markets for flexibility

it don't mean a thing if it ain't got that swing

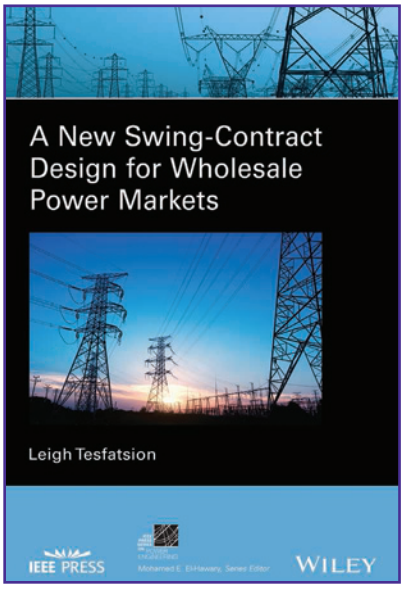
THIS ISSUE'S "BOOK REVIEW" column discusses *A New Swing-Contract Design for Wholesale Power Markets*, written by Leigh Tesfatsion. This reviewer writes, "this book is timely and topical, given the increasing amount of variable and distributed energy sources penetrating markets worldwide."

A New Swing-Contract Design for Wholesale Power Markets

By Leigh Tesfatsion

Leigh Tesfatsion's latest book proposes a new wholesale electricity market design paradigm, with a focus on North America, for centrally managed electricity markets that are based on the novel concept of "swing contracts." Tesfatsion, a professor at Iowa State University, has been working on electricity market design and agent-based computational economics for many years. Her extensive academic, research, and industry experiences, as well as her training in both economics and mathematics, make her highly qualified to provide fresh thinking in this important area.

The book proposes the adoption of swing contracts between the system operator and relevant resources to provide flexibility ("swing"). This flexibility is represented in the form of future availability of dispatchable power paths ("reserve") with prespecified physical attributes (e.g., location, exercise time, ramp rate limits, and minimum/maximum production levels) and economic attributes (for pricing purposes). Dispatchable resources offer such power paths into multiple, centrally managed markets linked across different timescales (from years ahead, for adequacy purposes, to minutes ahead, for real-time balancing). The system operator clears different markets with a process similar to and consistent with current security-constrained unit commitment and economic dispatch mechanisms. However, the result is higher flexibility for providing supply-demand balance, given the more flexible form of swing contracts relative to current markets.



The cleared contracts can be remunerated based on a two-component model, namely, an offer price (to recover ex ante avoidable fixed costs to ensure the availability of relevant power paths when required) and a performance payment (to recover ex post and after actual performance verification of operational costs to deliver relevant power paths). This could more readily ensure market players' recovery of their different types of costs, from investment (e.g., instead of, but aligned with capacity mechanisms and capacity markets) to operational, quasi-fixed costs (e.g., instead of make-whole payments for binary-commitment cost recovery).

The book is timely and topical, given the increasing amount of variable and distributed energy sources penetrating markets worldwide. The proposed concepts and paradigm are extremely refreshing and novel. At the same time, they build on the status quo of current electricity markets in the United States. This presents clear opportunities and pathways for a smooth transition toward centrally managed electricity markets with high penetration

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of variable renewable energy sources, storage, and flexible demand.

Although the focus is on centrally managed markets with unit-commitment functions, the general concepts presented may also be extended to other markets. The core thinking behind the concept of swing contract is the valuation of different types of flexibility that different resources could offer into different markets. This is a key topic of discussion around the world. In a swing contract, the key product to be sold is a power paths-based "reserve," rather than multiple products such as energy or capacity. Given this outlook, the physical and economic construction principles of a swing contract represent a solid framework for evaluating flexibility in different contexts.

The book is composed of 20 chapters and an appendix that comprehensively cover the subject matter. The topics range from the motivation to change current market structures to modeling different types of swing contracts, potential implementations, and examples of transitions from the current situation. Aspects such as the inclusion of distributed energy resources and platforms to validate the proposed mechanisms are also discussed. The general tutorial chapters on wholesale electricity markets provide a helpful context.

The book contains rigorous mathematical descriptions of the proposed mechanism and implementations. It assumes a good knowledge of power system operation (particularly optimal power flow and unit commitment), fundamentals of power system economics and electricity markets, and basics of linear and mixed-integer linear programming. As such, the book may be most appealing to knowledgeable postgraduate students, researchers, and instructors as well as market designers and regulatory support staff. It could be adopted in advanced courses of electricity markets, although some tutorial-like chapters could also be used for introductory courses to power system operation and economics. Despite being United States centric, general concepts may be suitable for a more universal, international audience interested in the topic.

> The proposed concepts and paradigm are extremely refreshing and novel.

I commend the author for accomplishing such a challenging task. It is a book that proposes a coherent and systematic redesign of well-established market mechanisms while dealing with the pressing issue of reliable and affordable integration of variable, renewable and distributed energy resources. Finally, students and researchers would benefit if more worked examples, data, and sample code could be made available on the book's website.

—Pierluigi Mancarella