Market Benefits and Seams: Options and Implications

PREPARED BY

John Tsoukalis
Johannes Pfeifenberger
Kai Van Horn

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Experience in the Eastern U.S.

While seams between RTOs will generally be more efficient than seams between non-market regions, five sources of inefficiencies associated by market seams are well documented:

1. **Interregional transmission planning** is ineffective
2. **Generator interconnection** delays and cost uncertainty created by affected system impact studies (effective coordination, such as the SPP-MISO JTIQ, can reduce costs by 50%)
3. **Resource adequacy** value of interties (often not considered in resource adequacy programs) and barriers to capacity trades (often created by RTOs' restrictive capacity import requirements and incompatible resource accreditations)
4. **Loop flow management** inefficiencies through market-to-market coordinated flowgates (with shares of firm flow entitlements) under the markets' Joint Operating Agreements
5. **Inefficient trading** across contract-path market seams and the need for intertie optimization (as discussed next)

Lessons from the East: Poor Utilization of Interties has a Long History and Continues Today

Potomac Economics has documented inefficient utilization of interregional transmission interties since 2003.

- David Patton, Coordinated Interchange Recommendations, March 13, 2003 (Presentation to New England RTO Working Group).

In 2010, Potomac Economics estimated that optimizing interties between MISO, PJM, NYISO, ISO-NE, and Canadian system operators would conservatively yield between $160-300 million in annual cost savings.

- See Analysis of the Broader Regional Markets Initiatives, pp. 10-13

In 2011, NYISO and ISO-NE proposed to address these seams-related inefficiencies through intertie optimization

- See Interregional Interchange Scheduling (IRIS) Analysis and Options

Yet, little has changed and interregional interties continue to be utilized poorly (see next slides)

The 2011 Intertie Optimization Proposal by NYISO & ISO-NE

In 2011, NYISO and ISO-NE proposed to implement intertie optimization to address the inefficiencies from poor utilization of interregional transmission.

- ISOs agreed with concerns raised by its Market Monitor since 2003
- The ISOs' analysis showed that "too little power is flowing in the correct direction more than 4000 hours per year." "Nearly half of the time that New England has higher-cost generation on the margin than New York, the net scheduled flow is westbound into New York"
- "The price difference exceeds $5 per MWh (in absolute value) more than half of the year and exceeds $10 per MWh (in absolute value) nearly one-third of the year [when] there is transmission capacity available to schedule additional transfers across the interface." "[T]otal energy expenditures would be on the order of one to two hundred million dollars lower annually—or perhaps half a million dollars per day lower—if the real-time inter-regional interchange system produced efficient tie schedules."
- The three root causes are:
  - **1. Latency Delay**. The time delay between when the tie is scheduled and when power flows, during which time system conditions and LMPs may change.
  - **2. Non-Economic Clearing**. The ISOs make decisions about which tie schedule requests to accept without economic coordination, producing inefficient schedules.
  - **3. Transaction Costs**. The fees and charges levied by each ISO on external transactions serve as a disincentive to engage in trade, impeding price convergence and raising total system costs

NYISO/ISO-NE Recommended Intertie Optimization but CTS was Implemented Instead

NYISO and ISO-NE offered designs for two possible solutions:

- Intertie Optimization: similar to the least-cost economic dispatch system used internally for each ISO's energy market, it relies on the bid-based supply offers from generators and demand resources to determine real-time LMPs and transmission flows within and between the two ISOs' networks.
- Coordinated Transaction Scheduling (CTS): facilities bilateral trading in real time through a simplified bid format (called an interface bid) and coordinated acceptance of interface bids by the ISOs (using an improved clearing rule).

The ISOs recommended the Intertie Optimization because:

- Intertie optimization is the more efficient solution
- The CTS system was not expected to produce as complete a price convergence between regions

Only CTS was implemented between NYISO and ISO-NE (and later PJM and MISO):

- Concerns were raised that intertie optimization may unnecessarily displace bilateral trading
- It was hoped that CTS might be almost as efficient as intertie optimization

CTS has not been Successful in Reducing Seams Inefficiencies

The Potomac Economics (the NYISO and MISO Independent Market Monitor) has documented the ineffectiveness of CTS:

- For example, in the MISO 2021 State of the Market Report, the IMM notes that CTS between MISO and PJM: "*has produced very little of the sizable savings it could generate*" and that "*more than 40 percent of the current CTS transactions are ultimately unprofitable*" (at xx and 90, emphasis added).

