
**“COMPUTER-BASED SIMULATION OF AUCTIONS OF OPTION
CONTRACTS AND OF FUTURES CONTRACTS IN THE COLOMBIAN
WHOLESALE ELECTRICITY MARKET”**

Final Report – Introduction

Prepared for:



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1. INTRODUCTION

This report corresponds to the Final Report carried out by the Consortium **Mercados Energéticos, Power Systems Research and Risk Capital Management Partners**, during the study “Simulation of Auctions of Option Contracts and of Futures Contracts in the Colombian Wholesale Electricity Market.” A preliminary version of the Final Report was discussed with the World Bank, the Colombian Energy and Gas Regulatory Commission CREG and outside advisors, in Bogotá during February 14th, 2003.

Prior to this Report, the Consortium had sent to The World Bank and the CREG three different Reports. The first of them, presented to the CREG on the first week of August, comprised different options for adjusting the proposed methodology of the study, based on a comprehensive evaluation of TERA’s “Final Report, Volume 3, Phase 1 & 2” and after considering transmission congestion issues which had been left out in TERA’s analyses.

The second, presented to the CREG on the second week of October, embraced simulations carried out with the SDDP program, of the Colombian Wholesale Electricity Market under different market conditions, involving scenarios with uncertainties related to demand growth and the Long Term Marginal Cost. The output of these simulations were adapted to evaluate the price of the options, and were presented on a third report, sent to the CREG on the last week of November and discussed with them during the second week of January.

This Third report included the computer-based simulations of the market of options and futures contracts, a description of the model developed to simulate the functioning of the market of options and futures, an analysis of the attractiveness of the proposed energy options for existing and new generators and their impact in terms of capacity expansion, and a first approach to the problems that must be faced in order to organize these kind of derivative markets.

1.1. BACKGROUND

As mentioned in the Terms of Reference of this project, spot price volatility in the Colombian wholesale electricity market has been a cause of concern for market administrators and participants. Current bilateral contracts have scarce liquidity given their non-standardized characteristics and this has limited their use as hedging instruments against the risk of significant price movements, which normally stems from climatological cycles. On the other hand and to ensure the reliability of power supply in the medium and long term, the Colombian regulatory framework includes a mechanism to intervene prices known as “mínimos operativos” and an administrative procedure to remunerate available capacity known as “carga por capacidad”.

Accordingly and to improve the performance of the wholesale electricity market, the CREG commissioned a study carried out by TERA for developing a theoretical scheme of energy options and futures contracts including a set of allocation and settlement rules. This study had as main objective to design a methodology to substitute the current capacity payments by market driven financial instruments that are efficient to encourage investments in generation, and that incentive market participants to improve the reliability of the electricity supply.

The results of this study, known as the TERA Proposal (the Revised Framework), recommend replacing the current capacity payments with mandatory options that consumers (distribution companies, traders) will have to buy to generators (directly or through traders) in a primary or secondary market. An options and futures market will be created, where consumers will be able to buy these financial instruments. A summarized description of the results of TERA's proposal is presented in Appendix I at the end of this chapter.

Before considering full implementation of TERA's proposal, CREG with the support of the Public-Private Infrastructure Advisory Facility PPIAF, decided to contract our Consortium to carry out the modeling and simulation of the derivatives market operation, to assess the range of implications of TERA's proposed mechanism and to gain insight into the detailed mechanics of the process and its potential shortcomings.

To achieve this, we have modeled and simulated the operation of the options and futures market, under different kind of scenarios, including events critical to system operation, and have defined modifications to ensure its proper operation. The results of these simulations and modifications constitute the body of this Final Report.

