History and Evolution of Financial Transmission Rights in PJM

Brian Chmielewski
Manager, Market Simulation
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AFMTF

Key work activity 1: review the history and evolution of the ARR / FTR market

Key takeaways

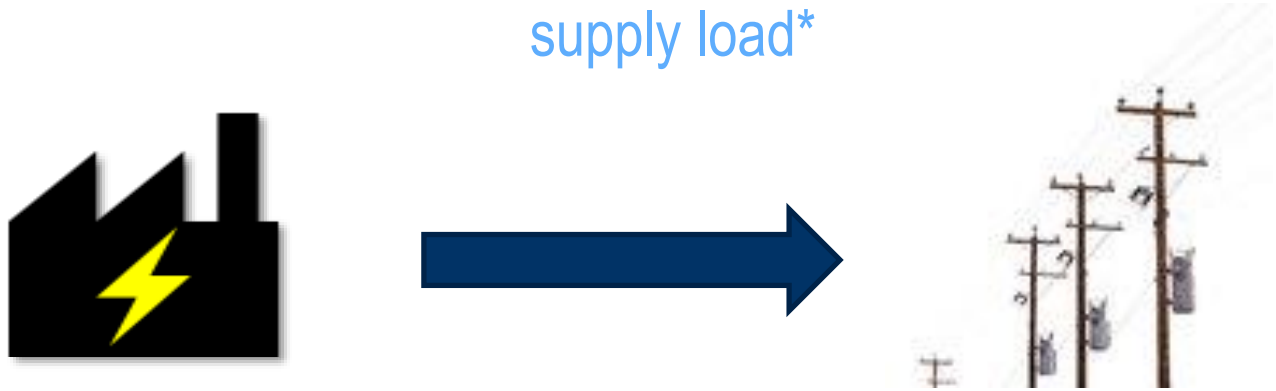
- FTRs started in PJM with LMP in late ‘90s as a direct allocation to load with monthly FTR auctions
- Well established purpose to serve as the financial equivalent of firm transmission service, and to ensure open access to firm transmission service by providing a congestion-hedging function
- Structural changes 2003, 2005, 2008, 2015
- Constant enhancements implemented over time

Why do we need FTRs?

- Challenge:
  - LMP exposes PJM Market Participants to price uncertainty for congestion cost charges
  - During constrained conditions, PJM Market collects more from loads than it pays generators
- Solution:
  - Provides ability to have price certainty
  - Provides load a priority right to the transmission system and congestion revenues because they pay the embedded costs
  - FTRs provide hedging mechanism that can be traded separately from transmission service

Self-supply and Bilateral Transactions

Key Takeaway: Majority of load uses self-supply or bilateral transactions to supply load*



- ARR/FTR point-to-point mechanism provides financial hedge equivalent to physical delivery
- Appendix A provides example of importance of point-to-point nature of FTR to support self-supply and bilateral contracts

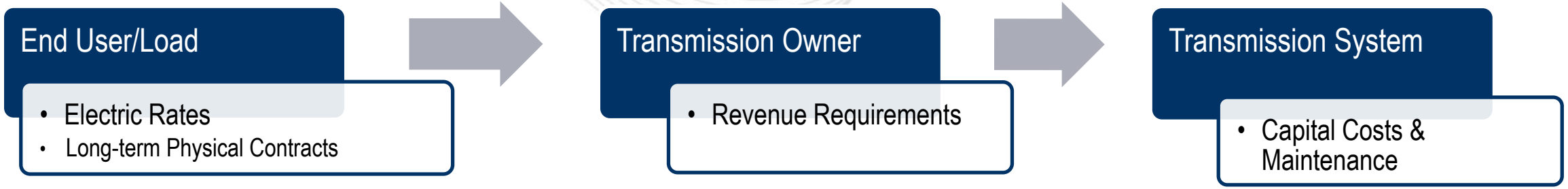
*Method for Supplying Load**

	Spot market	Self-Supply and Bilateral
2018	27.7%	72.3%
2017	26.7%	73.3%
2016	23.9%	76.1%
2015	29.3%	70.7%
2014	26.7%	73.3%
2013	25.0%	75.0%
2012	23.2%	76.8%
2011	26.6%	73.4%
2010	20.2%	79.8%
2009	17.0%	83.0%
2008	20.2%	79.8%
Average	24.2%	75.8%