To address these continued inefficiencies the IMM recommends to modify CTS so it can better approximate intertie optimization:

- "we recommend the RTOs consider modifying the CTS to clear transactions every five minutes through [the Unit Dispatch System, UDS] based on the most recent five-minute prices in the neighboring RTO area."
- Doing so was estimated to offer cost savings of $23m for transactions with PJM and $44m for transactions with SPP

Table 14: CTS with Five-Minute Clearing Versus Current CTS
2021

	Percent of Intervals Adjusted	Production Cost Savings	Profits	Percent Unprofitable
PJM				
Current CTS	9.7%	$7,203,734	$199,456	39.4%
5-Minute CTS	77.5%	$23,207,329	$11,765,360	13.8%
SPP				
5-Minute CTS*	89.6%	$44,089,866	$25,984,814	22.1%

* Results omit Feb. 13-19 when SPP experienced very high prices from the Arctic Event.

Source: MISO 2021 STATE OF THE MARKET REPORT (potomaceconomics.com)

PJM's Market Monitor Recommended Intertie Optimization

The PJM Market Monitor has recommended to reconsider intertie optimization since 2014:

- In the 2022 PJM State of the Market Report (at 105), the PJM Market Monitoring Unit (MMU) repeats the recommendation it has made since 2014: "The MMU recommends that PJM explore an interchange optimization solution with its neighboring balancing authorities that would remove the need for market participants to schedule physical transactions across seams. Such a solution would include an optimized, but limited, joint dispatch approach that uses supply curves and treats seams between balancing authorities as constraints, similar to other constraints within an LMP market."

The recommendation is supported by a finding of inefficient intertie schedules that are inconsistent with seams-related price differences during almost half of all trading periods:

Table 9-27 Distribution of hourly flows that are consistent and inconsistent with price differences between PJM and MISO: 2022

Price Difference Range (Greater Than or Equal To)	Inconsistent Hours	Percent of Inconsistent Hours	Consistent Hours	Percent of Consistent Hours
$0.00	4,176	100.0%	4,584	100.0%
$1.00	3,773	90.3%	4,190	91.4%
$5.00	2,517	60.3%	2,737	59.7%
$10.00	1,570	37.6%	1,612	35.2%
$15.00	989	23.7%	1,056	23.0%
$20.00	673	16.1%	700	15.3%
$25.00	490	11.7%	531	11.6%
$50.00	150	3.6%	243	5.3%
$75.00	65	1.6%	137	3.0%
$100.00	38	0.9%	94	2.1%
$200.00	26	0.6%	34	0.7%
$300.00	19	0.5%	15	0.3%
$400.00	17	0.4%	8	0.2%
$500.00	15	0.4%	6	0.1%

Table 9-29 Distribution of hourly flows that are consistent and inconsistent with price differences between PJM and NYISO: 2022

Price Difference Range (Greater Than or Equal To)	Inconsistent Hours	Percent of Inconsistent Hours	Consistent Hours	Percent of Consistent Hours
$0.00	3,463	100.0%	5,297	100.0%
$1.00	3,193	92.2%	5,021	94.8%
$5.00	2,327	67.2%	3,834	72.4%
$10.00	1,667	48.1%	2,511	47.4%
$15.00	1,206	34.8%	1,664	31.4%
$20.00	912	26.3%	1,173	22.1%
$25.00	709	20.5%	881	16.6%
$50.00	360	10.4%	360	6.8%
$75.00	220	6.4%	209	3.9%
$100.00	143	4.1%	133	2.5%
$200.00	49	1.4%	54	1.0%
$300.00	22	0.6%	28	0.5%
$400.00	14	0.4%	24	0.5%
$500.00	9	0.3%	20	0.4%

Source: 2022 State of the Market Report for PJM (monitoringanalytics.com)

Coordinated Transaction Scheduling vs. Intertie Optimization

Coordinated Transaction Scheduling (CTS)

- 75+min prescheduled 15-min transactions, based on forecasts, which often results in uneconomic trades
- Based on CTS bids by traders, who need to reserve transmission (at a cost)
- Transmission charges reduce CTS efficiency
- If transmission charges are eliminated, traders capture value of transactions (free rides)
- Experience:
  - Low transaction volume due to costs and risk of inefficient trades;
  - Has not been able to improve inefficient use of interregional transmission

