# CAPS Briefing in re:
# PJM Review of FTR Market Design

*John E. Parsons*

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# Presentation Outline

- Brief Summary of Main Points
- The Current Market Design
- Problems
- Options for Reform
- Perspectives on Hedging, Market Structure and Liquidity in FTR Markets

# Main Points

- 3 big problems
  - Load is not receiving full congestion revenues
    - Primarily due to low prices in FTR auctions caused by zero reservation price.
    - Exacerbated by the inability to secure useful self-scheduled FTRs.
  - Hedge products are shaped for financial traders, not load and gen.
    - Increasingly divorced from operation of power market.
  - Poor credit and risk management at the ISO.

- Reform Options
  - Fundamental reform: convert to standard commodity derivative market design.
  - Amendments to the current design:
    - Improve ARRs and self-schedule options to suit load's hedging needs.
    - Use LSEs as agents for sale of FTRs, letting them set the reservation prices.
    - Other product definition changes.
  - Credit and risk management reforms.

# The Current Market Design

# Section Outline – the Current Market Design

- Preliminaries
    - Congestion Pricing
    - Returning the Congestion Surplus

- The Basic Design
    - Two Objectives
    - Market Structure

# The Rationale for Congestion Pricing (1)

- Why charge for congestion in the first place?
  - In the current system, the charge does not in any direct and immediate way produce any new transmission capacity.

- It economically rations the use of transmission, a key feature of open access.
  - LMP equals the marginal cost of electricity at each location.
  - Within the constraints of the transmission network to deliver, generators are on an equal footing to supply.
  - Yields the maximal economic use of the transmission network. This is an indirect production of ‘more’ transmission capacity.

- Creates a transparent, public signal of points of congestion and the value of new investments in transmission.

# The Rationale for Congestion Pricing (2)

- In earlier decades, especially at the beginning of ’restructuring’ in the 1990s, there was an imagination that congestion revenues would become the incentive payment for competing companies to invest in new transmission.
  - This would be they way to deregulate transmission.
  - However, it became clear that this is not practical. There are too many externalities and other complications with transmission investments.
  - So, transmission remains under classic rate-of-return regulation.
  - Congestion revenues returned are a credit against the promised return and reduce transmission charges.

- The congestion surplus could be simply and readily returned to customers via any number of formulas without that undermining either congestion pricing or open access. We will return to this point under options for reform.

# Returning the Congestion Surplus

- LMPs create a '*congestion surplus*'.
  - The total revenue paid by consumers exceeds the total revenue received by generators.
  - The difference is the congestion surplus.

- Returning the congestion surplus to customers requires deciding which customers get how much of the surplus—i.e., an allocation rule.

- <u>One way</u> to allocate the surplus is to pay fees to transmission owners that are determined by congestion prices.
  - Calculate fees based on the quantity of power injected and withdrawn at various nodes across their system;
  - Set the price per unit of power equal to the congestion component of LMPs.
  - Total payments to transmission equals the congestion surplus.

The '*congestion surplus*' is also known as '*congestion rents*' or as '*merchandising surplus*'. All of these terms refer to the same thing.

# The FTR Market Objectives

- In addition to returning the congestion surplus, the designers of the FTR market wanted to also create a forward market in transmission rights.
  - That is, they wanted load and generation to be able to contract for transmission rights ahead of time, in advance of the spot market.
  - This would enable hedging of congestion price risk.

- So, the current FTR market is designed to fulfill two objectives simultaneously:
  - Return the '*congestion surplus*' to customers, and
  - Create a forward market in transmission capacity, enabling load and generation to hedge congestion price risk.

**Two Birds, One Stone**

# Market Structure

- PJM sponsors the FTR market:
  - PJM hosts a sequence of centralized auctions in which companies can place bids to buy and offers to sell financial derivatives with target payoffs that are a function of the future price of congestion between pairs of locations;
  - PJM is the central counterparty to each FTR;
  - owners can resell in subsequent auctions, or via bilateral transactions.

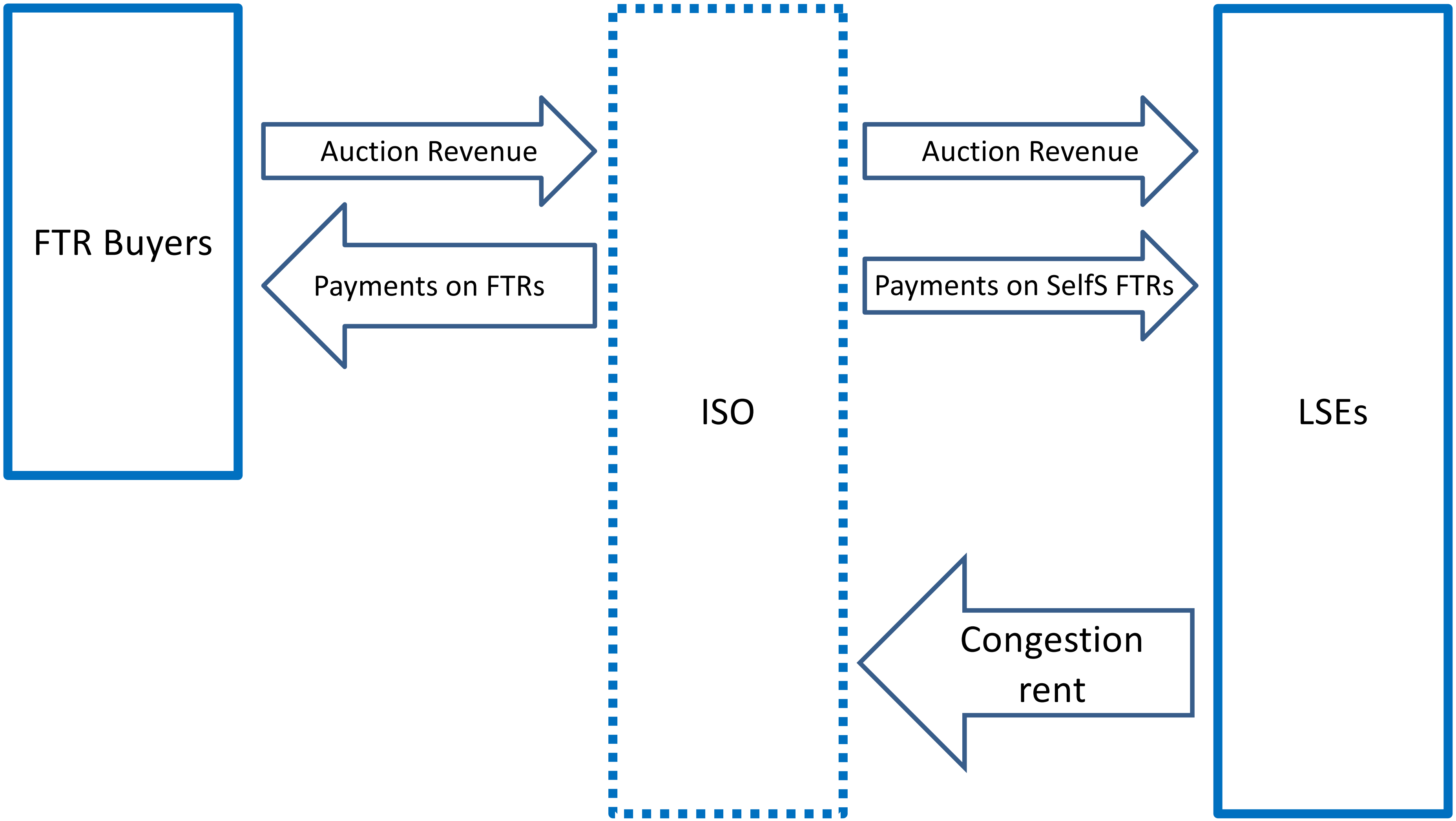
  This derivatives market enables hedging congestion price risk.

