Memo: Analysis Of PJM ARR/FTR Market Design And Reform Options

John E. Parsons

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1 Introduction and Charge

PJM has initiated a comprehensive review of ARR/FTR market design, including a review of the history and evolution of PJM's design, of designs in other regions, and opportunities to improve the design. CAPS has requested that I brief them on the subject. In particular, CAPS requested that I highlight key design issues and the impact for consumers, including the congestion pricing model, congestion risk, hedging and liquidity, and that I identify FTR designs that return a greater portion of congestion rents to load. CAPS also requested that I identify important data and research related to these issues.

2 Problems and Diagnoses

PJM's FTR market has experienced a number of diverse problems that motivate the current review. I sort them into three groups:

1. Congestion revenues not being returned to load,
2. Hedge ineffectiveness for load, and
3. Poor credit risk management by PJM.

2.1 Returning Congestion Revenues to Load

Electricity markets that employ locational marginal pricing produce a congestion surplus–that is, the revenue collected from customers on the system is greater than the revenue paid to generators. These congestion revenues are not a reimbursement for any service. They can be returned to customers without undermining the economic performance of the wholesale market. Failure to return congestion revenues to load is a dead-weight cost to load.

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 open the door to deregulation of 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. Reducing the amount of congestion revenues returned increases the transmission charge load must pay.

Congestion revenues could be returned to customers directly, without the use of an FTR market. However, PJM has chosen to use the FTR market. The full details of PJM's market design are extensive, but the basic structure is simple: instead of distributing congestion revenues to load, it sells a forward claim on them and distributes to proceeds of the sale to load.[1] Congestion revenues are sold in the form of FTRs, and the proceeds of the sale are distributed via the Auction Revenue Rights (ARR) process.

A major problem with PJM's design is that it is not returning the full value of the congestion revenues to load. Table 1 shows the annual shortfall between total congestion revenues and the amount returned to load over recent years. The amounts of deficiency have been significant.

2.1.1 The Auction Price is Too Low

The main cause of the shortfall is that the FTR auctions prices are too low. Bidders succeed in paying much less for an FTR than the payoff they expect on the FTR. The problem has been documented in a variety of different studies using different techniques, analyzing auctions in different ISOs, and across time from the very first auctions to the current time. The most studied case is NYISO–see Adamson and Englander (2005), Zhang (2009), Hadsell and Shawky (2009), Adamson et al. (2010), Mount and Ju (2014), Toole (2014) and Leslie (2019). Olmstead (2018) documents it for Ontario, Baltaduonis et al. (2017) and CAISO (2016) for CAISO, and Molzahn and Singletary (2011) and MISO (2019) for MISO. The problem is especially severe in PJM's Long-Term FTR auctions–see Opgrand (2019).

The universality of the problem argues strongly that the cause of the problem must be something common to the market design being used across ISOs and over time. There may be particularities in the auction rules that contribute to the problem, but

[1] A forward claim is a right to a future payoff. The FTR is sold in advance of the period over which the FTR has a claim on congestion revenues. At the time of the sale, the amount of the congestion revenues on which it has a claim is unknown. Congestion revenues vary with system conditions, and so are an uncertain revenue stream. The auction of the FTR therefore converts this uncertain revenue stream into a fixed payment. As the period on which the FTR has a claim arrives and the amount of the congestion revenue is realized, it will almost certainly turn out that the realized congestion revenue is higher or lower than the fixed price paid in the auction. In any single period, the difference may be substantial. However, one would hope that the fixed price is close to the expected congestion revenue, and that over time the fixed price is on average close to the expected revenue.

Table 1: The Shortfall Between PJM's Total Congestion Revenues and the Amount Returned to Load, Planning Periods 2011/2012–2019/2020.

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.

adjusting the particularities is unlikely to resolve the whole problem.

2.1.2 Lack of a Reservation Price

The common cause is likely the commitment to sell a pre-specified quantity without regard to price. The pre-specified quantity is what PJM determines to be the network transmission capacity.[2] As a general rule across all sorts of commodities and settings, an unconditional commitment to sell is a poor bargaining strategy. In most auctions, sellers impose one form or another of a reservation price below which the sale does not take place. Reservation prices are widely understood to improve the expected price of an auction. However, ISOs use a reservation price of zero in FTR auctions.

Even in a market as deep and competitive as the global oil market, we see that well known large sellers of forward contracts avoid making definite commitments to sell a

[2] When I speak of network transmission capacity, I mean point-to-point capacity–the capacity to inject at one set of nodes and to withdraw at another set of nodes. Technically, there is ambiguity in aggregating capacity involving various sets of nodes. In FTR auctions this aggregation is made using a pricing function. However for the level of exposition of these notes I simply ignore this ambiguity. It is not central to most of the points made here.

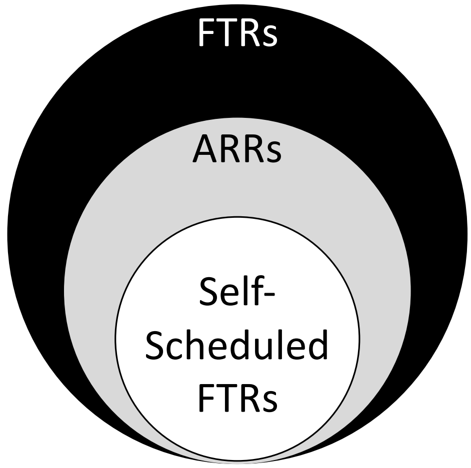

Figure 1: Schematic Diagram of the Total FTR Capacity and the Portions Allocated to ARRs and selected as Self-Scheduled FTRs.

fixed supply on a fixed date. For example, the Mexican government has emphasized flexibility and confidentiality as it executed its annual hedging of the anticipated oil sales of its state oil company, Pemex. The government does not make a public commitment to sell futures in any specific quantity at a single point in time regardless of the bids submitted–see, for example, Arezki et al. (2012). The contrast is especially stark because one would expect the Mexican government's readiness to walk away from bids to have a smaller impact on the final price, whereas in the latter case, one would expect the ISO's commitment to sell would have a larger impact.