The aspect of major interest related with the substitution of the current methodology of capacity payments for a market of options and futures by generators/traders, is **the revelation (disclosure) of the true value of the capacity**. The premium of an option at a certain exercise price (energy) can be considered as the true value that the market would give to a Mw of power generated with a variable cost similar to the corresponding exercise price. Therefore, the price of the capacity would not be set any longer subjectively by the regulator, instead, it would be a value assigned by the market. This is an important change from the current framework, where capacity payments (price and quantities) are set by the regulation through a computer model and administrative procedures. Obviously, for this last statement to be true, the market where the options are traded should be competitive, so that the participants reveal the prices at which they are really willing to sell or to buy.

After reviewing the issues left out in TERA's analyses, such as transmission congestion problems, it was agreed with the CREG that to make possible the use of options and futures without modifying the current regulatory framework, it would be necessary to limit the scope and goals of the TERA Proposal in the following way:

- The options will exclusively be financial instruments for price hedging in "la bolsa," applied on the price resulting from the single bus economic dispatch, leaving aside the up-lift on which the sellers cannot offer any type of hedging¹. In Appendix II, a short review is made of these kind of products and their financial structure.
- The physical exercise of the option would not be allowed. The rationing regulation is not modified, so that curtailments at supply remain independent of the contracts that the parts could have carried out.

As it is shown in this Final Report, in an indirect way, options will encourage the availability of the generators who sold such financial instruments, since they will reduce

¹ Generators can hedge the risk on price in "la bolsa" with their own generation. But they cannot hedge the risk on the up-lift as it is out of their control.

their risks if they can permanently support the options with their own generation, and as long as their unavailability is hidden by situations where they are “constrained off.” Therefore, under this proposal, the advantages of the Revised Framework that would remain are:

- Replacement of the current methodology of capacity payments for a new one that would reveal the (almost) true value of the power, and that would not need of administrative methods (simulation of dry years) to identify the generators that will be benefited with capacity payments. Therefore, the need for administrative intervention in the current methodology, would be eliminated with the Revised Framework.
- Provision of more efficient incentives to investments in generation, since the price signals would be the result of market oriented principles that affect both, the price of energy and capacity (replaced by the premiums of the options). Currently only the price of the energy is market driven.
- Provision of indirect incentives to the availability of generators.

This Report is divided into eight chapters, the first of which is this introduction. In chapter two we model the Colombian wholesale electricity market based on the commercial and operational rules defined by the legal and regulatory framework of the power sector. To assess the different term effects of the proposed scheme, a definition of the critical events affecting the supply and demand of the electricity system and different short, medium and long-run scenarios, is modeled.

In Chapter three a description of the model developed to simulate the functioning of the market of options and futures is outlined, testing and validating the model with regard to real past observed behavior, and making considerations of the risk profile of market participants and their risk tolerance. This task was particularly challenging since there are no data available to estimate risk tolerance of market players in Colombia nor in other electricity markets worldwide.

Chapter four encompasses simulations of complete auction cycles for different auction frequencies and option maturity offerings. Specifically, value estimations for options for participants without risk aversion were carried out for performance variables in one year, two year and five year periods. For each one of these performance periods a simulation of the operation of the options and futures market was made. Different alternatives of risk tolerance for market participants and of spot price uncertainty projections are also analyzed. The chapter is closed with a simulation of the trading activities.

In Chapter five we forecast market behavior and analyze the attractiveness of the energy options for new generators. Two kinds of analyses are carried out. The first one is for the existing generators (hydro and thermal plants) and the second, for the new ones, to whom investment decisions have to be made. The latter point is important to evaluate to what extent firm energy option can contribute to generation expansion. Both types of analysis are based on the spot price and generation scenarios computed in chapter two.

In chapter six we estimate institutional, technological and financial needs of the Market and its agents, in order to run the derivatives market. Specifically, we make recommendations related to auction rules, transaction costs in the secondary market, reference prices, settlement options, option strike prices, contract volumes and contract tenors.

In chapter seven we make recommendations on how to avoid possible situations of market power exercise and dominant position abuse by participants in the derivatives market.

The Report is closed with a section of conclusions outlined in chapter eight.