- PJM uses this derivative market to return congestion surplus to customers:
  - PJM issues a positive '*net supply*' of FTRs in the auctions; i.e., PJM goes short;
    - most derivative markets are zero net supply, and the central exchange or counterparty has a balanced position—is neither long, nor short;
  - It distributes to LSEs rights (ARRs) to a choice between:
    - particular FTRs ('*self-scheduled FTRs*') withdrawn from the auctions; or
    - claims on the FTR auction revenues.

  Customers receive these instead of the congestion surplus.

**Two Birds, One Stone**

# Diagram of Current Structure



# Problem #1
# Congestion Revenue is Not Fully Returned

# Section Outline – Problem #1

- Congestion Revenue is Not Fully Returned
- Diagnosis: The Auction Price is Too Low
- Alternative Diagnosis: Is It a Risk Premium?
- Underlying Cause: Reservation Price = 0

# Failure to Return Congestion Surplus to Customers

| Planning Period | Total Congestion | Returned | Percent Offset | Unreturned |
|---|---|---|---|---|
| 2011/2012 | $749.7 | $762.0 | 101.6% | -$12.3 |
| 2012/2013 | $524.8 | $531.4 | 101.3% | -$6.6 |
| 2013/2014 | $1,870.6 | $794.1 | 42.5% | $1,076.5 |
| 2014/2015 | $1,357.6 | $886.8 | 65.3% | $470.8 |
| 2015/2016 | $951.1 | $858.7 | 90.3% | $92.4 |
| 2016/2017 | $780.8 | $809.1 | 103.6% | -$28.3 |
| 2017/2018 | $1,192.6 | $595.7 | 49.9% | $596.9 |
| 2018/2019 | $680.0 | $626.3 | 92.1% | $53.7 |
| 2019/2020* | $185.5 | $215.5 | 116.2% | -$30.0 |
| Total | $8,292.7 | $6,079.6 | 73.3% | $2,213.1 |
| Average | $921.4 | $675.5 | 73.3% | $245.9 |

Source: Monitoring Analytics, 2013 Q3 State of the Market Report for PJM, p. 681, Table 13-20.

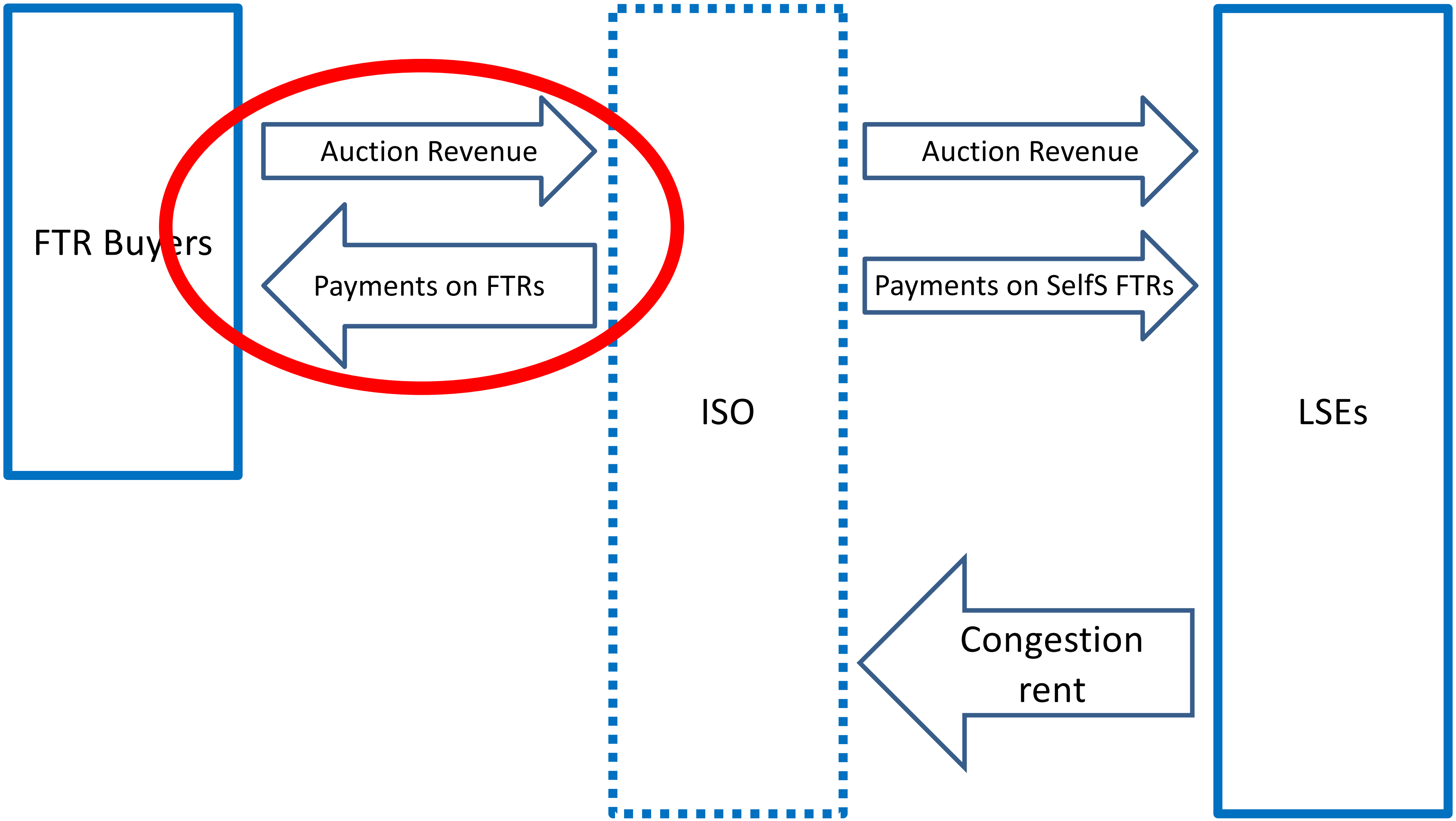
# Diagnosis: FTR Auction Revenues Too Low.

| Planning Period | FTR Value | ARR + Self-Sched. FTR Value | Shortfall | |
|---|---|---|---|---|
| 2007/2008 | $1,931 | $1,771 | $160 | 8.3% |
| 2008/2009 | $1,597 | $1,723 | -$126 | -7.9% |
| 2009/2010 | $765 | $925 | -$160 | -20.9% |
| 2010/2011 | $1,433 | $1,253 | $180 | 12.6% |
| 2011/2012 | $718 | $812 | -$94 | -13.1% |
| 2012/2013 | $605 | $564 | $41 | 6.8% |
| 2013/2014 | $1,473 | $852 | $621 | 42.2% |
| 2014/2015 | $947 | $786 | $161 | 17.0% |
| 2015/2016 | $736 | $825 | -$89 | -12.1% |
| 2016/2017 | $633 | $788 | -$155 | -24.5% |
| 2015/2016 | $782 | $591 | $191 | 24.4% |
| Total | $11,620 | $10,891 | $729 | 6.3% |
| Average | $2,324 | $2,178 | $146 | 6.3% |

Source:

Opgrand, Jeffrey, J. (2019). The Role of Auction Revenue Rights in Markets for Financial Transmission Rights. Purdue Dissertation, August, 39, Table 3, PJM-wide Results in the ARR Market.

# Diagram of Current Structure



# A Persistent Result Across ISOs

- NYISO – Adamson and Englander (2005), Zhang (2009), Hadsell and Shawky (2009), Adamson et al. (2010), Mount and Ju (2014), Toole (2014) and Leslie (2019)
- Ontario – Olmstead (2018)
- CAISO – Baltaduonis et al. (2017) and CAISO (2016)
- MISO – Molzahn and Singletary (2011) and MISO (2019)
- Especially in PJM's Long-Term Auction – Opgrand (2019)

# A Risk Premium?

- Is the shortfall between the payoffs on FTRs and the price in the auctions a *'risk premium'* paid by load to financial investors for the benefit of reducing risk?

- It is conceivable.
  - Risk premia are real things.
  - They have been identified and measured in many financial markets and commodity markets, including electricity.