2.1.3 Self-Scheduled FTRs

Prior to the yearly FTR auctions, load has the right to convert its ARRs into self-scheduled FTRs which are then unavailable for sale in the auction. Figure 1 is a schematic diagram that will be useful in an analysis of how the ARR process works for load self-scheduling FTRs. The outermost circle, in black, represents total transmission capacity that could be allocated to FTRs. The portion of this capacity allocated as ARRs is represented by the gray circle. Only approximately 65-70% of capacity is available to the ARR process. The innermost circle, in white, represents the portion of capacity that is converted to self-scheduled FTRs. The portion not self-scheduled–both the black and the gray crescents–is sold by the ISO in the FTR auctions.

Self-scheduling FTRs helps mitigate the problem of the low auction price. By self-

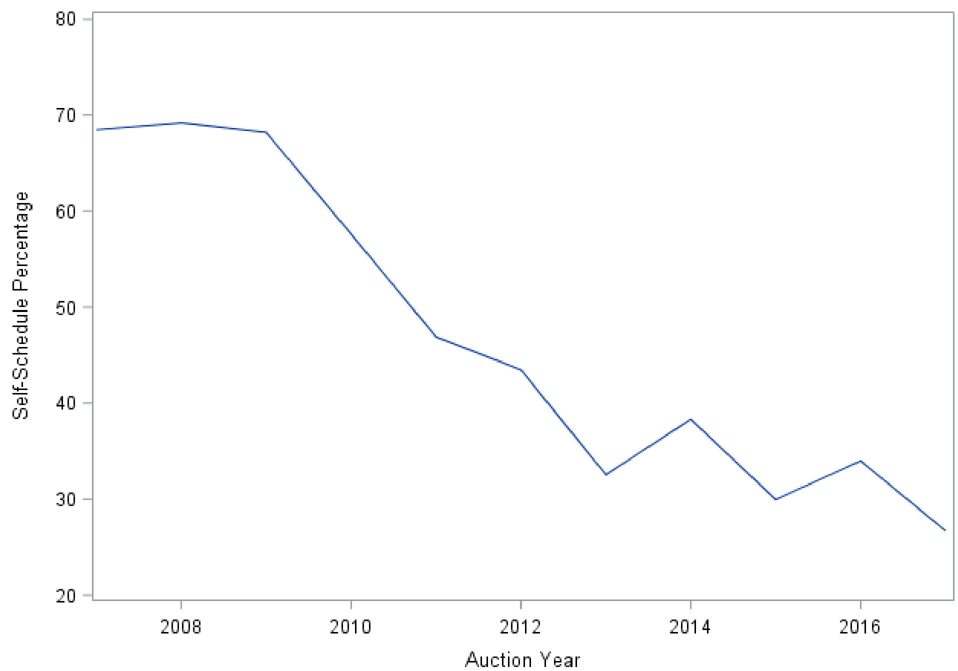

Figure 2: The Proportion of ARRs Self-Scheduled as FTRs in PJM, 2007-2017.

Source: Opgrand (2019), Figure 7.

scheduling, an ARR holder is withdrawing some FTRs from the forward sale and holding on to a direct claim on congestion revenues. This directly avoids incurring the shortfall between the expected congestion revenues and the auction price.[3] It also indirectly reduces the shortfall by improving the auction price as shown in research by Opgrand (2019).

Unfortunately, Figure 2 shows that the portion of ARRs self-scheduled has been declining. Below, in the section on hedging effectiveness we discuss one potential cause of this decline. Here we simply note that the decline in self-scheduling exaggerates the problem of a low auction price and the failure to return congestion to load.

2.1.4 Variable and Stochastic Transmission Capacity

Transmission capacity is inherently variable and often stochastic. The obvious source of variability is line outages for maintenance. This can be planned, but emergency outages arise, too. Many other factors come into play as well. Simple changes in ambient tem-

[3]The fact that the auction price is less than the expected payoff to FTRs is true on average, but may not be true for particular FTRs and the significance of the shortfall may vary by the FTR.

perature through a day or across seasons changes capacity. Capacity also varies when contingency factors, such as thunderstorms, power plant outages, or other equipment trips force deratings of particular lines in order to preserve security and stability of the network. There is a lot of discretion involved in these decisions. Finally, loop flow from connected systems is another variable factor that alters the net capacity available to internal flows. Joskow and Tirole (2005) highlight the stochastic attributes of transmission capacity as one of the main problems with trying to incentivize merchant investments in transmission.

Since FTR auctions are a forward sale of capacity, the ISO must estimate capacity. It does this with some error. Some of the errors can be minimized with effort, and the ISO imposes responsibilities on transmission companies to provide good information. However, no matter how good the forecasting, there remains an irreducible amount of uncertainty. Inevitably, over the course of the year or more between an FTR auction and one of the Day-Ahead markets setting the payouts, details about the capacity of the transmission network will have evolved. Moreover, modeling transmission and power flow is complex and time consuming. The ISO uses a simplified transmission model for its FTR auction, and it focuses its estimation on the key elements of this simplified model. When it comes time to do the Day-Ahead dispatch, it uses a reparameterized, but still simplified model. The Day-Ahead model will have some new constraints imposed and others relaxed. Thus, the transmission capacity sold in the FTR market differs from the capacity sold in the Day-Ahead dispatch.

