"U.S. RTO/ISO-Managed Wholesale Power Markets: A Fundamental Reconsideration"

Virtual Presentation/Discussion Meeting
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Abstract: This talk highlights four conceptually-problematic economic presumptions reflected in the legacy core design of current U.S. RTO/ISO-managed wholesale power markets that appear to be hindering their smooth transition to decarbonized grid operations. The key presumption is the static conceptualization of the basic transacted product as energy amounts competitively determined for delivery at designated grid locations during successive operating periods, supported by ancillary services. The reality is far more daunting: U.S. RTOs/ISOs are fiduciary "conductors" tasked with orchestrating the availability and subsequent possible dispatch of increasingly diverse dispatchable power resources to service the just-in-time power demands of increasingly diverse customers while meeting just-in-time power requirements for reliable grid operation. Thus, U.S. RTO/ISO-managed wholesale power markets must operate as *flexibility-support mechanisms*.

The talk then briefly reviews an alternative "Linked Swing-Contract Market Design" that appears better-suited for the support of decarbonized grid operations. This design entails a fundamental switch to a dynamic insurance focus on advance reserve procurement permitting continual balancing of real-time net load. Reserve consists of available collections of diverse RTO/ISO-dispatchable power flows with swing (flexibility) in their attributes, offered into linked RTO/ISO-managed forward reserve markets by two-part pricing swing contracts in firm or option form.

Short Bio: Leigh Tesfatsion received the Ph.D. degree in economics from the University of Minnesota, Minneapolis, in 1975, with a minor in mathematics. She is Research Professor of Economics, Professor Emerita of Economics, and Courtesy Research Professor of Electrical & Computer Engineering, all at Iowa State University. Her principal current research areas are electric power market design and the development of agent-based computational platforms for the performance testing of these designs. She is the recipient of the 2020 David A. Kendrick Distinguished Service Award from the Society for Computational Economics (SCE) and an IEEE Senior Member. She has served as guest editor and associate editor for a number of journals, including the *IEEE Transactions on Power Systems*, the *IEEE Transactions on Evolutionary Computation*, the *Journal of Energy Markets*, the *Journal of Economic Dynamics and Control*, the *Journal of Public Economic Theory*, and *Computational Economics*.

Key References:

[1] Leigh Tesfatsion (2022), **"Economics of Grid-Supported Electric Power Markets: A Fundamental Reconsideration"** Econ WP No. 22005, ISU Digital Repository, ISU, Ames, IA 50011-1054
https://www2.econ.iastate.edu/tesfatsi/EconomicsGridSupportedPowerMarkets.ISUDR22005.LTesfatsion.pdf
[2] Leigh Tesfatsion (2021), **A New Swing-Contract Design for Wholesale Power Markets**, 20 Chapters, 288pp., John Wiley & Sons, Inc. (IEEE Press Series on Power Engineering), Hoboken, New Jersey, USA. **(Book Review,pdf)**, **(Presentation,Slide-Set,pdf)**, **(Wiley/IEEE Press Book Flyer,pdf)**.

Argonne NL Talk/Meeting, Wednesday, 11am CT, October 5, 2022: Audun Botterud et al.

Discussion Focus:

U.S. RTO/ISO-managed wholesale power markets: A fundamental reconsideration

[1] Leigh Tesfatsion (2022), **"Economics of Grid-Supported Electric Power Markets: A Fundamental Reconsideration"** Econ WP No. 22005, ISU Digital Repository, ISU, Ames, IA 50011-1054
https://www2.econ.iastate.edu/tesfatsi/EconomicsGridSupportedPowerMarkets.ISUDR22005.LTesfatsion.pdf
[2] Leigh Tesfatsion (2021), **A New Swing-Contract Design for Wholesale Power Markets**, 20 Chapters, 288pp., John Wiley & Sons, Inc. (IEEE Press Series on Power Engineering), Hoboken, New Jersey, USA. **(Book Review,pdf)**, **(Presentation,Slide-Set,pdf)**, **(Wiley/IEEE Press Book Flyer,pdf)**.

Key Discussion Points:

1. Role of RTOs/ISOs [1, Sec. 1]: RTOs/ISOs are ***fiduciary "conductors"*** tasked with orchestrating the availability and subsequent possible dispatch of ***increasingly diverse*** dispatchable power resources to service ***just-in-time*** power demands of ***increasingly diverse*** grid-connected customers while meeting ***just-in-time*** power requirements for reliable grid operation.

2. Energy is Not a Commodity within the Context of a Grid-Supported RTO/ISO-Managed Wholesale Power Market [1, Secs. 1, 3.4.3] By definition, *a* ***commodity*** is an asset with a standard unit of measurement such that, conditional on a given location and time period***, all units of this asset are perfect substitutes;*** that is, *any unit can be substituted for any other unit with no change in valuation.* Yet an RTO/ISO, power producer, or power customer will typically ***not*** be able to assign a benefit or cost value to a given amount of energy E* (MWh) delivered at a given bus b during a given operating period T ***without knowing the dynamic attributes of the power-path (i.e., flow of power) used to deliver E* at b during T.***

3. DAM/RTM Two-Settlement Design Is Therefore Conceptually Problematic [1, Secs. 3-4]: Apart from ISO-NE, U.S. RTOs/ISOs conduct a daily day-ahead market DAM(b,D+1) for each grid bus b and operating day D+1 ***as a competitive commodity spot market*** for the *co-optimized* determination of: (i) ***scheduled energy (MWh) and operating reserve (MW) levels*** at bus b for each hour H of day D+1; (ii) a ***uniform energy price*** LMP(b,H,D+1) ($/MWh) at bus b for each hour H of day D+1; and (iii) a ***uniform price for each "availability type" of operating reserve (e.g., Regulation, Spinning, Supplemental)*** at bus b for each hour H of day D+1. However, since energy and operating reserve do not function as commodities in this context, the efficiency and optimality justifications given for these "competitive commodity spot markets" and "uniform market prices" are conceptually problematic. ***Similar concerns arise for real-time markets (RTMs).***

4. Linked Swing-Contract Market Design proposed in [2] is a conceptually consistent design tailored for the support of decarbonized grid operations. The design consists of a collection of RTO/ISO-managed forward reserve markets, where ***reserve for an operating period T*** consists of *power-paths available for possible RTO/ISO dispatch during T*. ***Reserve offers*** submitted to a forward reserve market M(T) for a future operating period T are *two-part pricing swing-contracts in firm or option form* that permit suppliers of cleared contracts to ensure their revenue sufficiency.

5. Gradual Transition from current RTO/ISO-managed market operations to Linked Swing-Contract Market operations is possible [2, Ch. 16]. Key design differences involve product definition, contract forms, and settlement rules, ***not*** real-time operations; and ***these design differences can be introduced gradually.***