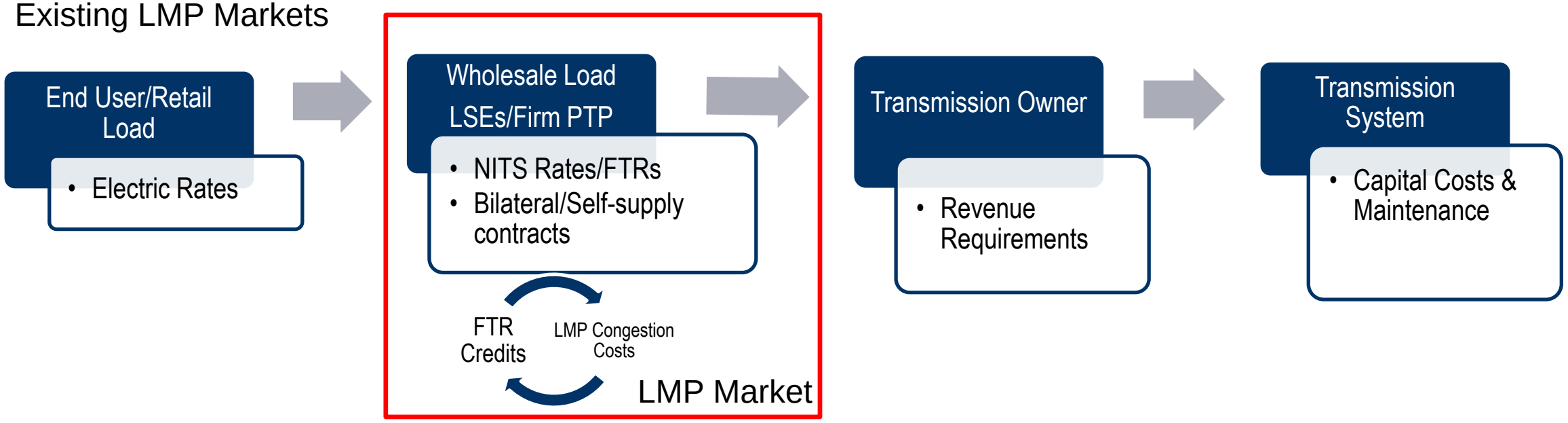
*Data from Monitoring Analytics SOM Reports

Cash Flow Before and with Existing LMP Markets

Before LMP Markets

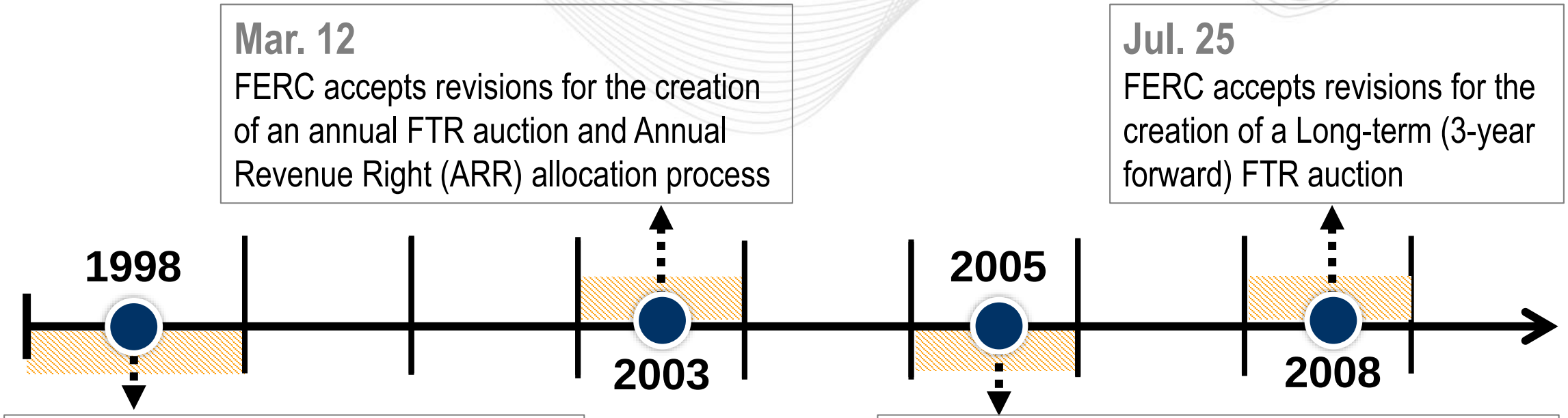


Existing LMP Markets



PJM FTR Policy Background

Financial Transmission Rights have evolved over time



What are Auction Revenue Rights?