These differences can have a big impact on FTR payouts. The differences open the door for traders to profit off of private information on model differences as opposed to on information about fundamentals. For example, a trader may identify a line outage that is included in the model employed for the FTR auction, but which the trader believes will no longer be relevant when the Day-Ahead network is modeled, and the trader may identify FTRs it thinks will be cheap but have high payoffs due to this change.[4] This sort of private information weakens the competitiveness of the auction and lowers the expected auction prices, as CAISO (2016) explains.

2.1.5 Other Payout Definition Problems

Prorating FTR Payouts

[4] This is also fertile ground for insider information being valuable.

The ISO is the counterparty to FTRs sold in the auction. It counts on the congestion revenue earned in the wholesale energy market to cover the payouts on the FTRs. In theory 'Revenue Sufficiency' is assured, so long as the ISO takes care that the FTRs sold in the auction are consistent with the actual transmission capacity of the network–Hogan (1992). However, as we have already indicated, transmission capacity is stochastic and can only be estimated at the time of the FTR auction. If the ISO misestimates the amount of capacity, then the results of the revenue sufficiency theorem no longer hold. There are also a number of other practical compromises with the promise of revenue sufficiency that arise in the implementation, such as loop flow from neighboring networks.

To protect its balance sheet against the danger of a revenue shortfall, the ISO makes a distinction between the 'target allocation' and the actual settlement on an FTR. If the actual congestion revenues earned in the wholesale energy market are less than the aggregate FTR target allocations, then payouts are reduced below the target allocations. Recently, PJM experienced a number of years in which the payout fell substantially below the target allocation.

While pro-rating payouts below the target allocation is useful for assuring the financial integrity of the PJM entity, it brings its own problems. The target allocation on an FTR is entirely defined by the congestion price between the two locations specified for the FTR, and a buyer can reasonably anticipate the expected payoff. However, in the case of revenue insufficiency the payoff on each FTR becomes a function of the total pool of congestion revenue. Pro-rating the payoff this way transforms an FTR from a cleanly defined derivative contract into a complex mutual ownership share on a pool of congestion revenue. This increases the challenge of pricing FTRs. PJM applies a number of other settlement rules that muddy the definition of the product in comparable ways–for example prorating settlements on flow and counterflow FTRs differently and then applying a portfolio rule.

In muddying the definition of the product, PJM is also probably contributing to the low auction prices. The more difficult it is for bidders to model and understand the product, the less competitive they will be in their bidding.

Redefining Responsibility for Congestion Charges

The other major way PJM has responded to this problem of revenue insufficiency is to redefine responsibility for certain congestion charges. In particular, PJM was directed by FERC to fund FTR payouts from gross congestion charges defined by the day-ahead congestion without deducting balancing congestion charges and M2M charges.

This does not so much solve the problem of revenue insufficiency as it redefines it and declares victory. It is a little bit like decluttering your den by moving everything to your living room. Regardless of who pays what, total FTR payouts remain above total congestion revenues. Instead of forcing FTR holders to take a haircut, the burden is passed to load. This has the benefit of making FTRs an apparently better defined product from the point-of-view of a financial speculator. Nevertheless, it may worsen the results of the auction for load. This is because the total pool of revenues being sold in the FTR auction are now increased, and since the auction is returning a price that is cents on the dollar, the loss to load can be larger even if the pricing is marginally improved.

As we will discuss below, this cannot be good for load looking to hedge congestion charges. A portion of load's congestion risk is now excluded from the FTR payout.

2.2 Hedge Effectiveness

There seems to be a widespread presumption that the current FTR market design provides an effective hedge to market participants. Unfortunately, there is startlingly little evidence to support this.

We do know that load pays congestion and therefore bears congestion risk on the scale of their ARR allocation. However, under the current market design, it is primarily financial traders who end up holding the majority of FTRs. Instead of financial traders supplying a hedge to load, these traders buy the hedges themselves because they are a profitable speculation. This is the exact opposite of what should prevail in a successful hedging market.

2.2.1 ARRs and Self-Scheduling

Unfortunately, the current ARR and self-scheduling process is ill suited to serving load's hedging needs. Figure 3 is a histogram of "maximum self-schedule hedge ratios" (MSS hedge ratio) in PJM's 21 Control Zones across planning periods from 16/17, 17/18 and 18/19. An MSS hedge ratio is the ratio of (i) the payoff to self-scheduled FTRs assuming all ARRs are converted to self-scheduled FTRs, and (ii) the Day-Ahead Congestion. A hedge ratio of 100% means that load would be perfectly hedged if it had converted all of its ARRs to self-scheduled FTRs–the total payoffs received on the self-scheduled FTRs exactly offset the total Day-Ahead congestion paid. A hedge ratio of less than 100%