- It has never been established that the shortfall in the FTR market has anything to do with risk premia.
  - It is often just a lazy excuse. Simply define any difference as a risk premium, regardless of other evidence or information.
  - No one has assumed the burden.

- There is evidence that the shortfall, or at least much of it, is not a risk premium.
  - Opgrand (2019)
  - Leslie (2019)
  - Adamson et al. (2010)

# Seller Choice: In General

- An FTR auction price is not a reflection of the Fair Market Value of an FTR by the '*willing buyer-willing seller*' standard.
  - Because the seller is compelled to sell.

- PJM sells FTRs on behalf of transmission customers regardless of the price received.
  - If the sales price is too low, PJM nevertheless sells.
  - PJM makes no independent investigation into the value of an FTR, and
  - PJM generally does not set a minimum bid in order to elicit a higher buy price, i.e., a reservation price = 0.

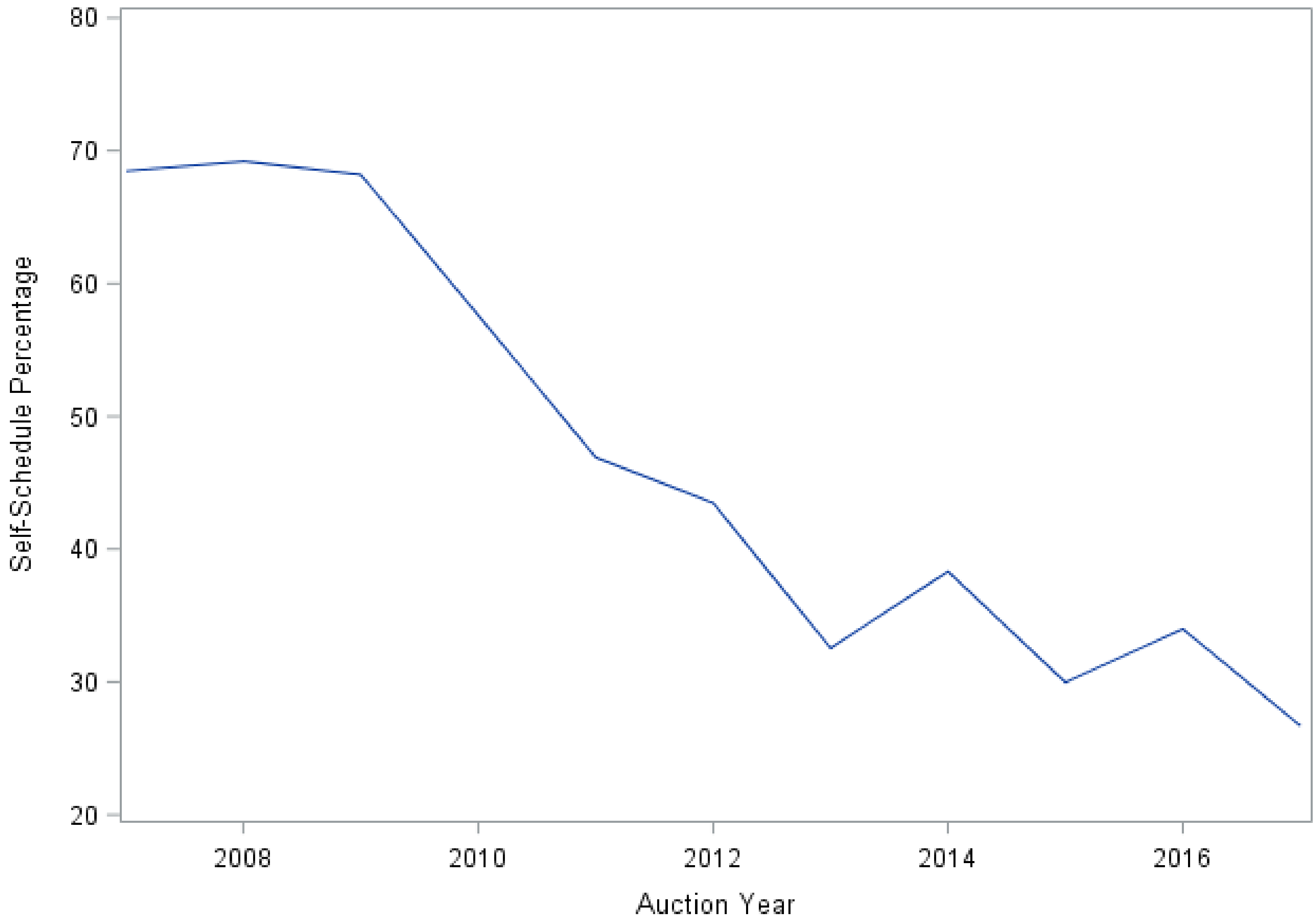
- In a normal forward or futures market, the two sides of a trade agree on the price.
  - the FTR market is unusual in this regard.

**Conscripted Liquidity**

# FTR Auction Algorithm

- PJM's algorithm for selecting the quantity of FTRs to sell fails to maximize revenue returned to customers:
  - PJM maximizes the sum of
    - (1) revenue on FTRs sold, and
    - (2) the *imputed* value of self-scheduled FTRs.
  - while,
    - (3) PJM imputes a zero value to unsold FTRs, although these can have a positive value to load due to "payoff aggregation"—about which more later.
  - An auction in which the slate of products sold and the prices accepted is in part based on an imputed value to products not sold is VERY PECULIAR.

# Self-Scheduling is on the Decline



# Options for Self-Scheduling are Restrictive

- The option ARRs provide to self-schedule FTRs is heavily constrained.
  - Each ARR corresponds to a specific collection of FTRs.
  - LSEs cannot pick and choose which FTRs within the collection to self-schedule, and which not. It must make a decision to either self-schedule the whole collection, or none at all.
    - For example, whenever load self-schedules, it must self-schedule the set for the full 24-hours; it cannot self-schedule the peak hour FTR and sell the off-peak hour FTR.
    - And load must choose zonal load-weighted sinks; it cannot choose FTRs for a subset of sinks in its load zone.
  - Therefore, load cannot determine whether it is willing to sell any individual FTR, but only whether it is willing to sell a collection.
  - Therefore, even for ARRs, it is the case that a seller can sell an individual FTR at a price lower than it is willing to receive on that individual FTR.

# Transmission Modeling Also Reduces Auction Price

- Forward sale of transmission requires estimating the state of the transmission network more than 1 year ahead.
    - …and generally assumes it is constant throughout a full year.
- Transmission capacity is variable and stochastic.
    - Some of this is discretionary.
- Modeling transmission capacity is complex and time consuming. PJM uses a simplified model relative to the actual transmission system.
- Different models and parameterization for the FTR auction and the Day-Ahead markets setting FTR payouts
- Significant share of traders' FTR profitability has to do with second guessing the modeling differences, not fundamentals.
- This irrelevant private information decreases auction prices.
    - Invites insider trading.

# Other Payout Definition Problems

- Prorating payouts is used to preserve the fiscal integrity of PJM.
    - ‘Revenue sufficiency’ is not assured in practice.
- Proration transforms the nature of FTRs…
    - from individually well-defined derivatives on separate market risk factors,
    - into a complex mutual ownership share on a pool of congestion revenue.
- Other details of pro-ration add to the complexity.
- Contributes to the complexity of FTR products, reducing bidder competition and lowering auction revenue.