Financial Equivalent to Physical Transmission Service

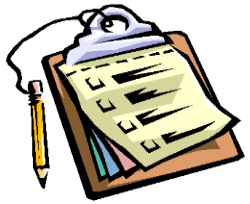
Nomination Process (no cost) to Firm Transmission Service Customers

Point-to-point hedging mechanism to offset future unknown costs
(Stage 1A ARR 10 years)

+/- Value determined by FTR auction clearing prices

Auction Revenue Rights Construct

- Provides LSEs priority rights to the transmission system and the congestion revenues.
- Allows non LSEs to participate to add liquidity and price discovery.



- Protects native load utilization of the transmission system while providing long-term certainty.
- Point-to-point hedging for self-supply and bilateral transactions.

- Flexibility to adjust hedging paths annually.
- Choice to collect a fixed revenue stream by holding on to the ARR or a refund of congestion revenues (via FTR) on either historical paths or alternate path.

What are Financial Transmission Rights?

Financial instruments awarded to bidders in the FTR Auctions

+/- Cost determined by auction clearing results

Point-to-point hedging mechanism to offset future unknown costs
(1 mo. – 3 yrs. in future)

+/- Value determined by day-ahead congestion price differences

Characteristics of FTRs

- Economic value based on Day-Ahead Congestion Prices
- Defined from source to sink
- Can be in form of obligation or option
  - obligation can be benefit or liability
  - option can be benefit but never liability
- Financial entitlement, *not* physical right
- Independent of energy delivery
- Must be simultaneously feasible

Economic Value of FTRs

FTR Target Allocation = (FTR MW) * (Congestion Price $_{\text{FTR Sink}}$ – Congestion Price $_{\text{FTR Source}}$)

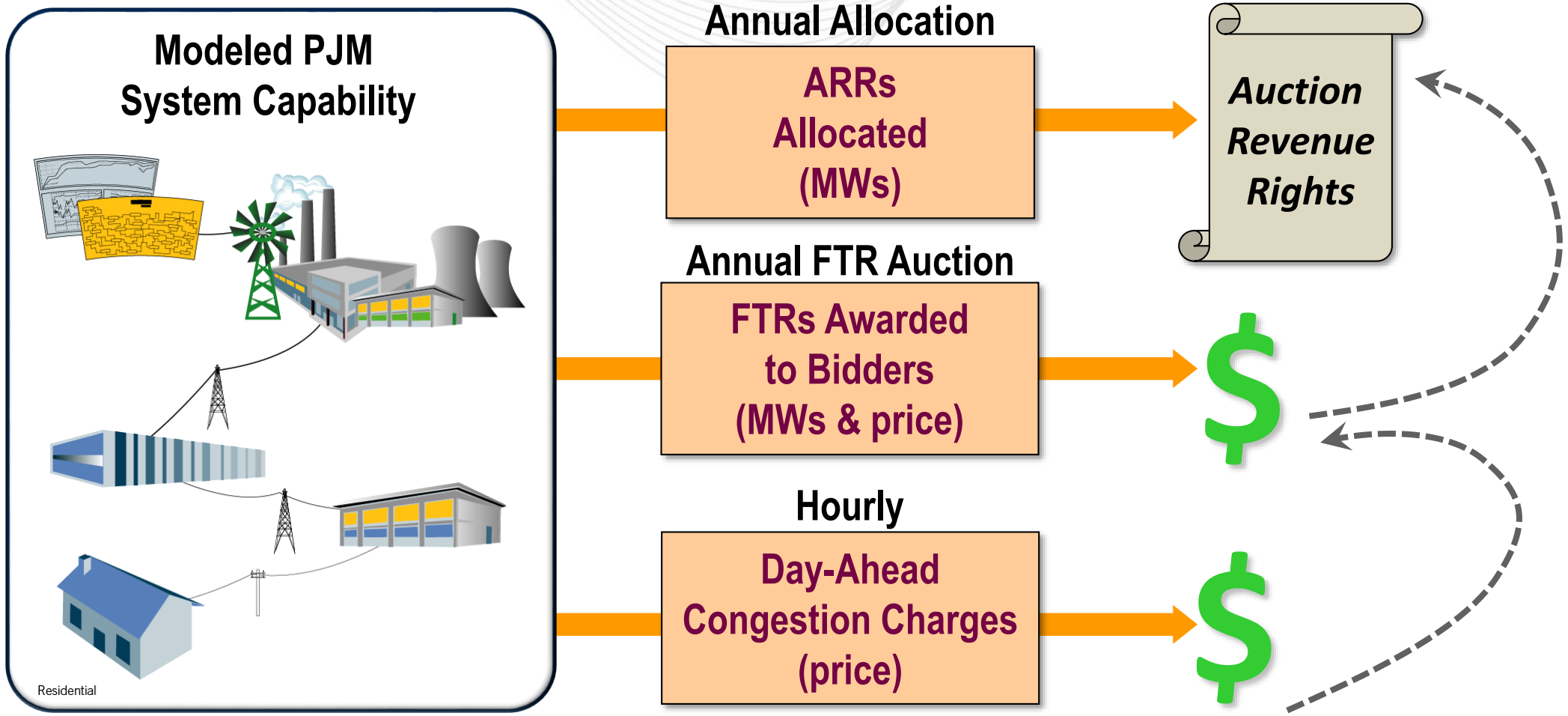
- FTR Target Allocation is equal to the FTR MW amount times the congestion price difference from the FTR sink point to the FTR source point
- Congestion Price based on the clearing prices from Day-Ahead Market
- If Congestion Price $_{\text{FTR Sink}}$ < Congestion Price $_{\text{FTR Source}}$
  - The FTR is a liability if FTR defined as Obligation
  - The FTR has zero value if defined as Option