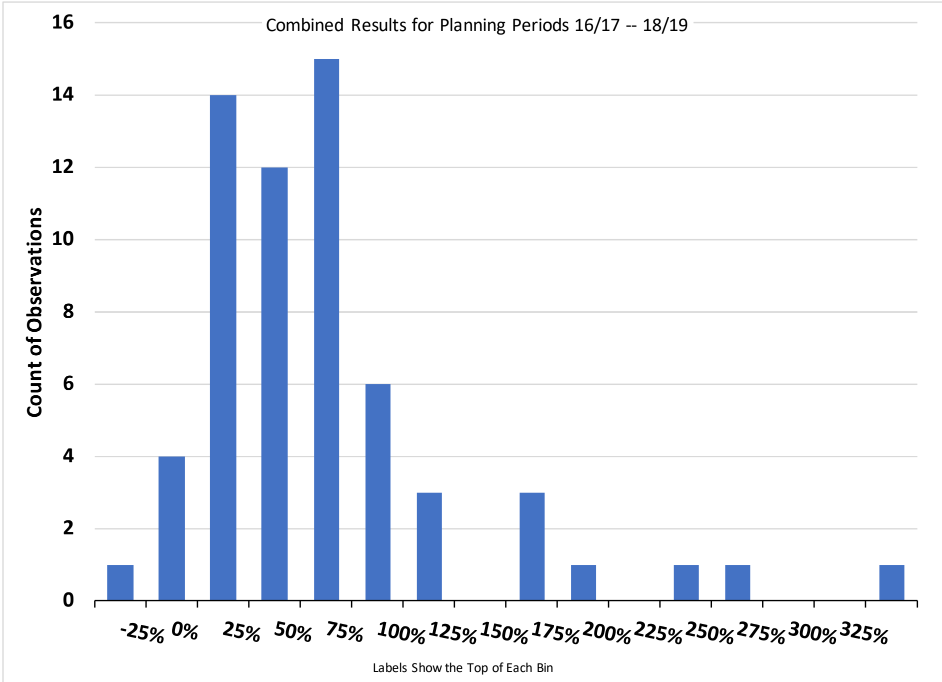

Figure 3: A Histogram of "Maximum Self-Schedule Hedge Ratios" in PJM's 21 Control Zones Across Planning Periods 16/17, 17/18 and 18/19.

Source: Monitoring Analytics, 2020, Updated ARR/FTR Offset and Price Convergence Data, p. 3.

means that the total payoffs received on the self-scheduled FTRs was less than the total Day-Ahead congestion paid. Each column contains the count of MSS hedge ratios falling in the respective bins. The leftmost bin shows a count of 1 MSS hedge ratio lying below -25%. The next bin shows a count of 4 MSS hedge ratios lying between -25% and 0%. Most of the observations lie below 100%, meaning that it is impossible to fully hedge Day-Ahead congestion by converting all ARRs into self-scheduled FTRs. The median MSS hedge ratio is 55%.

In addition to being on average too small, the MSS hedge ratio for a control zone is very volatile year-to-year. This reflects the fact that the ARR locations do not match the locations from which zones source their power. The realized congestion that determines the payoff on self-scheduled FTRs is different from the realized congestion in the power prices load pays. One year the former can be high, while the latter is not, and the next year it is the other way around. Thus, the available self-schedule FTRs are not a good vehicle for LSE hedging needs, which encourages LSEs not to convert them and instead to purchase better hedges in the FTR auction.

2.2.2 Balancing Congestion

As mentioned above, FERC's direction that load pay balancing congestion undermines the usefulness of FTRs as a hedge for load's congestions costs. FTRs become better defined in the sense that the their payoff is well defined in terms of a simple market risk parameter, which is Day-Ahead congestion. On the other hand, load's total congestion risk is now less well correlated with the FTR's payoff.

2.2.3 Bilateral Energy Contracting

One of the motivations for operating an FTR market is to facilitate forward bilateral energy contracting. There is very little evidence to support that it does.[5]

A large amount of what passes for evidence are simplified illustrative examples of how an idealized thermal power plant and LSE can succeed in locking in a fixed price for baseload power by combining a fixed price energy contract together with an FTR. These illustrations are fine for introducing a novice to the concept of a hedge, but they are a far cry from demonstrating the actual usefulness of FTRs for real participants engaged in forward contracting. For example, they always abstract from key complexities, such as hedging an uncertain load and an uncertain place in the generation stack or uncertain renewable generation. These examples always assume away the very issues that complicate the actual market, such as balancing congestion.

It would be valuable to obtain significantly greater information about bilateral contracting in the PJM market. Two key issues relevant to understanding how FTRs interact with bilateral energy contracts are (i) pricing terms and (ii) delivery commitments and contingencies. For pricing terms, we need to know (i) the structure of price indexes, if any, and (ii) the relevance of full LMPs or CLMPs. For delivery commitments and contingencies, it would be interesting to learn whether contracts are with specific generators or not, how flexible scheduling is, and the impact of dispatch on payments. It would be interesting to see contract structures across different types of generation, including renewables and peakers, and which types utilize FTRs.

[5] The current AFMTF began with a review of the "History and Evolution of Financial Transmission Rights in PJM", which attributes the high share of load scheduled as 'self-supply' or 'bilateral' to the ability to hedge congestion on physical delivery using FTRs. However, the only basis for claiming causality is a numerical example provided in the Appendix, and the logic of that example is deficient.

2.3 Poor Credit Risk Management by PJM

Buyers and sellers of FTRs, like buyers and sellers of other commodity derivatives, face important credit risk considerations. Most markets concentrate credit risk at a central clearing counterparty (CCP). Estimating and managing credit risk is a major focus of CCP operations and management. In the FTR market, PJM operates as the CCP. Poor credit risk management has the potential to produce large losses, as evidenced in the Green Hat case. I have little to add to the observations contained in the Independent Consultants Report on Green Hat. I will note that FTR markets currently operate under an Exemption granted by the CFTC to FERC and the ISOs. Under the Exemption, FERC and the ISOs should be exercising supervision. However, they have not enforced the standards that would be normal in a CFTC supervised market.

3 Options for Reform

In this section I sketch out a range of options for reforming the design of the FTR market. The main objective is to survey the landscape and better understand what different reform options are targeted to do. The objective is not to select or advocate for an option.

I group the options for reform into three types of options:

- first, a fundamental of the market which implements the standard design of other commodity derivative markets,
- second, amendments to the details of the current market design, and
- third, reforms to the ISO's credit and risk management protocols.

The following subsections address each of these types in turn.