# Summary

**PJM sells FTRs on behalf of load.**
**It sells whether the price is good or not.**
**The evidence is that PJM does not get a good price.**

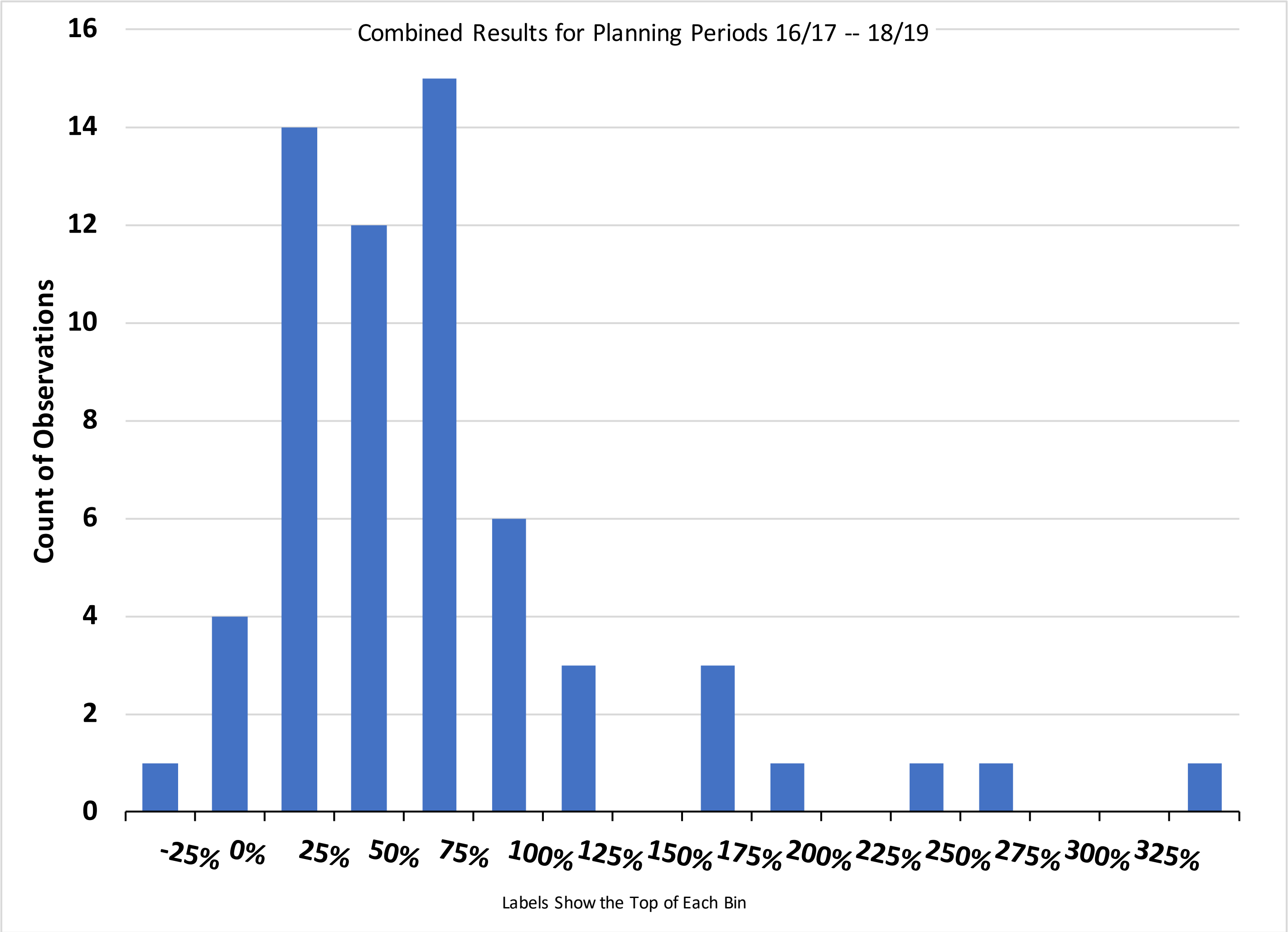
# Problem #2
# Hedge Effectiveness

# What About the Other Bird – Hedging Effectiveness?

- Bottom line questions:
  - Do load and generation use FTRs to hedge?
  - Does the existence of the FTR market enable more or better forward contracting?

- Little direct evidence at all.
  - We do see some use of FTRs by LSEs and generators which we presume to be for hedging.
  - But there is reason to believe the current system limits hedging. The current design specifically fractures trading across all nodes instead of concentrating it in a few, liquid, benchmark contracts.
    - Inherent to the current design which requires the slate of FTRs be simultaneously feasible, which excludes concentrated trading.

# ARR Offer Poor Hedge Effectiveness




A Histogram of "Maximum Self-Schedule Hedge Ratios" in PJM's 21 Control Zones.

# Other Dirty Hedge Issues

- PJM exclusion of balancing congestion undermines the usefulness of FTRs as a hedge for load.
  - Balancing congestion is an inherent feature of load's congestion risk problem.
  - By excluding balancing congestion from FTR funding, PJM makes the product less useful to load because the two payoffs now become negatively correlated.
- FTRs appear suited to baseload operation. Not to the current energy market.

# Problem #3
# The ISO as a Derivatives Exchange

# The ISO as a Derivatives Exchange

- FTRs are Financial Derivatives
  - With financial risk implications like other derivatives such as oil futures or natural gas futures.

- The ISO Runs the Market, but More Importantly, It Acts as the Central Counterparty
  - Every FTR has a buyer or seller on one side, and the ISO on the other side.
  - Similar role to the CME or ICE.

- Derivatives Involve Credit Risk and Require Sophisticated Risk Management
  - Poor credit risk management has the potential to produce large losses.
  - The Green Hat case is just the most recent of what have been multiple credit events at PJM

- FERC has failed to enforce risk management standards on the FTR market comparable to those required by the CFTC for other commodity derivatives.

# Options for Reforming PJM's FTR Market Design

# Section Outline – Options for Reform

- Group #1: Fundamental: convert to standard commodity derivative market design.
- Group #2: Amend the Current Design
- Group #3: Raising the Standards of PJM as a Counterparty

