RESERVOIR TO WIRE PROJECTS IN BRAZIL – HOW TO IMPROVE THE CURRENT REGULATORY FRAMEWORK

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ROADMAP

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1. Natural Gas Regulation in Brazil
2. Research Questions
3. Modelling Issues
4. Results
5. Alternatives to Improve Regulation
6. Conclusions

NATURAL GAS REGULATION IN BRAZIL

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- Brazil has a large amount of potential natural gas resources, both offshore and onshore
  - These resources could be used as a fuel to the industrial sector and the electricity generation sector, reducing energy prices and greenhouse gases emission while providing a reliable source to balance the penetration of intermittent renewables

- Nevertheless, Brazil hasn't established a pathway to the development of its natural gas market
  - Difficulties in the expansion of transportation and distribution networks
  - Unpredictability of natural gas power plants demand

- At this context, Reservoir-to-wire (R2W) business model, based on the integration of upstream natural gas production and downstream electricity generation, can provide an economically viable way, if not the unique way, to monetize onshore natural gas resources

RESEARCH QUESTIONS

- Considering the potential benefits of such business model, it is important to analyze if the current Brazilian energy industry regulation meets the criteria of economic efficiency

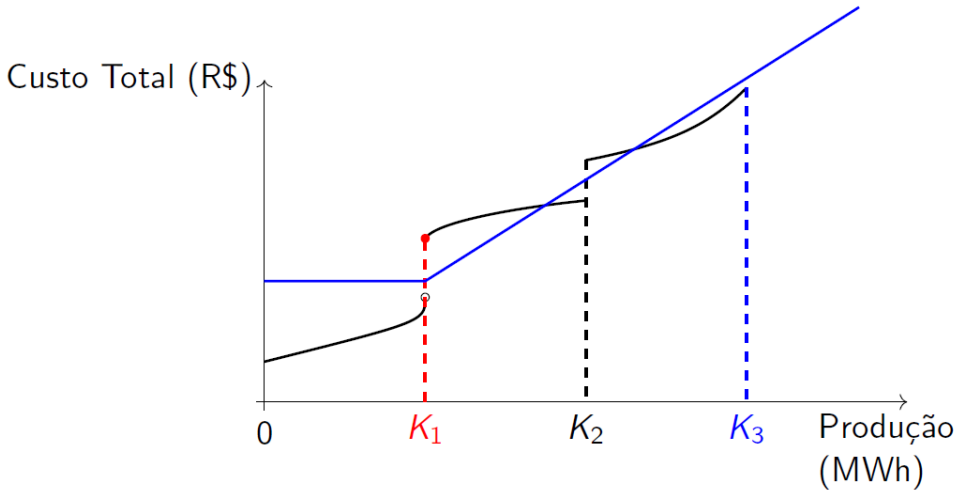
- Economic efficiency guarantees that a low-cost energy producer will be able to have proportionally more chances to be the winning bid and participate in the electrical grid than a high-cost producer

- R2W projects usually have lower costs at the long term, but this business model faces more challenges to obtain the amount of gas reserves demanded by the associated thermal power station:

  - 1 - Cost structure: As a consequence of the upstream integration, the accumulated total cost as a function of the accumulated energy produced will not be a linear function
  - 2 - E&P uncertainty: An unexpected increase in the electricity demand will have to be followed by additional E&P expenses. Naturally, there will be a great amount of uncertainty at the quantity of time spent until new gas reserves get developed

MODELING ISSUES: 1 – COST STRUCTURE

- A conventional natural gas power station in Brazil has gas supply agreements with a take-or-pay level P_{min} and a constant price for consumption higher than P_{min}, generating a linear cost structure. This structure has the same linear format used by the regulator to remunerate these costs.
- In a R2W context, if it is necessary to increase gas production, another well must be drilled in a manner that the cost structure takes the format of a piecewise function. This cost structure cannot be easily accommodated by the linear format of remuneration.



MODELING ISSUES: 2 – E&P UNCERTAINTY

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- As the E&P uncertainty happens after the auction in which energy generators are contracted, when agents are risk averse, theory predicts that they will require a higher level of return compared to the level required by a generator that faces less ex-post auction uncertainty

- In order to check how this uncertainty can affect the financial outcomes of a R2W project, it was built an integrated physical-financial model that incorporates dispatch outcomes, E&P capital expenditures decisions and other sources of risk

- This physical-financial model is incorporated to another model that support decision-making in auctions. So, both the E&P uncertainty and the piecewise cost format are integrated to assist a critical evaluation of the current regulatory framework