3.1 Fundamental Reform: Implement the Standard Design of Other Commodity Derivative Markets

FTRs are a financial derivative, like any other commodity derivative. And yet, the market design for FTRs is unlike the design for any other commodity derivative market. Here are the key points of difference:

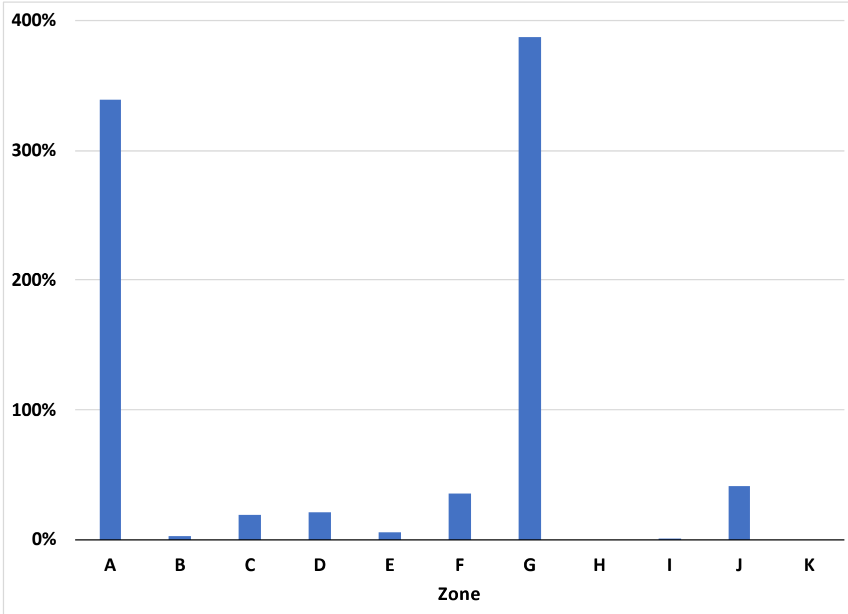

Figure 4: Ratios of Open Interest in Energy Futures (MWh) to Annual Load (MWh) for the Different Zones of NYISO, 2014

Source: Exchange Data, NYISO, ICE and Nodal.

- In most commodity derivative markets, it is the choices of buyers and sellers that determines the scale of trade (open interest). In contrast, in the FTR market, the Independent System Operator (ISO) fixes the quantity of FTRs available for sale.

  - In most commodity derivative markets, open interest on benchmark contracts is often many times the scale of the spot market in the benchmark physical commodity, and open interest in other, non-benchmark, contracts is often smaller than the scale of the spot market in the non-benchmark physical commodity. For example, as shown in Figure 4, below, the open interest in futures contracts on NYISO electricity prices is overwhelmingly concentrated in contracts specifying either Zone A or G. Open interest for contracts specifying each of these zones is more than 3 times total load in the zone. In contrast, open interest in a couple of zones is zero, and overall the ratio of open interest in futures to load is less than 1. In contrast, FTR markets attempt to fix the quantity of outstanding FTRs to exactly match physical transmission capacity. This means that total congestion exposure from FTRs is supposed to match the spot market exposure, and also that the profile of FTR exposure across pairs of nodes is supposed to match the profile of potential spot market congestion between various pairs of nodes.

  - In most commodity derivative markets, each trade reflects the decision of both a willing buyer and a willing seller. In contrast, in FTR markets the ISO commits in advance to selling an aggregate quantity and conducts an auction that fails to extract the highest price for each FTR sold.

- In most commodity derivative markets, the central counterparty (CCP) that clears trades maintains a balanced book (zero net exposure) on all contracts. In contrast, in the FTR market, the ISO is the CCP and purposefully runs an imbalanced book. It primarily sells FTRs so that it accumulates a negative net exposure.

  - In most commodity derivative markets, payments from the CCP out to traders with profitable derivative positions are funded by payments into the CCP from traders with losing derivative positions. Settlements in the derivative market are almost entirely separate from settlements in the spot market trade in the physical commodity.

  - In contrast, in the FTR market payments from the ISO out to traders with profitable FTR positions are primarily financed from accounts funded by participants in the spot electricity market.

- Most commodity derivative markets are established as private businesses and only operate where a balanced interest from both buyers and sellers makes derivative trading profitable. In contrast, the FTR market is government sponsored via the non-profit ISO and operates where buying FTRs is profitable and selling FTRs is unprofitable.

The FTR market design could be fundamentally reformed to match the standard design of commodity derivative markets. Primarily this would involve:

1. Letting the quantity of FTRs bought and sold to be determined by the free trade of buyers and sellers, and not by the ISO; letting 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;

2. Funding payments out to traders with winning FTR positions using payments in from traders with losing FTR positions, and not funding 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.

The schematic diagrams in Figures 5 and 6 illustrate the structural differences between the current FTR design and a fundamentally reformed design.

Trading in this reformed FTR market could continue to be hosted by the ISO. Therefore the upper left portion of Figure 6 shows the ISO potentially sitting over top of the marketplace. However, the ISO need not host it. A private exchange could host FTR trading. Without the need to determine the quantity of physical transmission capacity, it is hard to think of why the ISO would be a better choice for hosting trading. The market would also need a CCP, and since ISO accounts would no longer be a source of funding to cover payouts to traders, it would make sense to use a private CCP the way other derivative markets do. Since the reformed FTR market operates exactly as standard commodity derivative markets, it could potentially be regulated by the CFTC just as all other commodity derivatives markets are, including the electricity futures markets for energy and capacity.

As Figure 6 indicates, the fundamentally reformed design no longer uses the congestion surplus to fund FTRs, and therefore the ISO would need to develop a rule for allocating it back to transmission customers.