# Group #1

# Fundamental: convert to standard commodity derivative market design.

# Contrasting Market Designs (1)

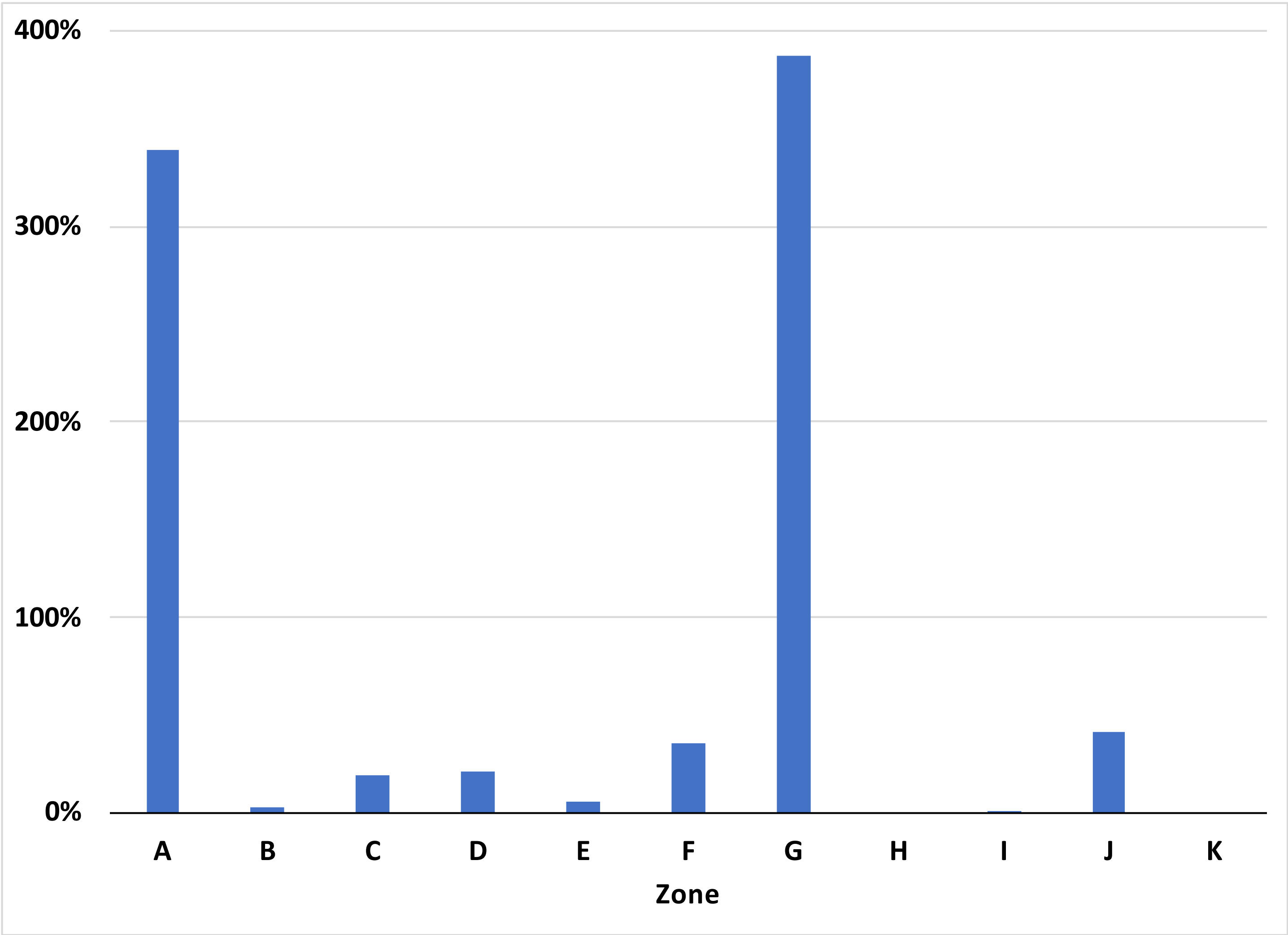
Standard Commodity Derivative Market

- Buyer and seller interest determines the quantity of open interest in a product.
  - Benchmark products arise with very high open interest.
  - Non-benchmark products have low or no open interest.

FTR Market

- The quantities for forward sale are fixed to match transmission capacity throughout the system.

# Example: NYISO Electricity Futures by Zone



# Contrasting Market Designs (1)

**Standard Commodity Derivative Market**

- CCP maintains a balanced book, i.e., zero net exposure.
- Payments to profitable derivative traders are funded by payments from losing derivative traders.
- Settlements in the derivatives market are separate from settlements in the spot market.
- Privately organized exchanges and CCPs.

**FTR Market**

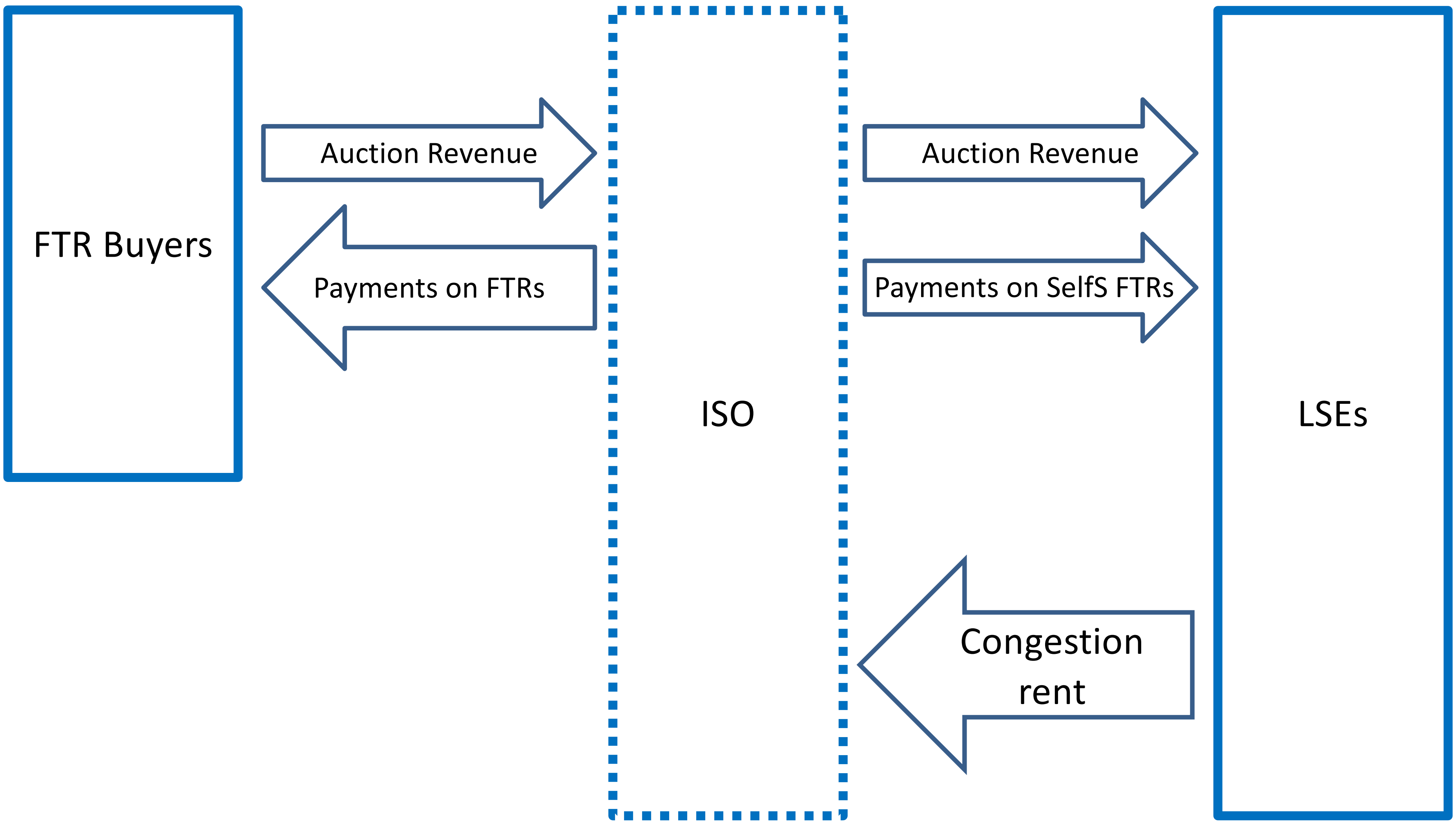
- The CCP, which is PJM, maintains an imbalanced book, i.e., a negative net exposure.
- Payments to profitable derivative traders are funded from PJM accounts.
- Settlements in the derivatives market are claims on settlements in the spot market.
- Government sponsored exchange and CCP.