Intertie Optimization

- Optimized in real time every 5 min, greatly reducing the frequency of uneconomic trades
- Optimized by RTOs using transmission that remains available after bilateral markets have closed
- Hurdle-free optimization increases market efficiency
- Value of transactions shared by RTOs (i.e., their transmission owners and, ultimately, customers)
- Experience:
  - High transaction volume with substantial benefits to participating BAAs (e.g., Western EIM)
  - Can greatly reduce inefficient use of interregional transmission (e.g., European “market coupling”)

Bottom Line: CTS is not working – not for Traders, not for RTOs, not for TOs, and not for Customers

See: Intertie Optimization, Frequently Asked Questions

Potential Value of Intertie Optimization in the WECC

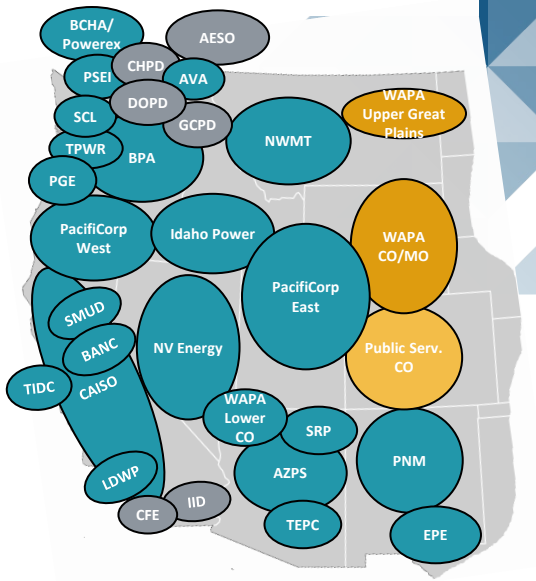
Brattle EDAM/Markets+ Benefits Analyses (for NVE)

Scenarios to capture range of potential footprints:

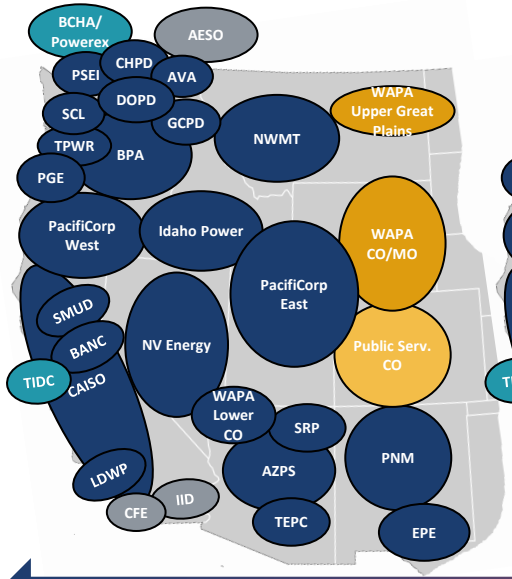
- Status Quo (BAU) vs. WEIM+EDAM vs. Markets+
- M+ assumed to have day-ahead and real-time markets
- RTO West co-optimized with M+ where applicable

SPP RTO West
WEIS only
Markets+
EDAM & WEIM
WEIM only
Non-Market BA

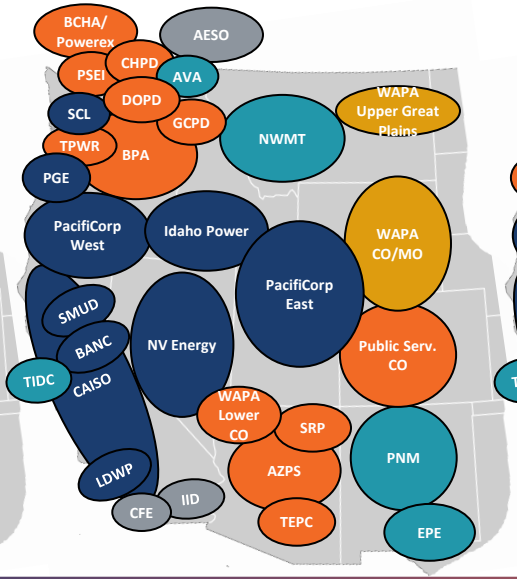
Status Quo (BAU)