3.1.1 Reservations

Industry professionals have operated for so long with the current FTR design, it is perhaps difficult to imagine that the industry could function using another design. The devil we have ... Of course, we should take some encouragement from the fact that we would be moving from a peculiar market design that has evidenced many problems to a standard derivative market design that works well for many other commodities. Nevertheless, there are a few specific reservations we can address directly.

#1. Selling the Wrong Quantity, Producing the Wrong Price

The current FTR market design demands an enormous effort on the part of ISOs to model the transmission system and identify the capacity, and then to administer a complex auction clearing algorithm to assure the 'simultaneous feasibility' of the set of FTRs sold. The fundamentally reformed design makes no such demand on the ISO whatsoever. This raises the question, Is it really possible that an FTR market can operate without all this effort? The answer is "yes."

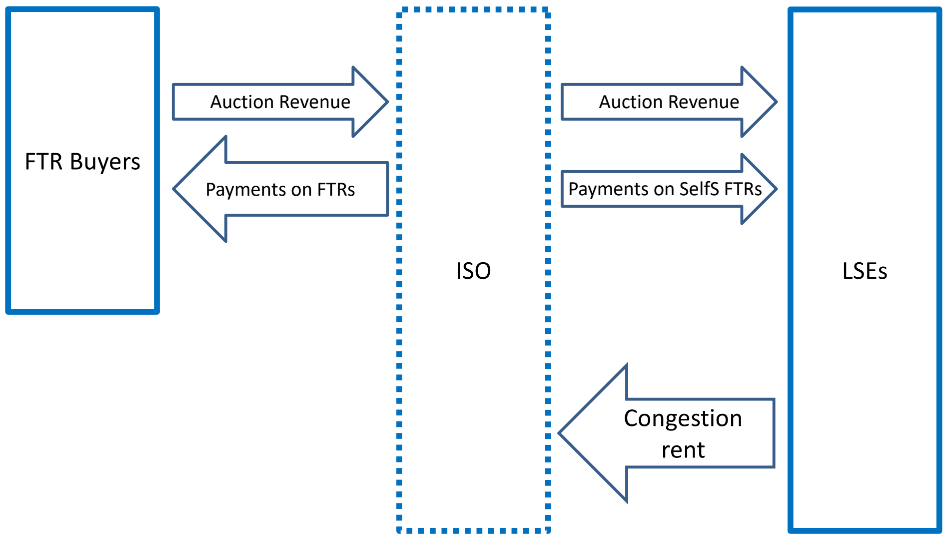

Figure 5: Schematic Diagram of the Current FTR Market Design

The ISO sells FTRs, creating a negative net exposure. Payments on FTRs are primarily financed from accounts funded by participants in the spot electricity market, including congestion rents. Thus, the financial FTR market is intertwined with the spot electricity market.

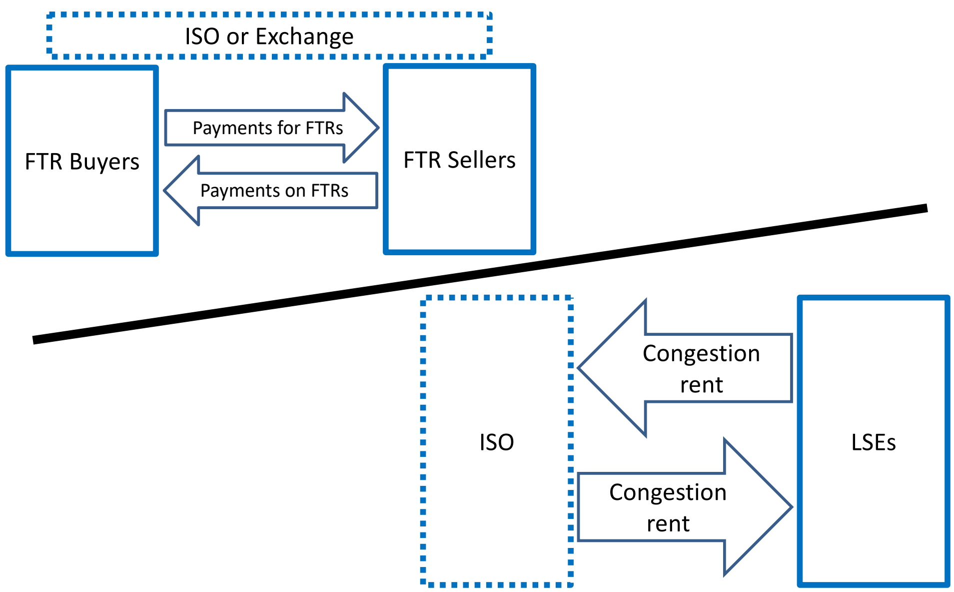

Figure 6: Schematic Diagram of the Fundamentally Reformed FTR Market Design

The top left shows settlements for FTR trade, while the bottom right shows settlements in the spot electricity market. Settlements in the two markets are separate as indicated by the black line between them. The FTR market now consists of trade between willing buyers and willing sellers, with the ISO no longer taking a position, but possibly supervising or managing settlements. Spot market settlement now requires an allocation rule for returning the congestion surplus to the transmission customers.

The current design of the FTR market is inspired by the vision of developing a competitive market in transmission to operate in parallel alongside the competitive market in energy. FTRs are described as a complement to energy contracts signed between a generator and load located at different points on a transmission system: by packaging a contract for energy together with an FTR, the pair are often said to have locked in a sale from one point to the other.

If physical transmission rights were actually being sold, we would, of course, need to be careful to sell no more than the actual capacity available. However, FTRs do not provide any physical transmission rights. They do not establish priority access to the transmission system. They do not provide firm transmission access. FTRs are a purely financial instrument, identical in all respects to other financially settled commodity derivatives.[6] So, why is it necessary to fix the quantity of FTRs to match the actual physical capacity of the transmission system? It isn't necessary.