# Fundamental Reform: Implement SMD for Derivs

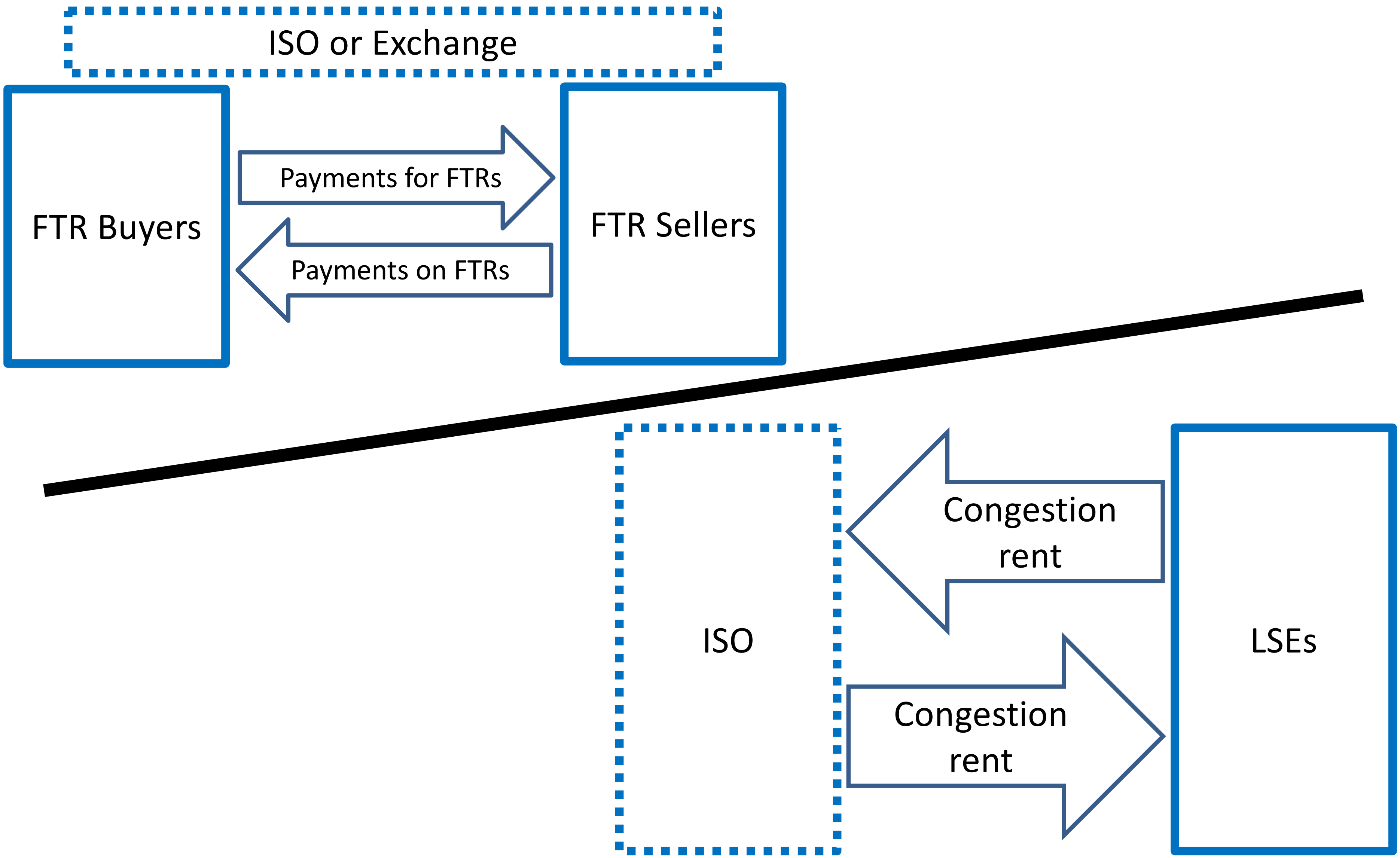
- Step #1: Let the quantity of FTRs bought and sold to be determined by the free trade of buyers and sellers, and not by the ISO; let the total open interest in FTRs be whatever market interest establishes it to be, whether that be greater or less than the capacity of the transmission system.

- Fund payments out to traders with winning FTR positions using payments in from traders with losing FTR positions; do not fund payments to FTR traders using revenues from the spot electricity market; thus, separating settlements in the FTR market from settlements in the spot electricity market.

# Diagram of Current Structure



# Diagram of Reformed Structure



# FTRs Would Be Traded Only by Willing Sellers

- Financial traders could offer FTRs directly to load and to generation with the price determined by the two sides.
  - PJM would no longer be a counterparty to any trades.
  - PJM would no longer attempt to forecast transmission capacity and determine the slate of FTRs for sale.

# FTRs Product Slate Could be More Useful for Hedging

- FTR trade could be concentrated in a few benchmark products, increasing liquidity and the usefulness for hedging.
  - At the same time, the array of products—whether benchmark or basis—could be broader than PJMs current offerings.
    - e.g., it would be possible to offer a hedge of Real-Time congestion, or of the combines Day-Ahead + Real-Time congestion.
- See discussion below, under hedging, for a discussion of the normal structure and role of benchmark and basis contracts.

# FTRs Would Be Well Defined

- FTR target payoffs would be the actual payoff;
  - with the normal proviso about credit risk in any derivatives market.
  - this would improve the value of the FTR market for hedging.

# Market Viability?

- There seems to be a broad fear that if the PJM does not 'sponsor' the FTR market, it won't exist.
  - Maybe. It is not clear what evidence argues in favor of this point.
    - But if so, why does that argue in favor of PJM subsidizing the market's existence at the expense of customers' claim on the congestion surplus?
    - I cannot think of another commodity market that is subsidized via conscripted liquidity.
  - In general, it makes sense to create sensible market rules and let market supply and demand determine the level of trade.

# Allocation Rule of the Congestion Surplus

- Many options.
- No economic rationale that pushes overwhelmingly for one or another.

# Group #2
# Amendments to the Current Design

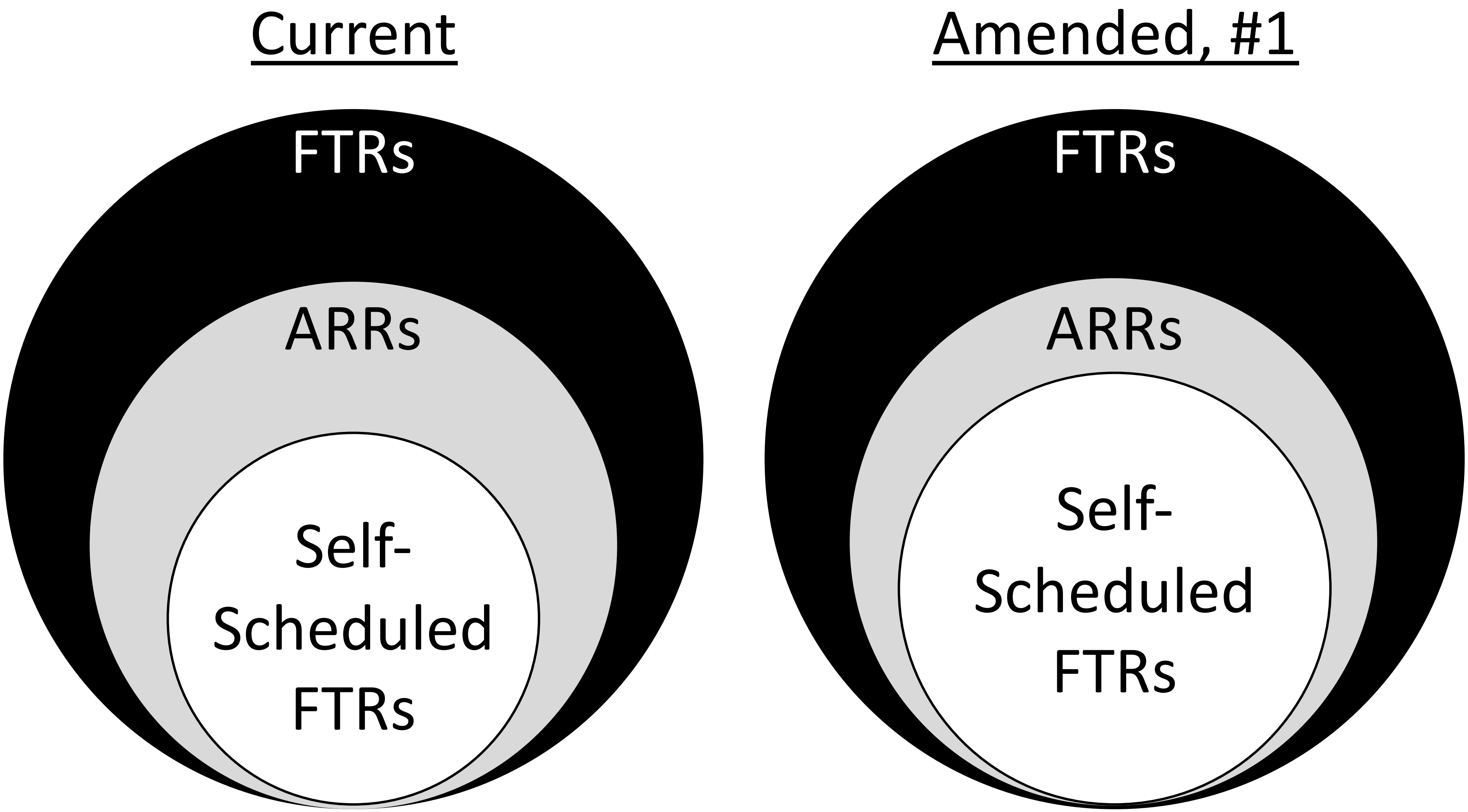
# Amendment #1: Improve ARR Allocation and Self-Scheduling Options

- Step #1. Revise ARR allocation rights.
  - Possibly enable bidding on point sources.

