



Risk-Sharing Contracts and risk management of bilateral contracting in electricity markets[☆]

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ARTICLE INFO

Keywords:

Bilateral contracts
Electricity markets
Negotiation strategy
Risk management and attitude
Risk-Sharing Contract

ABSTRACT

The liberalization of the electricity sector has conducted to the establishment of spot markets, derivative markets and private bilateral contracts to trade electricity, increasing the competition in the sector. Spot markets are composed of day-ahead, intraday and real-time markets, and their prices are highly volatile. Derivative markets are composed of physical and financial products to hedge against spot price volatility. Players can set the terms and conditions of private bilateral contracts but these have several risks that can be mitigated using a risk management process composed of three phases: risk assessment, characterization and hedging. This paper focuses on both risk attitude and risk-sharing, and how they can influence the negotiation of the price. It presents the standard and non-standard designs of a new type of contract, the Risk-Sharing Contract (RSC). Furthermore, it describes the trading process of these contracts and introduces a negotiation strategy for dealing with risk. It also presents case studies on bilateral contracting involving the negotiation of RSCs, where different demand and supply agents interact and trade according to the rules of an alternating offers protocol. Results from the case studies prove the benefit of RSCs to hedging against spot price volatility, benefiting risk-averse players by reducing the price risk and conducting mutually beneficial agreements. While the use of derivatives products can conduct losses/revenues between -15% and 3% concerning the spot market, by using non-standard RSCs those outputs vary between -1% and 3% with substantially less risk.

1. Introduction

The liberalization of the electricity sector has resulted in a wholesale market for electricity production, and a retail market for electricity trading. This market structure was created to obtain competitive market prices of electricity and decrease its net cost through an increase in concurrence [1]. In wholesale markets, producers trade electricity with retailers and large consumers, facing the risk of future changes in the market prices, such as in the quantities required by demand-side players [2–4]. In retail markets, retailers normally consider fixed tariffs when signing private bilateral contracts with customers, being subject to their uncertain consumption (quantity risk) and also to the price volatility (price risk) of spot markets, where they can acquire the energy required by their consumers [5,6]. In liberalized markets, normally the tariffs offered to consumers are revised periodically, and consumers are free to change their supplier. So, retailers support all risks, being the risk asymmetry between retailers and consumers substantial [7,8]. Spot markets are commonly divided in day-ahead, intraday and real-time markets, where supply and demand agents submit their bids. These markets close before real-time commitment,

existing balancing markets to fix short-run deviations between supply and demand [9].

Traditionally, governments stimulated the installation of new non-mature variable renewable energy sources (VRES), such as tidal and wave power, by proposing feed-in-tariffs or other incentives for a fixed period, when they are passive players, dealing only with operational and maintenance issues [10,11]. After that period, these technologies have to be active players, start bidding their power forecasts at markets, subject to quantity and price uncertainty [9]. VRES are characterized by near-zero variable costs of production, decreasing market prices and consequently their return from markets [12,13]. Furthermore, the increase in the penetration of mature VRES, such as wind power and photovoltaic, increases the variability and uncertainty of the prices at spot markets. [14,15]. VRES and demand-side players, as retailers, face the uncertainty related to their real-time production and consumption, respectively, paying high penalties for their deviations [16–18]. While these penalties are reflected in retail tariffs and the VRES levelized cost of energy, without incentives new VRES are subject to a high risk of investment [8,19]. Currently, new projects of these technologies have difficulties being financed, having to compete in new capacity auctions

[☆] This work has received funding from the EU Horizon 2020 research and innovation program under project TradeRES (grant agreement No 864276).
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