In operating financially settled derivative markets, there is absolutely no need to fix the quantity of the open interest to match the anticipated spot supply. Price in these derivative markets is not established by end-users making claim on a limited supply of the physical good, but by financial traders' willingness to buy or sell at the going price.[7]

In fact, releasing the FTR market from the constraint of selling a defined amount of capacity could readily improve the pricing of FTRs. Recall that the auction prices produced by the current market design are systematically undervaluing FTRs, and that this is likely due to the commitment to sell. In a reformed design, sellers would reduce the quantity sold until prices matched value.

#2. Will the Market Survive at All? Will Congestion Hedging Be Available?

Some individuals have speculated on whether financial markets separate from the ISO would offer FTRs at all. That is, in the absence of the ISO committing to auction a definite quantity, would there be any liquidity at all?

Maybe. Maybe not.

Under the reformed market design, traders, generators and load are all free to come together to freely buy and sell FTRs at whatever prices they can mutually agree upon. If there is mutual interest in a hedge contract, then why would there not be trade at

[6] Some will insist that while FTRs are purely financial, they provide financial insurance so that a generator's and a load's payoff on a contract is just "as if" they had had firm transmission. This may be true, but does not undermine the distinction I am making.

[7] This same premise lies behind the concept of prediction markets which would not be viable on the principle guiding the current FTR market design. See, for example, Wolfers and Zitzewiz (2004) and Arrow et al. (2008).

fair prices? No one has identified any specific obstacles to trade in FTRs. There is just a generalized anxiety.

There are many commodities in which the corresponding derivatives trade is plentiful, and others in which it is non-existent. And, as mentioned earlier, there are commodities for which the corresponding derivatives trade is plentiful for particular benchmark specifications and non-existent for the non-benchmark specifications. It is entirely possible that there could arise trade in benchmark FTR products, while there is no trade in the vast majority of FTR location pairs. However, exactly this opportunity should be considered a potential advantage for the standard design of a commodity derivative market over the current FTR market design.

Certainly there are many details to be worked out in the course of implementing a standard derivative market design for FTRs. The exchange hosting trading would need to determine what products to offer and how frequently to price the products, among many other details. Getting the details right is worth the expenditure of significant effort. This is exactly the sort of investment that private exchanges make regularly as they explore new product offerings and refresh old ones.

Of course, it has to be said that the current design does have one important advantage. It can fund payments to FTR traders from ISO accounts, and the result has been large, persistent profits to traders. Without access to ISO accounts and the profits that access enables, there is going to be less incentive for traders to invest in this market the way they have under the current market design. However, it is hard to see how this would be a social loss, reckoning into the calculation the charges against ISO accounts which ultimately come from consumers. It certainly would be a unique case in which we justify using a government sponsored agency to directly subsidize derivative traders' profits.

3.2 Amendments to the Details of the Current Design

This second group of reforms retains much of the current market design, but amends details to improve performance. In particular, this second group continues to determine a quantity of transmission capacity it will ultimately place into the FTR market. This group continues to use ISO accounts as a source of funding for the payout on those FTRs. Within that constraint each alternative seeks to improve performance, whether by increasing the auction revenue or by improving the hedging quality of FTRs.

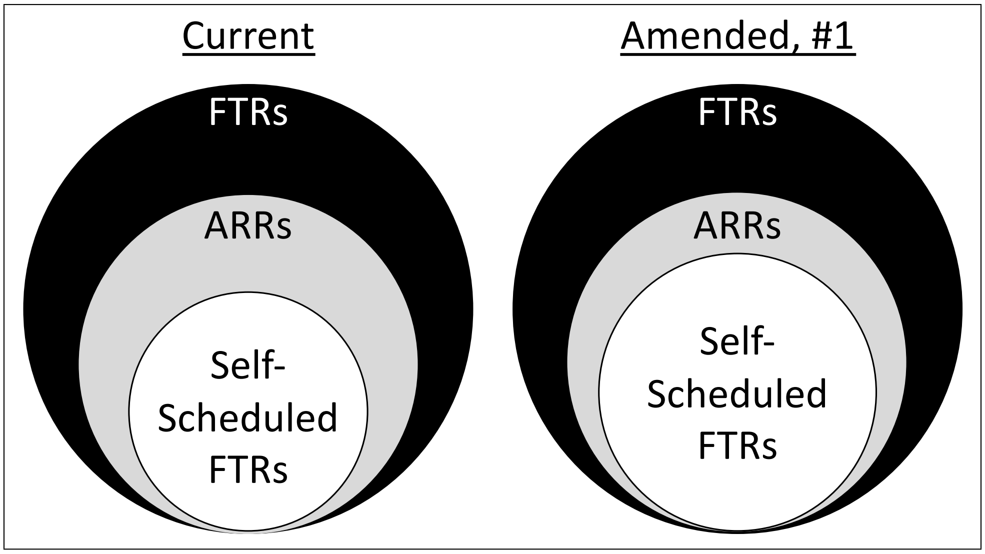

Figure 7: Schematic Diagram of the Total FTR Capacity and the Portions Allocated to ARRs and Self-Scheduled FTRs, Under the Current Design (Left) and in the Amended Design #1 (Right). The Portion of ARR Capacity Converted to Self-Scheduled FTRs is Larger in the Amended Design.