- Step #2. Expand flexibility for self-scheduling.

- Intended objective is increased self-scheduling of FTRs.
  - Better hedging directly.
  - Directly reduce volume of FTRs sold in auction.
  - Indirectly raise auction prices.

# Amendment #1: Improve ARR Allocation and Self-Scheduling Options

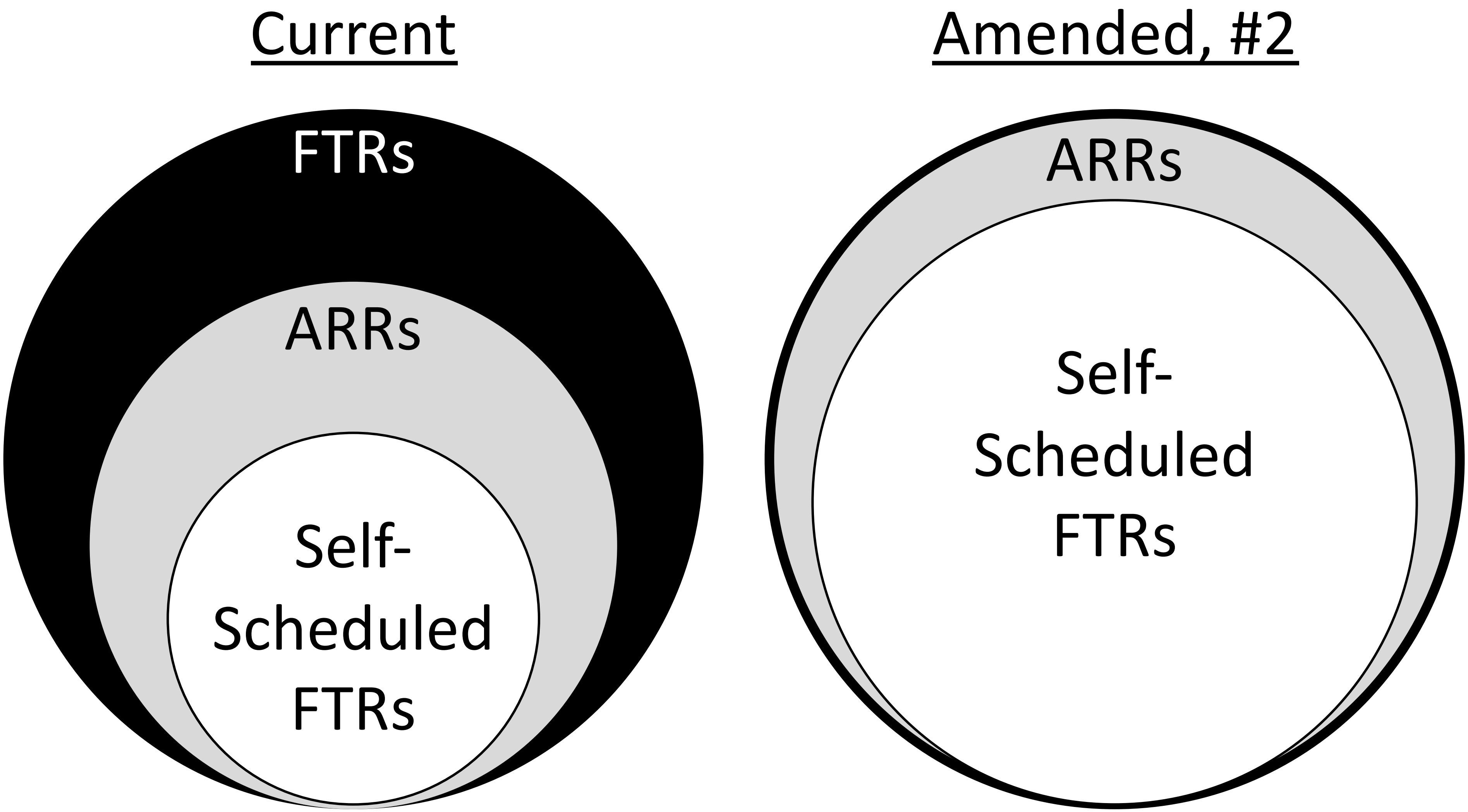


# Amendment #2: Promote the LSEs to be the Agents Selling All Network Capacity

- Allocate the FULL transmission capacity as ARRs.
    - Possibly enable bidding on point sources.

- Let LSEs choose whether to self-schedule FTRs or sell into the auction hosted by PJM.
    - Can set positive reservation prices.
    - Can set different reservation prices across different FTRs.
    - Whatever is sold is not self-scheduled, whatever is self-scheduled is not sold.
    - ISO is not a seller.

# Amendment #2: Promote the LSEs to be the Agents Selling All Network Capacity



# Other Amendments

- Reduce FTR bidding options. Limiting products increases bidder competition.

- Miscellaneous changes such as eliminate portfolio rule in payout ratio. Treat payments to an from identically.

# Group #3: Raise Standard for PJM as a Counterparty

- Invest in PJM's capability, with the objective of matching normal trading business' risk management.
- Contract with a professional exchange.
- Cannot get around the fact that PJM's stakeholders bear the costs.

# Perspectives on Hedging, Market Liquidity and Forward Contracting

# Section Outline – Perspectives on Hedging

- Market Risk Premium
- Liquidity and Futures Markets
- Forward Contracting

# What is a Risk Premium?

- In a competitive financial market, the risk premium is the price paid to sell a risk.
  - The cost of insurance is more than the expected payout on the insurance. Some of this difference covers administrative expenses. The remaining profit, which compensates the insurance company for putting capital at risk, is the risk premium associated with the risk being insured.
  - In commodity futures markets, the risk premium is the profit earned above and beyond costs of storage. The premium earned by the seller of insurance is the premium paid by the buyer of insurance.

- Define the variable $C_{ij}$ as the risky payoff to an FTR.

- Define the variable $p_{ij}$ as the market price of an FTR.
  - Assuming that the market price is set in a competitive market.

- Then, the market risk premium is:

$$p_{ij} = \frac{E(C_{ij})}{(1 + r_{ij})^t}$$

# Measuring Risk Premia

- We measure risk premia using data on the price at which risks are bought and sold compared against the realized payoffs.
    - Stocks
    - Bonds
    - Oil futures
    - Electricity futures
  - Quoted as a rate of return over time.

