Market Settlements - Advanced

FTR/ARR Module
Agenda

• FTR/ARR
  – Hedging Congestion
  – FTR and ARR Billing Examples
Hedging Transmission Congestion
What Are FTRs?

Financial Transmission Rights are ...

financial instruments awarded to bidders in the FTR Auctions that entitle the holder to a stream of revenues (or charges) based on the hourly Day Ahead congestion price differences across the path.

\[
\text{LMP} = \text{System Energy Price} + \text{Congestion Price} + \text{Marginal Loss Price}
\]
Why Do We Need FTRs?

• Challenge:
  – Protect Load Servers from price uncertainty for congestion charges
  – Redistribute excess congestion charges

• Solution:
  – FTR credits equal congestion charges on same path
  – FTRs provide hedging mechanism that can be traded separately from transmission service
Characteristics of FTRs

- Economic value based on Day Ahead Congestion Component of LMP
- Defined from source to sink
- Financial entitlement, *not* physical right
- Independent of energy delivery
Energy Delivery Consistent with FTR (a Conceptual Example)

Bus A
Source (Sending End)
Congestion = $15

Bus B
Sink (Receiving End)
Congestion = $30

Energy Delivery = 100 MWh

Thermal Limit
FTR = 100 MW

Congestion Charge = 100 MW * ($30-$15) = $1500

FTR Credit = 100 MW * ($30-$15) = $1500
FTR Value = 100 MW * (7 - (-3)) = $1,000 Credit

“Prevailing Flow” FTRs point in the same direction as the congestion”
FTRs as a Liability

Sink
LMP = $18
System Energy = $20
Congestion = ($3)
Marginal Loss = $1

Source
LMP = $29
System Energy = $20
Congestion = $7
Marginal Loss = $2

100 MW FTR

FTR Value = 100 MW * ((-3) - 7) = $1,000 Liability

“Counterflow” FTRs point in the opposite direction of the congestion”
Obtaining FTRs

• Annual Auction
  – Multi-round
  – Multi-period
  – Multi-product
  – Entire System Capability

• Secondary market -- bilateral trading
  – FTRs that exist are bought or sold

• Monthly & Balance of Planning Period FTR Auction -- Centralized Market
  – Purchase “left over” capability
What are FTRs Worth?

- Economic value determined by Day ahead hourly LMPs
- Benefit (Credit)
  - Prevailing Flow
- Liability (Charge)
  - Counterflow
- FTR Options Available
  - Never negatively valued
What are ARRs?

Auction Revenue Rights ...

are entitlements *allocated annually* to Firm Transmission Service Customers that entitle the holder to receive an allocation of the revenues from the Annual FTR Auction.
ARR / FTR Relationship

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

**Entire PJM System Capability**

**Annual Allocation**

- ARR Allocated (MWs)

**Annual FTR Auction**

- FTRs Awarded to Bidders (MWs & price)

**Hourly**

- Congestion Charges

---

**Auction Revenue Rights**

**$**

**$**
What Can the Holder Do with the ARR?

• Self-schedule ARR in FTR Annual Auction to obtain an FTR on exact same path as ARR

• Reconfigure ARR by bidding into Annual Auction to acquire FTR on alternative path or for alternative product

• May retain allocated ARR and receive associated allocation of revenues from the auction
ARR / FTR Settlements
Annual FTR Auction Settlements

• The Annual FTR Auction and corresponding ARRs will be settled for on a weekly basis over the course of the planning period for which the Annual FTRs are in effect

• Since ARR ownership can change daily through ARR reassignment, PJM Settlements calculates:
  – daily Annual FTR Auction revenues by dividing annual auction revenues by the number of days in the planning period
  – daily ARR credits by dividing ARR Target Allocation by the number of days in the planning period
Economic Value of ARR

ARR Target Allocation = \((ARR \text{ MW}) \times (LMP_{ARR \text{ Sink}} - LMP_{ARR \text{ Source}})\)

- ARR Target Allocation is equal to the ARR MW amount times the average price difference from the ARR sink point to the ARR source point over the 4 rounds.
- LMPs based on the average nodal clearing prices over the 4 rounds of the Annual FTR Auction.
- ARRls can be a benefit or a liability.
ARR Settlements (cont.)