3.2.1 #1: Improve ARR Allocation and Self-Scheduling Options

In the current design, the profile of available self-scheduled FTRs is poorly suited to LSE's hedging needs, and so fewer and fewer ARRs are being converted into self-scheduled FTRs. This first amendment option seeks to fix this problem and thereby drive the system to a higher proportion of self-scheduled FTRs. Figure 7 is a schematic to illustrate this goal. The outermost circle in both diagrams represents total transmission capacity and is identical for the current FTR market design (left) and the amended design (right). The middle circles, representing capacity allocated as ARRs and shown in gray, are also the same in the current and amended design. However, the portion of that capacity converted to self-scheduled FTRs is larger in the amended design. By producing a larger portion of self-scheduled FTRs, the reform increases the share of congestion revenues returned to load. This happens both directly, by removing self-scheduled FTRs from underpriced auctions, and indirectly by raising the price in the auctions as a result of reducing the supply.

In order to encourage more conversion of ARRs into self-scheduled FTRs, this amendment has two steps. First, revise the ARR allocation process so that LSEs receive rights that better match the actual sources of their generation and therefore the congestion risk they face. Second, expand the LSEs flexibility to convert its ARRs into self-scheduled FTRs.

PJM has already pursued some changes to the ARR process along the lines of the first step as it seeks to move away from historical paths. It could go much further. For example, it could open the allocation process to bidding by LSEs for the point sources they seek. PJM has not yet pursued changes along the lines of the second step, at least not as far as I am aware.

3.2.2 #2: Promote the LSEs to be the Agents Selling All Network Capacity

This second amendment option focuses on improving the prices paid in the auction by directly attacking the policy of having no reservation price. In order to accomplish that, while retaining the flexibility of setting different reservation prices for different FTRs, the amendment removes the ISO as the agent for selling FTRs and substitutes LSEs. This amended design would begin by allocating to load ARR-like rights equal to the full transmission capacity of the system. LSEs could submit bids for their preferred allocation of rights, so that competing selections would be decided by the highest bid. Once the allocation is complete, LSEs would be free to self-schedule FTRs or to sell FTRs in sequential auctions hosted by the ISO, one or the other. The ISO would no longer be selling FTRs, just hosting the market in FTRs that were originally distributed to LSEs.

Figure 8 is a schematic to illustrate the change in outcome this amendment is designed to achieve. The outermost circle in both diagrams represents total transmission capacity and is identical for the current FTR market design (left) and the reformed design (right). In the amended design, the full capacity of the system is assigned as ARRs, and a portion of that capacity is then converted to self-scheduled FTRs. The portion not self-scheduled is sold by LSEs through an auction managed by the ISO. Because the reformed design gives LSEs a greater opportunity to configure self-scheduled FTRs to match their hedging needs, a higher share of capacity will be self-scheduled and less will be sold in the FTR auction. The prices in the FTR auction will be higher since a smaller amount of capacity is sold there and since the sales are made only when the price received is favorable.

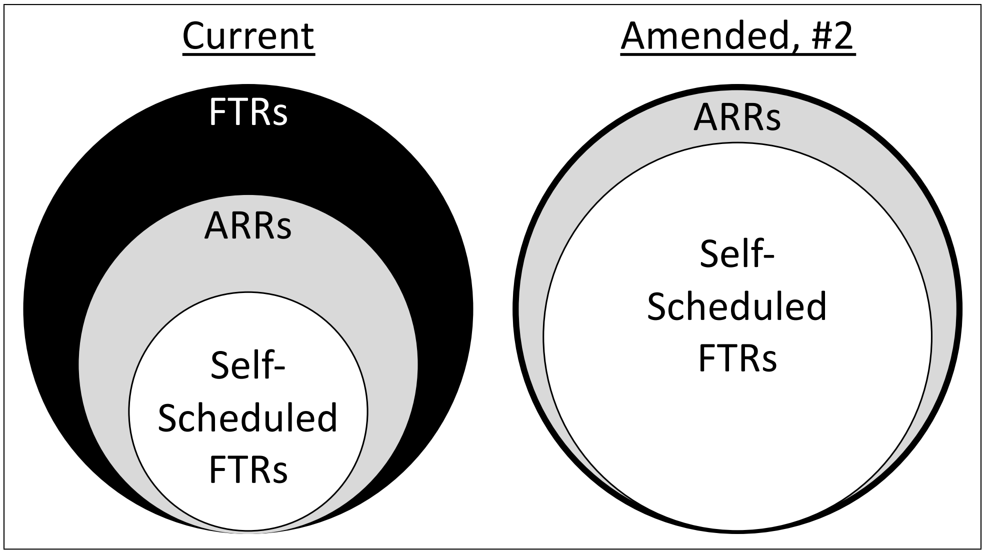

Figure 8: Schematic Diagram of the Total FTR Capacity and the Portions Allocated to ARRs and Self-Scheduled FTRs, Under the Current Design (Left) and in the Amended Design (Right) #2. The Entirely of FTR Capacity is ARRs in the Amended Design, and the Portion of Self-Scheduled FTRs is Much Larger Than in the Current Design.

3.2.3 Other Amendments

There are a variety of other amendments that could also improve the auctions. One set involves limiting the range of FTR products available in the auction. The objective is to improve bidding competition. A second set addresses the PJM settlement rules–such as eliminating portfolio netting or assigning balancing congestion to the FTR funding pool. These are intended to better define the product so as to increase competition among bidders. Finally, although PJM has worked to improve information about transmission, continued work to better estimate transmission at the time of the auction is always needed.

3.3 Reforms to the ISO's Credit and Risk Management Protocols

First, it is useful to point out here that fundamentally reforming the FTR market to match the standard commodity derivative market design as discussed in Subsection 3.1, above, would address the biggest credit risk problems. The standard design removes the ISO from being the CCP and establishes a net zero exposure at the CCP.

Reforms have been suggested in the Independent Consultants Report, and I do not have anything unique to add here and now.

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