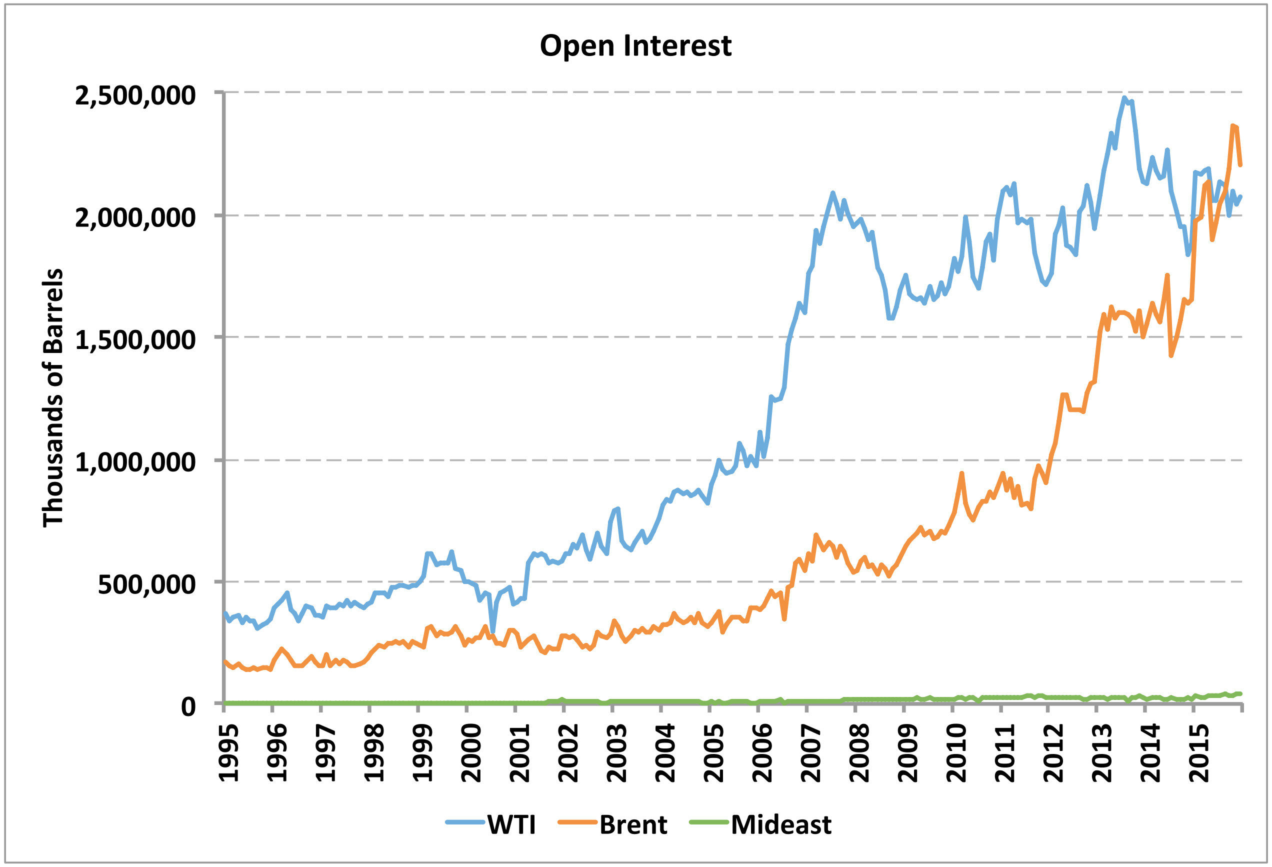
- FTRs are typically held for short windows of time, so that even with a high rate of return the total profit should be small.

- Risk premia are typically persistent over some stretch of time. And, this is the implicit assumption when we measure them.
- Risk premia are a feature of a competitive market. They should be common across a wide range of financial investors—a market fact, not the profit of a single investor.

- Cannot measure risk premia simply as a plug.

# Liquidity and Futures Markets (1)

- Futures markets typically succeed only for a few, well traded '*benchmark*' products.
  - In the oil market, there are two products that capture most all of the trade:
    - Brent
    - WTI




- Note the trivial share of trade on the Mideast contracts.
- Not shown is the even more trivial volume of trade of East Asian contracts.

# Liquidity and Futures Markets (2)

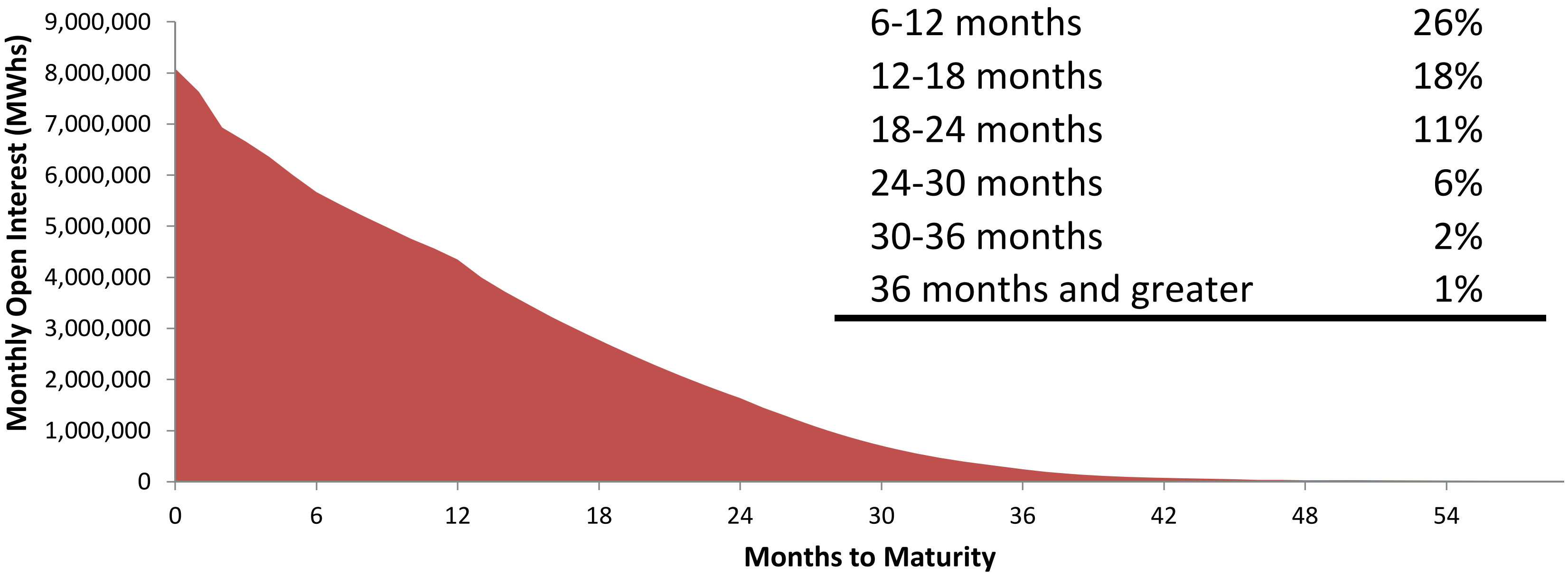
- Around the dominance of these benchmark contracts, there is a much smaller volume of trading on a few key '*basis contracts*'.
  - Like the Mideast oil contracts or a particular East Asian oil contract.
  - There is never a distinct futures contract for every physical location.

- Concentrating futures trading gives liquidity to the benchmark contract. Trading in that contract becomes cheaper. It becomes more competitive. There is less opportunity to manipulate the contract—although the value of manipulation can increase.
  - These gains are at the expense of the suitability of the futures contract for hedging—the so-called dirty hedge.

# Liquidity and Futures Markets (4)

- Also, futures contract trading is overwhelmingly located in short horizon contracts, with volume quickly declining as the horizon for the contract expands—e.g., NYISO again:

| Months to Maturity | Share of Open Interest |
|---|---|
| 0-6 months | 35% |
| 6-12 months | 26% |
| 12-18 months | 18% |
| 18-24 months | 11% |
| 24-30 months | 6% |
| 30-36 months | 2% |
| 36 months and greater | 1% |



# Some Background – Forward Markets (1)

- ISOs manage the spot market in electricity,
  - which is composed of the Day-Ahead and the Real-Time markets.

- Generation and load are free to enter into bilateral supply contracts, which then must be scheduled into the spot market.
  - Bilateral market is a '*forward market*'.
  - Regardless of the terms of the contract, when load and generation amounts are scheduled, load pays to the ISO its LMP and generation receives from the ISO its LMP – i.e., load pays a congestion price.
  - The contract can be written to assign this congestion risk to either the generator or the load, but there is no way to avoid it entirely.

- An FTR market is a '*forward market*' in transmission rights.

- Together, a generation contract + an FTR = a fixed price contract for generation + transmission between two locations.
  - Still pay for the expected congestion via the price of the FTR.

# Some Background – Forward Markets (2)

- The inspiration for FTRs is the ability to contract for firm transmission.
  - The simple example of an all-in fixed quantity and fixed price contract is a useful starting point, but elides important facts.
    - Very little generation supply should be via fixed quantity contracts. Sources of supply to load need to vary in predictable manners–hour-by-hour, season-to-season—and in response to contingencies.
    - Similarly, transmission utilization varies with the realization of many uncertain variables. Firm transmission rights are not very useful within a system that is operated optimally.
  - What does the data say about current operations?
    - What amount of generation is scheduled into the PJM spot market as contracted generation? About half?
    - What amount of FTR contracting should be expected or desired?

# The End