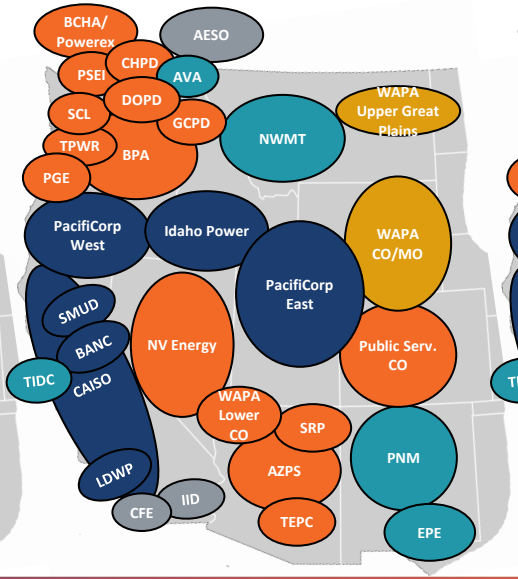
Bookend EDAM



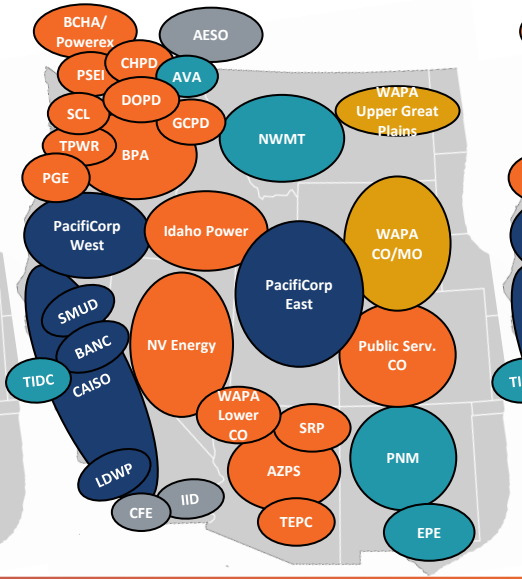
Middle View 1



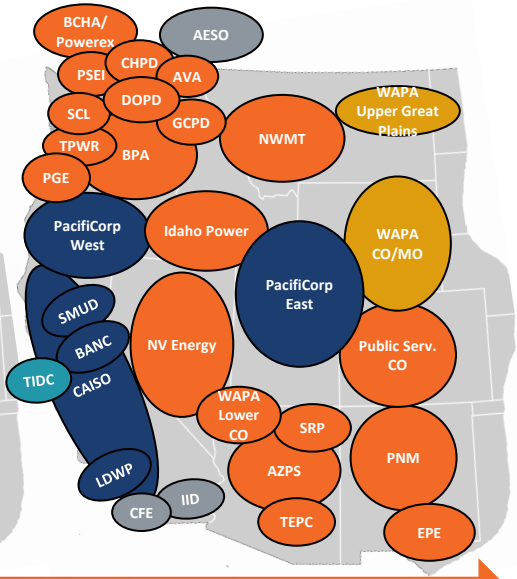
Middle View 2



Middle View 3



Bookend M+



NVE in EDAM | NVE in EDAM | NVE in M+ | NVE in M+ | NVE in M+

Bigger EDAM Footprint — **Bigger M+ Footprint**

Source: NV Energy Day-Ahead Market Benefits Studies

Markets offer Significant WECC-Wide Benefits

The implementation of M+ and/or EDAM produces significant WECC-wide customer benefits, with **estimated benefits ranging from $825-$985 million per year** across the footprint scenarios

- A single market covering most of the WECC (bookend EDAM in this case) produces the highest benefits
- A two-market EDAM/M+ scenario produces modestly lower benefits
- The difference across the different footprints illustrates the potential benefit of intertie optimization

WECC-Wide Benefits ($ Millions)

	BAU	Bookend EDAM	Middle View 1	Middle View 2	Middle View 3	Bookend Markets+
WECC-Wide						
Adjusted Production Cost	$10,273	$9,007	$9,880	$9,894	$9,919	$9,891
Wheeling Revenue	$446	$128	$378	$439	$434	$396
Trading Revenues:						
Bilateral	$1,327	$487	$506	$496	$477	$343
WEIM	$339	$263	$236	$192	$182	$99
WEIS/Mk+ RT Market	$28	$31	$89	$124	$125	$134
EDAM	-	$950	$946	$734	$676	$670
Markets+	-	-	$454	$606	$717	$945
Total System Cost	**$8,134**	**$7,149**	**$7,269**	**$7,303**	**$7,308**	**$7,304**
Benefit Compared to BAU		**$985**	**$865**	**$831**	**$826**	**$830**

