PJM ARR and FTR Market
Objectives

• Explain the concepts and principles of Auction Revenue Rights and Financial Transmission Rights

• Describe how to participate in the Annual ARR Allocation and FTR Auctions

• Calculate the Financial Benefits of FTRs and ARRs
Agenda

- Introduction
- Overview of Financial Transmission Rights (FTRs)
- Overview of Auction Revenue Rights (ARRs)
- Overview of Simultaneous Feasibility Test (SFT)
Introduction
Financial Transmission Rights and Auction Revenue Rights

• FTR’s and ARR’s are important financial instruments used as hedges against congestion charges

• Market participants that are transferring energy across the RTO are subject to congestion charges

• The FTR Forfeiture Rule is in place as a financial disincentive to deter the use of virtual bids to enhance the value of a FTR
Auction Revenue Rights (ARRs)

- Auction Revenue Rights ...

*are entitlements allocated annually to Firm Transmission Service Customers that entitle the holder to receive an allocation of the “revenues” (or charges) from the Annual FTR Auction*
Financial Transmission Rights (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
ARR/FTR Relationship

ARRs provide a revenue stream to the firm transmission customers, as a result of the FTR Auction, to hedge against congestion charges.
Overview of Financial Transmission Rights (FTRs)
LMP Components - Congestion

\[
\text{LMP} = \text{System Energy Price} + \text{Transmission Congestion Cost} + \text{Cost of Marginal Losses}
\]
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
  – FTRs provide hedging mechanism that can be traded separately from transmission service
  – Congestion Revenues shared by FTR holders
Characteristics of FTRs

• The economic value is based on the Day Ahead Congestion Component of LMP

• Defined from source to sink

• Financial entitlement, not a physical right

• Independent of energy delivery
How are FTRs Acquired?

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
Types of FTR Products

FTRs can be acquired in two forms ...

- FTR Obligations
- FTR Options

PJM©2016
What are FTR Obligations Worth?

Benefit
- the hourly congestion value is positive
- FTR same direction as congested flow

Liability
- the hourly congestion value is negative
- FTR opposite direction as congested flow
What are FTR Options Worth?

A Benefit

– the hourly congestion value is positive
– FTR same direction as the congested flow

Neither a Benefit or a Liability

– the hourly congestion value is zero
– FTR opposite direction to the congested flow

FTR Option cannot have negative value
FTR Credits and Congestion Charges

Congestion Charge =

\[ \text{MWh} \times (\text{Day-ahead Sink Congestion Price} - \text{Day-ahead Source Congestion Price}) \]

FTR Credit =

\[ \text{MW} \times (\text{Day-ahead Sink Congestion Price} - \text{Day-ahead Source Congestion Price}) \]
FTR Obligation is a Benefit

Thermal Limit

FTR Obligation = 100 MW

Energy Delivery = 100 MWh

Bus A
Source (Sending End)
Congestion Price = $15

Bus B
Sink (Receiving End)
Congestion Price = $30

Congestion Charge = 100 MWh * ($30-$15) = $1500
FTR Obligation Credit = 100 MW * ($30-$15) = $1500
FTR Obligation is a Liability

Thermal Limit

FTR Obligation = 100 MW

Energy Delivery = 100 MWh

Bus A
Source (Sending End)
Congestion Price = $15

Bus B
Sink (Receiving End)
Congestion Price = $30

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

FTR Obligation Credit = 100 MW * ($15-$30) = -$1500
Thermal Limit

FTR Option = 100 MW

Energy Delivery = 100 MWh

Bus A
Source
(Sending End)

Congestion Price
= $15

Bus B
Sink
(Receiving End)

Congestion Price
= $30

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

FTR Option Credit = 100 MW * ($30-$15) = $1500
FTR Option is Neither a Benefit/Liability

Thermal Limit

FTR Option = 100 MW

Energy Delivery = 100 MWh

Bus A
Source (Sending End)
Congestion Price = $15

Bus B
Sink (Receiving End)
Congestion Price = $30

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

FTR Option Credit = 100 MW * ($15-$30) = $-1500 = $0

***When calculated, the FTR Option Credit is negative, therefore the economic value will equal zero.*****
FTR Revenue Adequacy

- PJM awards FTRs based on the capability of the transmission system
- There must be adequate revenue from congestion to fund the FTRs that were awarded
- Revenue adequacy issues occur when we under-collect congestion revenue to fund FTRs
  - Transmission outages and de-ratings can have a significant impact on FTR revenue adequacy
Summary

- FTRs are financial instruments used to hedge congestion costs
- FTRs can be acquired in the Annual FTR Auction, Long Term FTR Auction, Monthly FTR Auction, or Secondary Market
- FTRs can be Obligations or Options
  - Obligation can be benefit or liability
  - Option can be benefit but never liability
- FTRs must be simultaneously feasible
Overview of Auction Revenue Rights (ARRs)
Annual ARR Allocation

• Allocated to Firm Transmission Service Customers annually in a two-stage allocation process
  – First stage protects native load utilization of the transmission system providing long-term certainty
  – Second stage provides flexibility to adjust hedging paths annually

• Supports retail programs by reassigning ARRs/FTRs as load switches between LSEs within planning period
Characteristics of ARRs

• Economic value based on LMPs from the Annual FTR Auction
  – Defined from source to sink
  – Only available as an obligation
    • obligation can be benefit or liability
  – Financial entitlement, not a physical right
  – Must be simultaneously feasible
What Can the Holder Do with the ARR?