FTRs are acquired in several market mechanisms . . .

- Annual FTR Auction
  - Multi-round
  - Entire system capability minus approved Long-Term FTRs
- Long-Term FTR Auction
  - Multi-round
  - Purchase residual system capability assuming the self-scheduling of ARRs
- Monthly FTR Auction
  - Single-round
  - Purchase “left over” capability
- FTR Secondary Market
  - Bilateral trading

ARR / FTR Relationship

ARRs provide a revenue stream to the firm transmission customer to offset purchase price of FTRs



Revenue Adequacy Issues 2011-2014

- Starting with the 10/11 planning period PJM experienced a dip in FTR revenue adequacy
- A task force was created to identify causes of FTR inadequacies and develop solutions
- Main causes were identified into four categories:
  - Stage 1A inadequacies
  - Transmission outages
  - Market-to-market constraints
  - Uncontrollable Inadequacy (forced outages, polar vortex, etc.)

- Effective with the 2017-18 planning period FERC Order determined the following:
  - A more restrictive ARR Allocation creates an inequitable shift from ARR holders to FTR holders
  - Source ARRs only at active generation – mimic actual system usage
  - Allocate RT imbalance of congestion costs to RT Load, not FTR holders

FTR Funding vs. ARR Allocation

FTR Revenue Adequacy

Funding Percentage
2015/2016: 107%
2016/2017: 110%
2017/2018*: 108%
*through 11/18

Allocation of ARR Rights

ARR Stage 1B:
2015/2016: $7 million
2016/2017: $10 million
2017/2018: $24 million

PJM Tariff and OA

7.5 Simultaneous Feasibility.....The goal of the simultaneous feasibility determination shall be to ensure that there are sufficient revenues from Transmission Congestion Charges to satisfy all Financial Transmission Rights obligations for the auction period under expected conditions and to ensure that there are sufficient revenues from the annual Financial Transmission Right Auction to satisfy all Auction Revenue Rights obligations.

Constant Change Since 2014

2014
- FTRSTF
- Modeling improvements

2015
- Balancing Congestion
- Stage 1A Retirements

2016
- Residual ARRs

2017
- FTRMPS
- Forfeiture rule

2018
- Long-term modeling

2019
- Credit changes

Planning Period	ARRs Allocated (MW)	FTR Revenue Adequacy	ARR Value ($ Millions)*
2015/2016	76,420	105%	483.7
2016/2017	80,620	110%	541.6
2017/2018	94,229	137%	660.0
2018/2019	97,787	**112%	715.0

*Utilizing 2018/2019 FTR Auction prices
**First Planning Period where surplus revenues are returned to ARR holders, not FTR holders.