- If sufficient revenues are collected from the Annual and Monthly FTR Auctions to satisfy ARR Target Allocations then:
  - ARR Credits = ARR Target Allocation

- Excess auction revenues are used to fund any deficiencies in FTR Target Allocation payments

- If insufficient revenues are collected from the Annual, Long-Term, and Monthly FTR Auctions to satisfy ARR Target Allocations then:
  - ARR Credits are prorated proportionately
  - ARR deficiencies are funded from:
    1) Any annual excess congestion charges remaining at the end of a planning period after fully funding all FTR target allocations for the planning period, then
    2) An uplift charge assessed to FTR holders on pro-rata basis according to total Target Allocations for all FTRs held at any time during the planning period
Long-Term FTR Auction Settlements

• The Long-Term FTR auction credits appear on the weekly billing statement

• Revenues from the Long-Term FTR auctions are used to first fund any shortfall in ARR Target Allocations then FTR target allocations for the planning period in which the Long-Term FTR is in effect
Monthly FTR Auction Settlements

- The monthly auction credits appear on the weekly billing statement.
- Revenues from the monthly auctions are used to first fund ARR Target Allocations then FTR Target Allocations.
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.
FTR Settlements (cont.)

• If sufficient congestion charges are collected from the Day Ahead and Balancing Market to satisfy FTR Target Allocations then:
  – FTR Credits = FTR Target Allocation

• Excess congestion charges are used to
  – cover any deficiencies in FTR Target Allocations within month
  – cover any deficiencies in FTR Target Allocations within planning period
  – any remaining year-end excess covers any deficiencies in ARR Target Allocation from previous months within planning period
  – any remaining year-end excess distributed to FTR participants pro-rata to total FTR Target Allocations
• If insufficient revenues are collected from the Day Ahead and Balancing Market to satisfy FTR Target Allocations then:
  
  – FTR Credits are prorated proportionately pro-rata to FTR Target Allocations
  – FTR Target Allocation deficiencies are funded from:
    
    1) Excess congestion charges from current month and subsequent months, then
    
    2) An uplift charge assessed to FTR holders on pro-rata basis according to total Target Allocations for all FTRs held at any time during the planning period
ARR & FTR Settlements

SUM OF MONTHLY ARR TARGET ALLOCATIONS

ARE ARR TARGET ALLOCATIONS FULLY-FUNDED FOR MONTH?

NO

FUND ARRs PRO-RATA TO ARR TARGET ALLOCATION

MONTHLY DEFICIENCY

ANNUAL ARR DEFICIENCY BUCKET

IF EXCESS EXISTS

DISTRIBUTED TO FTR PARTICIPANTS PRO-RATA TO FTR TARGET ALLOCATION

IF EXCESS EXISTS

YEARLY DEFICIENCY

ANNUAL EXCESS ARR REVENUE AND CONGESTION CHARGE BUCKET

YES

SUM OF MONTHLY FTR TARGET ALLOCATIONS

ARE FTR TARGET ALLOCATIONS FULLY-FUNDED FOR MONTH?

NO

FUND FTRs PRO-RATA TO FTR TARGET ALLOCATION

MONTHLY DEFICIENCY

ANNUAL FTR DEFICIENCY BUCKET

YEARLY DEFICIENCY

Funded by ratio share of total FTR target allocations

YES

SUM OF MONTHLY FTR AUCTION REVENUE

DAY AHEAD MARKET CONGESTION CHARGES

BALANCING MARKET CONGESTION CHARGES

MONTHLY FTR AUCTION REVENUE

YEARLY DEFICIENCY

DISTRIBUTE EXCESS ACROSS PRIOR MONTHLY DEFICIENCIES

DISTRIBUTED TO FTR PARTICIPANTS PRO-RATA TO FTR TARGET ALLOCATION

YEARLY DEFICIENCY

5/24/2017
Billing Examples
Agenda

• FTR/ARR
  – Hedging Congestion
  – FTR and ARR Billing Examples
### Example of Monthly Bill Charges