Potential benefit of intertie optimization could be as large as ~$150 million/year in the WECC

All market participation scenarios show benefits relative to BAU

Source: NV Energy Day-Ahead Market Benefits Studies

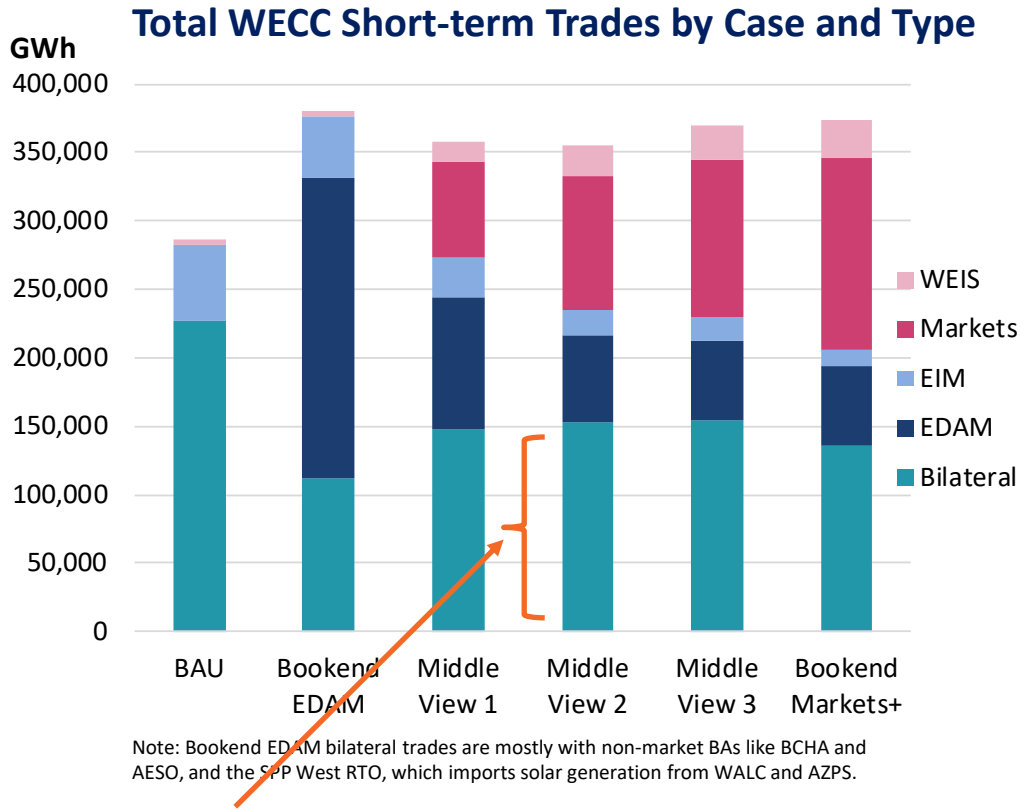
WECC-Wide Trading is Enhanced with One or Two Markets

Creating one or two optimized markets with depancaked transactions reduces trading inefficiencies relative to the status quo

- Bilateral trades face "hurdles" due to low of transparency and liquidity
- Bilateral trades between markets generally are more efficient than bilateral trades at hubs or between utilities, due to higher transparency and market-based liquidity (e.g., hourly CAISO intertie trades)

Adding organized DA markets increases WECC-wide trading by 20-30% (60-90 TWh) relative to the "bilateral" status quo

- Still ~125-150 TWh of bilateral trading in all the market cases simulated



~150 TWh of bilateral trading in the WECC after the DAMs, which would be more efficient with intertie optimization

Thank You!

Comments and Questions?

(Additional Slides)

See also Brattle Reports on:

Intertie Optimization (incl. FAQs)
Optimal Expansion and Use of Interregional Transfer Capability
NV Energy Day-Ahead Market Benefits Studies
Extended Day-Ahead Market Benefit Study
EDAM Simulations: PacifiCorp Results

Intertie Optimization: Implementation Options

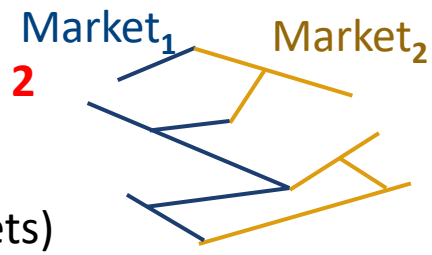
How would RTOs/ISOs determine and schedule optimal intertie transactions?

