COUPLING POWER & NATURAL GAS SECTORS IN BRAZIL
IS CONVERGENCE POSSIBLE IN TIMES OF MARKET REFORMS?
THE CASE OF RESERVOIR-TO-WIRE POWER PLANTS

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RESEARCH QUESTIONS

Analyze if the current economic regulation meets the criteria of efficiency and financial sustainability for enterprises with the R2W core business.

Under Brazilian current regulation, energy auctions rules and also the models used for physical dispatch do not take into account the main characteristics of R2W projects

They have a good representation only for conventional projects

They fail to capture the value of this business model and the potential benefits for the entire system.

For instance, in gas wells away from pipelines, it may be economically more efficient to convert gas into electricity and commercialize it.

R2W ENVIRONMENT & REGULATION IN BRAZIL

“Reservoir to Wire” (R2W) natural gas projects

Introduce pillars to develop a more competitive market since the **Project of Law 6.407/2013 (“Gas to Growth Program”)**, associated with Petrobras’ divestment program and the penetration of renewables (Wind and PV) in the Brazilian energy matrix

These projects are characterized by monetizing the upstream gas production with the creation of thermoelectric plants near the exploratory fields.

This is an ideal way to bring competitiveness to the generation process, which is suited to the current demands of the Brazilian energy system - security and reliability of the dispatch that soon will include more renewable intermittent sources.

REGULATORY FRAMEWORK EVOLUTION – NATURAL GAS

1997 – Petroleum Law

- Vertically integrated industry
- Lack of developed / robust regulatory framework
- Lack of market design
- No network expansion

2000 – "PPT - Programa Prioritário de Termeletricidade"

- Supply guarantee for NG thermoelectric generators
- Petrobras deals with exchange rate risk in fuels
- Long-term PPA

2005 – ANP regulation

- Access regulation
- Tariff regulation (where possible)

2009 – Gas Law

- Vertically integrated industry
- Lack of developed / robust regulatory framework
- Lack of market design
- No network expansion

2017 – Gas for Growth

- Efforts to establish a new legal and regulatory framework for NG

2019 – New Market

- Promotion of competition
- Harmonization of state and federal regulations
- Integration of the gas sector with Power and industrial sectors
- Removing tax barriers

MODELING ISSUES

Uncertainties involved on R2W thermal powers plants.

An integrated physical-financial model for an R2W project that incorporates dispatch outcomes, E&P capital expenditure decisions and other sources of risk

A model to support decision-making in auctions, with a better representation for R2W projects.

MODELING BUILDING BLOCKS

SDDP

Stochastic dynamic dual programming (SDDP) model that simulates the dispatch performed by the Electricity System Operator in Brazil. It takes into account, explicitly, the characteristics of a R2W Power Plant

E&P

Module that simulates the expenses in Exploration and Development of new reserves resulting from the need to meet the dispatch. It considers also the rules that oblige entrepreneur to prove that it has enough natural gas to operate.

VALUATION

Module that simulates cash flows from the project taking into account the generation required and expenses calculated in SDDP and E&P modules and other exogenous input parameters.

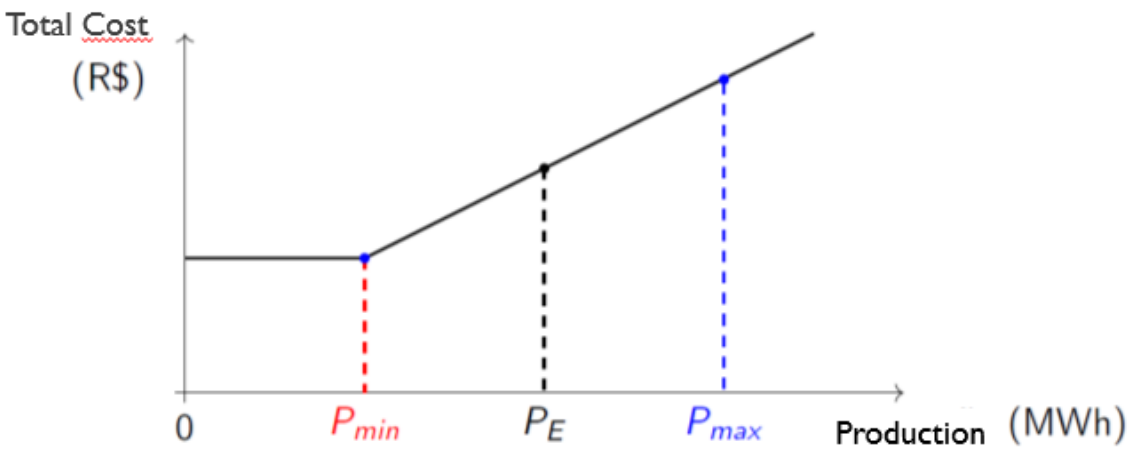
Auctions

Module that calculates the Cost-Benefit index for the project and evaluate its competitiveness, allowing for different auctions rules.