<table>
<thead>
<tr>
<th>CHARGES</th>
<th>ADJ</th>
<th>BILLING LINE ITEM NAME</th>
<th>SOURCE BILLING PERIOD START</th>
<th>AMOUNT</th>
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<tbody>
<tr>
<td>1100</td>
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<td>Network Integration Transmission Service</td>
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<td>$1,338,176.10</td>
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<td>1108</td>
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<td>Transmission Enhancement</td>
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<td>Firm Point-to-Point Transmission Service</td>
<td></td>
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<tr>
<td>1140</td>
<td></td>
<td>Non-Firm Point-to-Point Transmission Service</td>
<td></td>
<td>$0.00</td>
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<tr>
<td>1200</td>
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<td>Day-ahead Spot Market Energy</td>
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<td>1205</td>
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<td>Balancing Spot Market Energy</td>
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<td><strong>Day-ahead Transmission Congestion</strong></td>
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<td>1220</td>
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<td>Day-ahead Transmission Losses</td>
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<td>$1,097,534.94</td>
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<td>1490</td>
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<td>Load Reconciliation for Reactive Services</td>
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<td>$(6,173.33)</td>
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<td>1500</td>
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<td><strong>Financial Transmission Rights Auction</strong></td>
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<tr>
<td>1600</td>
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<td>RPM Auction</td>
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<td>$15,213.30</td>
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</table>

The amount charged for transmission congestion

The amount charged for buying FTRs in an auction
### Example of Monthly Bill Credits

<table>
<thead>
<tr>
<th>CREDITS</th>
<th>ADJ</th>
<th>BILLING LINE ITEM NAME</th>
<th>SOURCE BILLING PERIOD START</th>
<th>AMOUNT</th>
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<tbody>
<tr>
<td>2100</td>
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<td>2220</td>
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<td>2320</td>
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<td>Transmission Owner Scheduling System Control</td>
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<td>2330</td>
<td></td>
<td>Generation and Other Sources Service</td>
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<td>2340</td>
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<td>Regulation and Frequency Response Service</td>
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<td>2360</td>
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<td>2365</td>
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<td>Day-ahead Scheduling Reserve</td>
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<td>Day-ahead Operating Reserve</td>
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<td>2600</td>
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<td>RPM Auction</td>
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<td>$ 1,278,178.80</td>
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</table>

- **The amount credited for FTR transmission congestion**

- **2500**: The amount credited for selling FTRs in an auction
- **2510**: The amount credited for ARRs
MSRS Reports
Transmission Congestion/FTR/ARR

- Day-Ahead Scheduling Reserve
- Energy
- Energy Transaction Details
- FERC EQR
- Financial Credit
- Locational Congestion/Loss Details
- Load Response
- Load Reconciliation
- Month End
- Non-Synchronized Reserve
- Operating Reserve
- Other Ancillary Services
- PJM.com Reports
- Public Data
- Regulation
- RPM
- Synchronized Reserve
- Transmission Congestion/FTR/ARR
- Transmission Losses
- Transmission Service
- Schedule 9-HRU Changes

Transmission Congestion/FTR/ARR

<table>
<thead>
<tr>
<th>Description</th>
<th>CSV</th>
<th>XML</th>
<th>History</th>
<th>Date</th>
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<tbody>
<tr>
<td>ARR Target Credits</td>
<td>DOC</td>
<td>CSV</td>
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<td>Congestion Uplift Charge Summary</td>
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<td>Cross-monthly Congestion Credit Summary</td>
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<td>Explicit Congestion Charges</td>
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<tr>
<td>FTR Auction Charges and Credits</td>
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<td>CSV</td>
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<td>FTR Target Credits</td>
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</tbody>
</table>
1. Download FTR Auction Charges and Credits report from MSRS

2. Review the supporting calculations from the FTR Auction Charges and Credits description from Market Settlements webpage

**Supporting Calculations:**

If FTR Transaction Type = **BILATERAL** and customer is the buyer or the seller on the FTR, **OR**

FTR Transaction Type = **AUCTION** and the customer is the buyer on the FTR

- FTR Auction Charge (1500.01) = FTR MW Cleared (3000.53) * Price (1500.11)

Else FTR Transaction Type = **AUCTION** and customer is the seller on the FTR:

- FTR Auction Credit (2500.01) = FTR MW Cleared (3000.53) * Price (1500.11)

3. The Financial Transmission Rights Auction Credit (BLI 2500) is the sum of the FTR Auction Credits column
## FTR Auction Charges and Credits - BLI 2500

