or nonexistent) and for electricity consumers, since the low bid price will make it infeasible for the winner to carry out the expected EE actions. The winner’s curse has many causes; one of them is the bidder’s inability to predict the costs and risks involved and thus neutralize risk, resulting in the submission of extremely low bids just to ensure victory.

¹ Charness, G., Levin, D., e Schmeidler, D. 2019. An experimental study of estimation and bidding in common-value auctions with public information. *Journal of Economic Theory*, 179, 73-98.

One of the advantages of open auctions is information availability; the fact that other bids are known facilitates the process of devising a strategy to participate in the auction. Uncertainties about bidders' maturity in the EE market and inadequate estimates of expected revenues may also be conducive to the winner's curse. As stated by Levin and Reiss (2020), second-price open auctions do well in mitigating the winner's curse.²

ANALYSIS OF THE M&V METHODOLOGY

To ensure a suitable comparison between the treatment and control groups, it is important to check if the randomization process has managed to eliminate significant observable differences between the two groups. To that end, a balancing analysis must be carried out to compare the two groups based on averages for observable characteristics. Additionally, there should be no other energy efficiency programs in place at the same time (or recently concluded) in the city. If EE actions overlap, it is impossible to determine which share of avoided energy are attributable to the actions carried out by the winning bidder.

Including control variables in the analysis (e.g., climate) can help explain factors that, though unrelated to the EE auction, may affect energy savings projections. Including such variables makes for more precise estimates and a more robust model.

Proximity to EE actions in lots may lead to a "contamination" effect, i.e., units that had not been pre-selected as targets of EE actions may decide to join those actions. As highlighted by Angrist and Lavy (1999), when consumers realize they will not be covered by EE actions, they may choose to do them on their own.³ Mechanisms to prevent the control group from being included in EE actions are essential to prevent contamination of the control group from jeopardizing the assessment of avoided energy.

There are two sides to using this particular M&V methodology. While EE actions are important and should be widely adopted, it is also necessary to ensure that only part of the units receive the treatment (actions). The fact that EE actions will be restricted to the treatment group means that potential gains from EE measures may not be fully explored. One way to verify energy savings when EE actions encompass entire lots is by resorting to the synthetic control methodology. Under this method, contamination problems and a significant number of consumer units implementing energy efficient measures would not influence energy savings projections. Therefore, awareness-raising policies, for example, could be carried out across the entire lot. Additionally, consumer units wishing to adopt other EE measures can do so, even if they have not been assigned to the treatment group. The aim of this methodology is to build a "synthetic lot" for each lot, composed of the weighted average of other cities or neighborhoods. This would show the evolution of energy consumption in the lot if EE measures had not been adopted.

² Levin D., Reiss J. 2020. Can we overcome the Winner's Curse by (behavioral) Auction Design?. *Working paper*.

³ Angrist, J. e Lavy, V. 1999. Using Maimonides' rule to estimate the effect of class size on scholastic achievement. *The Quarterly journal of economics*, 114(2), 533-575.

ANALYSIS OF THE ALIGNMENT OF INTERESTS OF AVOIDED ENERGY BUYERS

The buyers - who will effectively pay for the energy to be avoided, as priced by the auction winners - will be energy distributors who have previously expressed interest. For each megawatt-hour saved in this auction, the winner of the lot will be granted credit for energy avoided. Participating distributors would buy credits from the winners in the auction lot and, in turn, use them to settle debts under the Energy Efficiency Program (*Programa de Eficiência Energética - PEE*).

The PEE is managed by ANEEL and seeks to encourage the efficient use of electricity across all economic sectors by enabling projects to promote the importance and foster the economic viability of energy efficiency actions. Proceeds that distributors must invest in EE but which are not used in a given year are carried over to the next fiscal year. As a result, certain companies in the electricity sector find themselves with a “stockpile” of funds that they have no other way to spend.

It is imperative to understand the cause of such high “stockpiles” of funds under the PEE. This happens because there is no incentive for distributors to encourage rational energy use. The distribution tariff is based on total electricity consumption. This means that distributors are tasked with implementing a public policy that ultimately lowers their profits.

The PEE also carries significant transaction costs for utilities. Utilities must implement and monitor all their EE projects and all projects must be approved by ANEEL, with the risk of incurred costs not being recognized. Though the auction may help solve this particular issue, it falls short of aligning the interests of the distributor with those of the central planner. The distributor’s revenue must be untied from amount of energy consumed, i.e., the sector must be modernized before the auction can be held.⁴

CONCLUSION

ANEEL has proposed a public tender for EE actions in the city of Boa Vista (RR). Though well structured, ANEEL’s proposal has provisions that could be changed to improve the auction and reduce potential risks.

With regards to the auction format, open second-price auctions are a good option to mitigate the winner’s curse. As for M&V, it is essential to ensure that there are no statistically significant differences between the treatment and control groups and that no other EE programs are taking place at the same time in the same consumer unit, which would make it impossible to ascertain the real reduction in energy consumption as a result of the auction. Additionally, this choice of M&V methodology restricts EE actions to the treatment group, thus failing to explore the region’s full EE potential.

⁴ The modernization of the electricity sector is a project under the coordination of the Ministry of Mines and Energy (MME) with a set of proposals for short, medium, and long-term improvements to the sector. One of the directives is to sever the link between energy consumption by consumer units and the distributor’s revenue.

Three other topics also warrant consideration: Firstly, the avoided energy is bought by the distributors, so there must be an alignment of interests to untie the distributor's revenue from the amount of energy consumed. In other words, the sector must modernize before the auction can be held.

Secondly, the entire EE Auction methodology is focused on the amount of energy avoided. This means that if a winning bidder fails to implement a project that can generate avoided energy, it will not be remunerated. Projects that shift energy consumption to off-peak hours instead of reducing the amount of energy consumed are, therefore, not encouraged.

Lastly, the model used to implement the EE auction pilot in Roraima may not be replicable elsewhere in the country, as the characteristics of Boa Vista are quite different from those of other regions. As such, the EE auction in Roraima may not be the ideal location test for such a market in Brazil.

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