- **Self-schedule** the ARR into the Annual FTR Auction on the exact same path as ARR

- **Reconfigure** the ARR by bidding into the Annual FTR Auction to acquire a FTR on an alternative path or for an alternative product

- **Retain** the allocated ARR and receive the associated revenue from the FTR auction
Example - ARR Candidates

ABC company requests 600MW ARR from Generator A to the load at Bus D.

ABC company requests 300MW ARR from Generator B to the load at Bus D.

ABC company does NOT request an ARR from Generator C to the load at Bus D.

ABC company requests 100MW ARR from Generator A to Interface X for its long-term firm point-to-point transmission service.

*Historical Day-Ahead LMPs
ARRs entitle the holder to receive an allocation of Annual FTR Auction revenues

ARRs are allocated to Firm Transmission Service Customers

ARRs may be self-scheduled to a FTR before the first round of the Annual FTR Auction

ARRs are reassigned on a proportional basis within a zone as load switches between LSEs within the planning period

ARRs are only available as an obligation
  - obligation can be a benefit or a liability

ARRs must be simultaneously feasible
Overview of the Simultaneous Feasibility Test (SFT)
What is a Simultaneous Feasibility Test?

- Test to ensure that all subscribed transmission entitlements are within the capability of the existing transmission system
- Test to ensure the PJM Energy Market is revenue adequate under normal system conditions
- **NOT** a system reliability test
- **NOT** intended to model actual system conditions
Feasibility of ARRs and FTRs

• ARRs must be simultaneously feasible to ensure that Annual FTR Auction revenues are sufficient to cover ARR Target Allocations

• FTRs must be simultaneously feasible to ensure that the total congestion charges collected from the Day Ahead and Balancing Markets are sufficient to cover the FTR Target Allocations
**SFT Example #1**

- **FTR 1**: 300 MW Obligation from A to B
- **FTR 2**: 180 MW Obligation from A to B

Net Flow on Line A-B = 480 MW

Line A-B Flow = Line A-B Rating therefore both FTRs are simultaneously feasible
FTR 1: 300 MW Obligation from A to B

FTR 2: 300 MW Obligation from A to B

Net Flow on Line A-B = 600 MW

Line A-B Flow > Line A-B Rating therefore both FTRs are **NOT** simultaneously feasible
Revenue Adequacy using SFT Examples

Day Ahead Market
Energy Flow = 500 MW

Day-Ahead Congestion Charge = 500 MW ($20 - $10) = $5,000

FTR Target Allocation (Using SFT Example 1 FTRs)
Total FTR Target Allocation = 480 MW ($20 - $10) = $4,800

FTR Target Allocation (Using SFT Example 2 FTRs)
Total FTR Target Allocation = 600 MW ($20 - $10) = $6,000
**FTR 1:** 500 MW Obligation from B to A

**FTR 2:** 1000 MW Obligation from A to B

Net Flow on Line A-B = 500 MW

Line A-B Flow = Line A-B Rating therefore both FTRs are simultaneously feasible
FTR 1: 500 MW Option from B to A
FTR 2: 1000 MW Obligation from A to B

Net Flow on Line A-B = 500 MW
– or –

Net Flow on Line A-B = 1000 MW (must ignore counterflow created by Option)

Line A-B Flow > Line A-B Rating therefore both FTRs are NOT simultaneously feasible
Revenue Adequacy using SFT Examples

Day Ahead Market
Energy Flow = 500 MW

500 MW Rating

Day-Ahead Congestion Charge = 500 MW ($20 - $10) = $5,000

FTR Target Allocation (using SFT Example 3 FTRs):
FTR 1 Target Allocation = 500 MW ($10 - $20) = -$5,000
FTR 2 Target Allocation = 1000 MW ($20 - $10) = $10,000
Total FTR Target Allocation = $5,000

FTR Target Allocation (using SFT Example 4 FTRs):
FTR 1 Target Allocation = 500 MW ($10 - $20) = 0
FTR 2 Target Allocation = 1000 MW ($20 - $10) = $10,000
Total FTR Target Allocation = $10,000
What are the FTR values?

How much congestion revenue is collected?

Is this system revenue adequate?
The Simultaneous Feasibility Test:

- FTRs like ARRs must pass the Simultaneous Feasibility Test
  - For revenue adequacy - collect enough congestion charges to pay the FTR holders
  - Can’t award more than the capability of the transmission path

- Counter flow positions allow for awarding additional prevailing flow FTR’s
The Member Community is PJM’s self-service portal for members to search for answers to their questions or to track and/or open cases with Client Management & Services.
Questions?