<table>
<thead>
<tr>
<th>Peak Type</th>
<th>Hedge Type</th>
<th>FTR Transaction Type</th>
<th>Source PNODE Name</th>
<th>Sink PNODE Name</th>
<th>FTR MW Cleared</th>
<th>Price ($/MW per day)</th>
<th>FTR Auction Charge ($)</th>
<th>FTR Auction Credit ($)</th>
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<tr>
<td>OFFPEAK</td>
<td>OBLIGATION</td>
<td>AUCTION</td>
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<td>PNODE A</td>
<td>18.9</td>
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<td>ONPEAK</td>
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<td>24H</td>
<td>OBLIGATION</td>
<td>AUCTION</td>
<td>PNODE B</td>
<td>PNODE A</td>
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<td>1.325</td>
<td>26.073178</td>
<td>34.55</td>
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</table>

### Daily report by FTR

- **FTRs sold during an auction and the monthly total of the auction results is BLI 2500**
  - The sum of the FTR Auction Credit is BLI 2500
  - **This company did not sell FTRs. Therefore BLI 2500 does not appear on the bill**
- **FTRs bought during an auction and the monthly total of the auction results is BLI 1500**
  - The sum of the FTR Auction Charge is BLI 1500
1. Download Hourly Transmission Congestion Credits report from MSRS
2. Review the supporting calculations from the FTR Auction Charges and Credits description from Market Settlements webpage

**Supporting Calculations:**

- If Hourly FTR Target Credit (2210.13) < 0
  - Hourly FTR Credit (2210.01) = Hourly FTR Target Credit (2210.13)

- Else if Total PJM FTR Revenues (2210.12) < 0
  - Hourly FTR Credit (2210.01) = 0

- Else if Total PJM FTR Revenues (2210.12) >= Total PJM FTR Target Credits (2210.11)
  - Hourly FTR Credit (2210.01) = Hourly FTR Target Credit (2210.13)

- Else (Hourly FTR Target Credit >= 0)
  - Hourly FTR Credit (2210.01) = Hourly FTR Target Credit (2210.13) / Total PJM FTR Target Credits (2210.11) * Total PJM FTR Revenues (2210.12)
3. The Transmission Congestion Credit (BLI 2210) is the sum Hourly FTR Credit and End-of-Month FTR Credit columns
   - The amount of congestion credit received for owning the FTR

4. If insufficient revenues are collected from the Day Ahead and Balancing Market to satisfy FTR Target Allocations then,
   - FTR Credits are prorated proportionately pro-rata to FTR Target Allocations
   - FTR Target Allocation deficiencies are funded from
     1) Excess congestion charges from current month and subsequent months, then
     2) An uplift charge assessed to FTR holders on pro-rata basis according to total Target Allocations for all FTRs held at any time during the planning period
### Transmission Congestion Credits - BLI 2210

<table>
<thead>
<tr>
<th></th>
<th>2210.11</th>
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<th>2210.13</th>
<th>2210.01</th>
<th>2210.02</th>
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<tr>
<td>Total PJM FTR Target Credits ($)</td>
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<tr>
<td>Total PJM FTR Revenues ($)</td>
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- Company has counter flow FTRs
- Insufficient revenues are collected from the Day Ahead and Balancing Market to satisfy FTR Target Allocations for certain hours
- This report is by company and by hour not all columns are shown
1. Download ARR Target Credits report from MSRS
2. Review the supporting calculations from the ARR Target Credits description from Market Settlements webpage

**Supporting Calculations**

ARR Total Target Credit (2510.12) = ARR MW (3000.54) * ARR Rate (2510.11)
ARR Target Credit (2510.01) = ARR Total Target Credit (2510.12) * ARR Ownership Share (3000.82)

3. The Auction Revenue Rights Credit (BLI 2510) is the sum of the ARR Credit column

<table>
<thead>
<tr>
<th>Sink PNODE Name</th>
<th>Source PNODE Name</th>
<th>ARR MW</th>
<th>ARR Rate ($/MW per day)</th>
<th>ARR Ownership Share</th>
<th>ARR Total Target Credit ($)</th>
<th>ARR Target Credit ($)</th>
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<tr>
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Questions?

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Toll Free Telephone: (866) 400-8980
Website: www.pjm.com

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