RESULTS

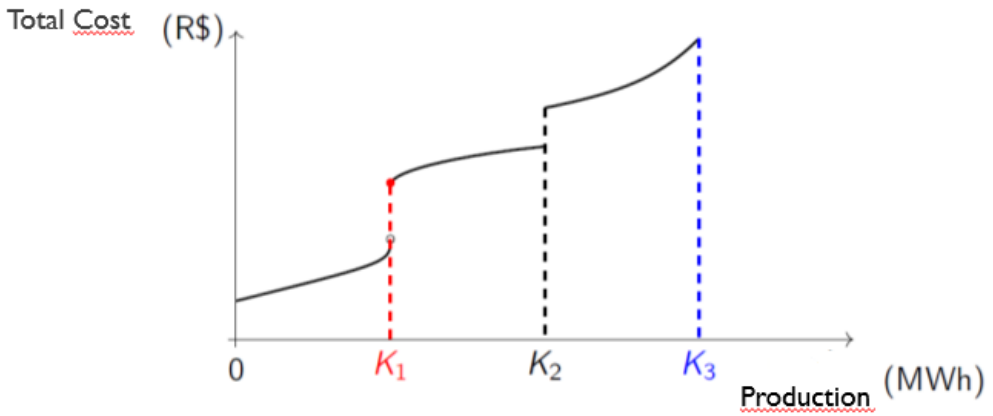
1. Current auction rules do not capture the real format of R2W cost function, making this type of enterprise arrangement less competitive compared to other structures

2. A conventional natural gas thermal power plant in Brazil has gas supply agreements with a take-or-pay level P_{min} and a different price for consumption higher than P_{min}. :



RESULTS

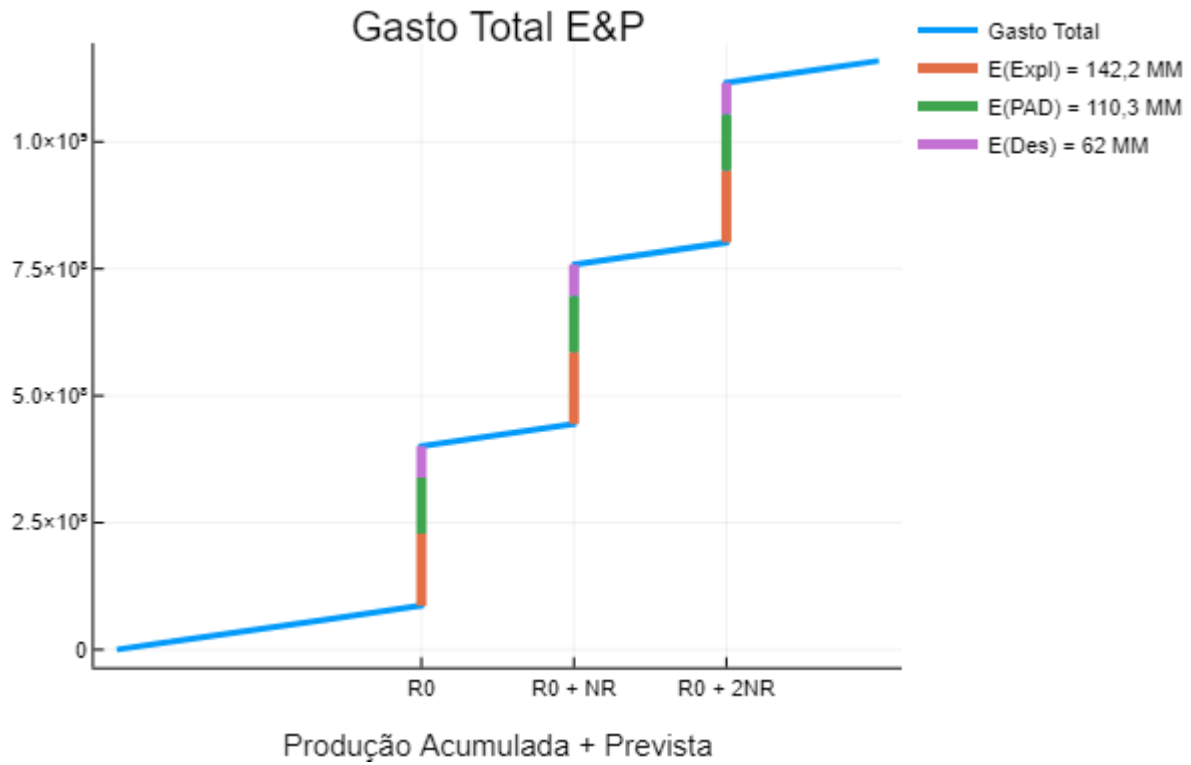
It is possible to drill a well up to a certain level and, if it is necessary to increase gas production (conditional to dispatch outcomes), another well must be drilled in a manner that the cost structure takes the form of figure below – a piecewise function:



The main result obtained from the implementation of simulation models is that **the current format of the Brazilian energy auctions do not display the real structure of costs of a R2W project, distorting the results of the competitive process and leading to economic inefficiency**.

RESULTS – EXAMPLE WITH REAL DATA – COST FUNCTION

Preliminary results were calculated using the energy generation historical record of the R2W power plants operating in Brazil.



POLICY - ALTERNATIVES TO IMPROVE REGULATION

Recommendations (in increasing order of complexity)

- Change the calculation of the cost-benefit index to allow R2W to express their costs
- The auction format could be changed to improve efficiency
- Broader Reform of the sector

Discontinuity of costs is not an issue by itself

- It is not unique to R2W generation - 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

- ✓ **R2W ventures have 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 showing that the regulation of such projects can be improved, increasing reliability and security of energy supply in Brazil.**

THANK YOU!

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