RESULTS

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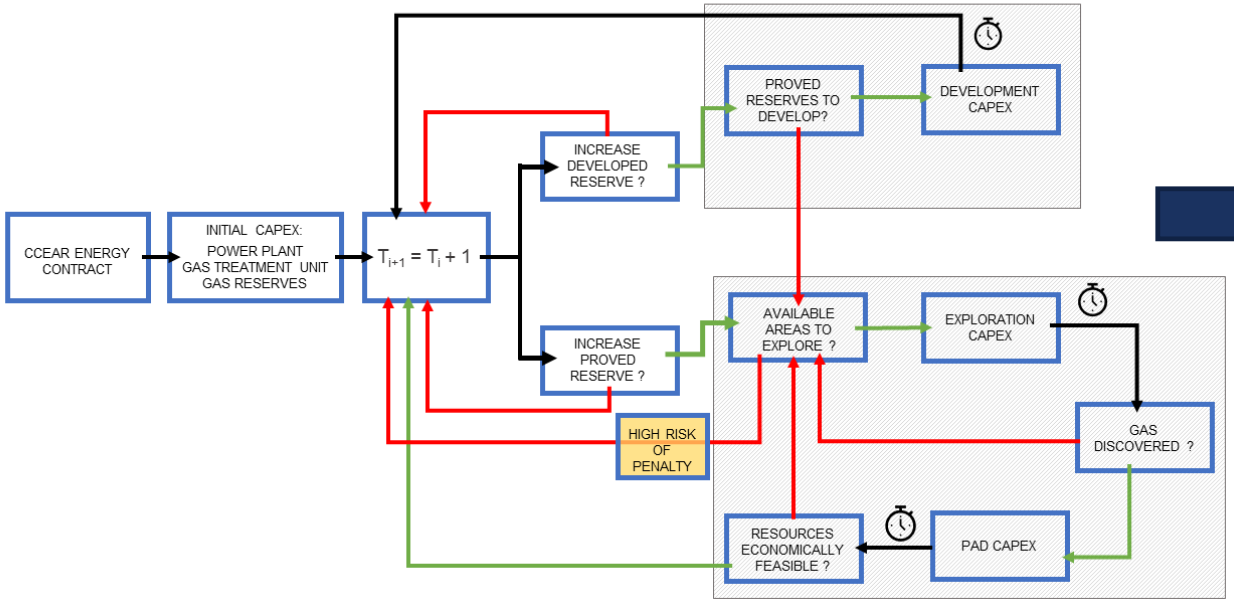
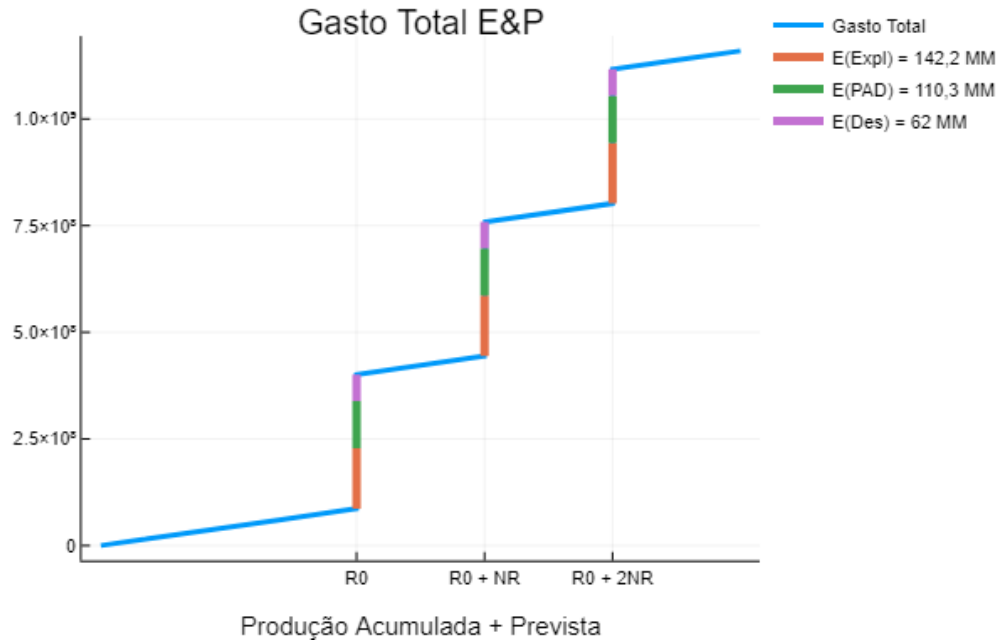
E&P Flowchart





RESULTS

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- The integration of the models (energy dispatch, E&P cycle, company financials and auction) allows an assessment of the sensibility of the economic viability of a R2W project to each stage of this business model. It is obtained an estimative of the value of each financial variable (expected value) but also a distribution of these values, providing an analysis of the risks involved

- From the regulatory point of view, our main result is that the current auction rules do not capture the real format of R2W cost function, making this type of enterprise arrangement less competitive compared to other structures, distorting the results of the competitive process and leading to economic inefficiency

ALTERNATIVES TO IMPROVE REGULATION

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- Recommendations (in increasing order of complexity)
  - Change the calculation of the cost-benefit index to allow R2W projects to express their costs in a competitive way
  - The auction format could be changed to improve efficiency
  - Broader reform of the sector

- Discontinuity of the cost is not an issue by itself
  - It is not unique to R2W projects – e.g., coal generators face turn on/off and ramp up/down costs
  - It may become an issue if the auction design does not allow generators to meaningfully express their costs
  - A market/auction design issue. Well-designed markets can cope with discontinuity of costs

CONCLUSIONS

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- R2W projects have a great potential to contribute to the Brazilian energy matrix, given the natural gas onshore availability and the competitive advantages of these types of projects

- This research, through economic simulation models, contributes to the theme by showing that the regulation of such projects can be improved, increasing the reliability, security and affordability of electricity supply in Brazil

THANK YOU!

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