The RTOs would use their existing market optimization SCED engines to optimize intertie schedules subject to available intertie capabilities after all bilateral transactions are closed

- As the PJM IMM explains, this would: "include an optimized, but limited, joint dispatch approach that uses supply curves and treats seams between balancing authorities as constraints, similar to other constraints within an LMP market"

1. **Contract-path option**: treat the contract path across the interface like a single line with a generator (representing the neighboring region) dispatched through SCED.
   - The neighboring region would provide generation supply curve (incremental/decremental cost of importing more or less) for RT intervals
   - Simplest, will increase efficiency, but not optimally use full physical transmission

2. **Flow-based option:** represent interface physically with limiting flow gates
   - The neighboring region provides binding flow gates and marginal generators with shift factors on these flow gates (ISO-NE's 2014 IEEE "Marginal Equivalent" proposal)
   - Will use full physical capability (ISO-NE simulations achieve 99% of full optimization)



3. **Combined SCED option:** used full, multi-regional SCED (similar to Western imbalance markets)
   - Assures full optimization but likely impractical for existing market-based regions

See: Intertie Optimization, Frequently Asked Questions

FERC Has the Authority to Implement Intertie Optimization

Norman Bay and Vivien Chum (Willkie Farr & Gallagher LLP):

- FERC has long recognized the inefficiencies of market seams. *See* Order No. 888 & Order No. 2000
- FERC's authority to address seams issues is clear given its duty to ensure just and reasonable rates
- There is well established precedent for FERC to address market seams:
  - Coordinated Transaction Scheduling (ISO-NE-NYISO; NYISO-PJM; and PJM-MISO)
  - Western EIM and EIS
  - FERC precedent with respect to CTS: recognizing the value of "Tie Optimization" and leaving the door open. *See NYISO*, 139 FERC ¶ 61,048 (2012) (recognizing the possibility of replacing CTS with a "different methodology for scheduling external transactions (i.e., Tie Optimization or a superior alternative), if it is determined that such changes could result in greater cost savings")
- If the RTOs/ISOs propose intertie optimization, FERC has the clear authority to accept the filing under section 205. FERC would also be able to require intertie optimization under FPA section 206

Estimated EDAM & M+ Benefits are Conservatively Low

The estimated benefits are likely understated due to several factors:

- **Overstated base-case efficiency:** our simulation of the BAU is more efficient than reality
  - The Base Case assumes that balancing authorities have optimal security-constrained unit-commitment and dispatch (SCUC and SCED) in both DA and RT, making the simulated dispatch more optimal than reality.
  - Inefficient utilization of transmission by bilateral trades is not fully modeled, understating the extent M+ and EDAM will be able to make better use of all physically and contractually available transmission.
  - Transmission outages are not modeled, which would magnify the benefit of SCED-based congestion management in EDAM and M+ compared to the BAU
- **Normalized loads and fuel prices:** the model uses weather-normalized loads and averaged monthly natural gas prices without daily volatility
  - Challenging market conditions (beyond the included heat wave and cold snap), such during as the 2022 gas price spikes, will magnify EDAM/M+ benefits. Illustrated by the WEIM experience of much higher benefits in 3Q of 2021 and 3Q-4Q of 2022
  - The Base Case does not reflect the limited liquidity of bilateral market during challenging market conditions
- **No capacity benefits quantified:** we have not quantified the extent to which EDAM and M+ may reduce investment costs associated with lower operating reserve requirements

Speaker Bio

John Tsoukalis

PRINCIPAL | WASHINGTON D.C.

John.Tsoukalis@Brattle.com

+1.202.908.2617

John has broad experience helping clients address a range of issues related to wholesale power markets. He is an expert in electric market modeling, analyzing regional market participation, transmission benefit-cost analysis, transmission rate design, market design, detection of market manipulation and damages analyses, and strategic planning.

John has worked with electric utilities, cooperatives, public power authorities, transmission developers, generation owners, power traders, and ISO/RTO staff. He has assisted clients in developing whole market rules, ancillary service product, designing market power mitigation regimes and auction clearing mechanics, leading strategic planning initiatives, and modeling the power system to assess the benefits of new transmission, the benefits of participating in wholesale power markets, and the value generation assets.

John has provided expert testimony to FERC, provincial regulators in Canada, and in U.S. Federal Court related to transmission rate cases, alternative transmission rate designs, cost allocation, and contracts for wholesale power.

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