Next Steps

- Library of FTR education and historical documents
- Additional education and whitepapers w/ feedback loop
- Comparison with other ISO/RTOs
- Requests send to FTRGroup@pjm.com

Appendix A

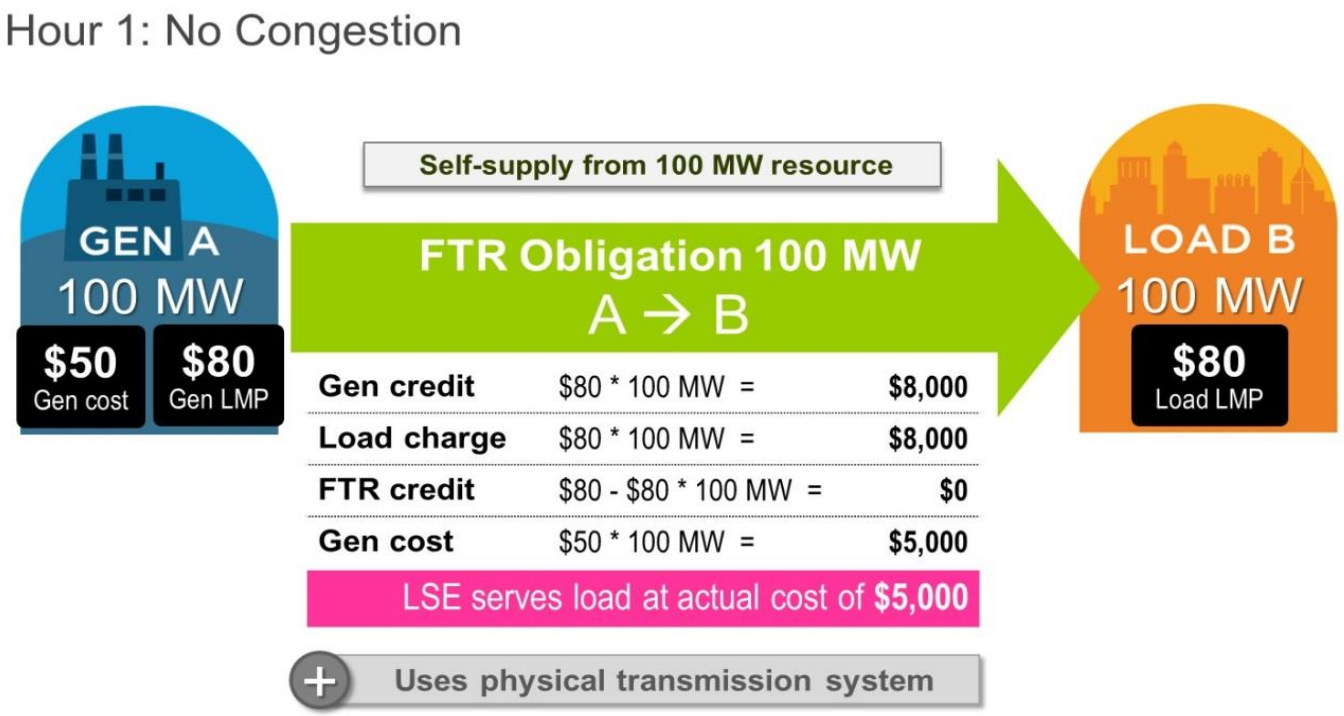
Example of Incentive to Follow dispatch with Point-to-Point Nature of FTR

Example 1: Incentive to Follow Dispatch With Point-to-Point FTR

The point-to-point nature of FTRs provides increased incentives to follow dispatch for those market participants who self-supply their own load.

Hour 1: No Congestion

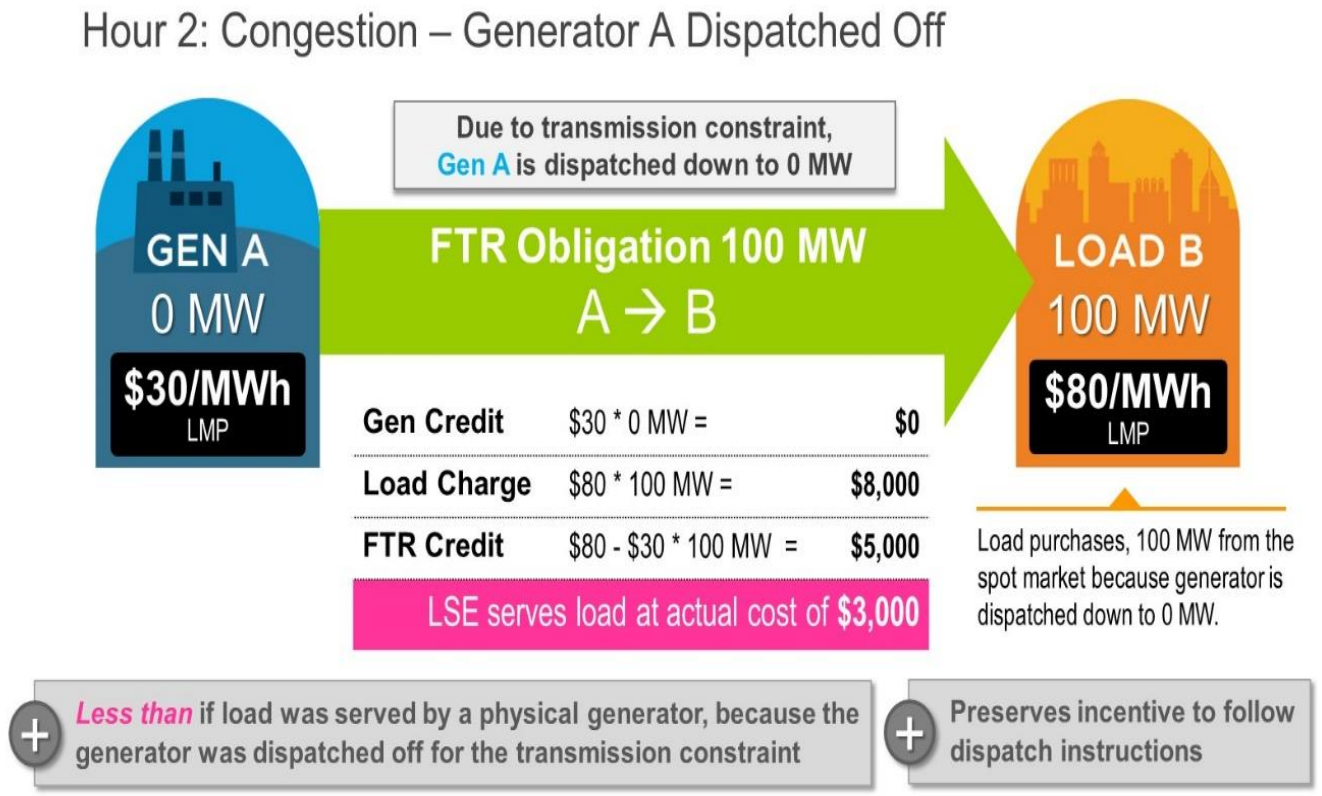
- Customer pays the marginal LMP to serve its load
- Customer gets paid the marginal LMP for producing power
- Net impact is the customer is indifferent due to the system LMPs



Example 1: Incentive to Follow Dispatch With Point-to-Point FTR (cont.)

Hour 2: Congestion and follows dispatch

- Customer instructed to turn off generator
- Zero generator revenue
- The FTR point-to-point product that aligns with the customer's self-supply contract provides a revenue stream equal to the LMP difference between the source (generator) and the sink (load) locations of the FTR and corresponding self-supply path
- Net Impact = $3000 (FTR rebate of $5000 and cost to serve load of $8000)
- The customer had an incentive to follow the dispatch instruction, because the FTR ensured they would still receive the necessary revenues.



Example 1: Incentive to Follow Dispatch With Point-to-Point FTR (cont.)

Hour 3: Congestion and does not follow dispatch

- Customer instructed to turn off generator and does not follow instructions
- Generator revenue = $1000
  - Below cost of producing actual power ($5000)
  - Loss of $4000
- Net Impact = $5000 (FTR rebate of $7000 and cost to serve load of $12,000)
- Although the customer was able to recover its costs, the customer could have done better if it followed its dispatch instructions similar to hour two