April 27 – May 1, 2015

Northampton, MA

Financial Transmission Rights (FTRs)

Introduction to Wholesale Electricity Markets (WEM 101)

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ISO new england

Goal

To present an overview of Financial Transmission Rights (FTRs) in the New England wholesale electricity market

- FTRs will be related to LMP concepts covered yesterday
- FTRs will be created, congestion will be managed; and revenues will be distributed
- Risks and benefits of FTRs will be considered

Objectives

At the completion of this module, you will be able to:

- Explain the relationship of DA LMPs to the FTR market
- Discuss the role of FTRs in congestion management
- Identify how FTRs are created
- Calculate how FTR congestion revenues are determined
- Relate how FTR auction revenues are allocated through the ARR process
- Appreciate that FTRs incur risks as they manage congestion
- Recognize the need for risk management training prior to FTR participation

Topics

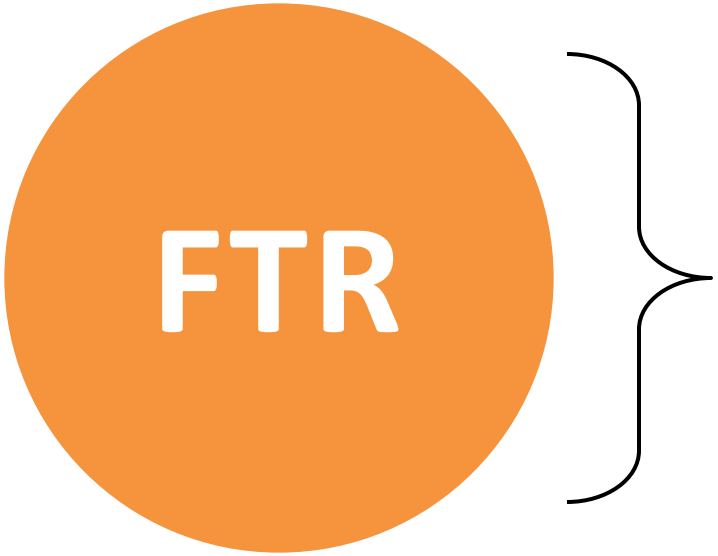
- FTR basics
- Day-ahead dispatch
- FTR auction
- FTR settlements in DA
- Auction Revenue Rights (ARR) / Incremental Auction Revenue Rights (IARR)
- Business requirements

FTR Basics

Section Topics

- What they are
- How they are valued
- FTR risks

How Does ISO New England Define an FTR?



- Failed to Report
- Federal Tax Return
- Federal Travel Regulation
- **Financial Transmission Right**
- Fixed Transmission Right
- First Time Right
- Follow the Reaper
- For The Record

The free dictionary by Farlex listed 44 definitions for the FTR acronym

Other Markets have FTR Like Products

Can you match these markets with products?

Market Operator	Product
California ISO	Congestion Revenue Rights
ERCOT	Financial Transmission Rights
Independent Electricity System Operator	Fixed Transmission Rights
ISO New England	Transmission Congestion Contracts
Midwest ISO	Transmission Congestion Rights
New York Independent System Operator	Transmission Rights
PJM Interconnection	
Southwest Power Pool	

Answers can be found on the last slide

Congestion Management / Multi-Settlement

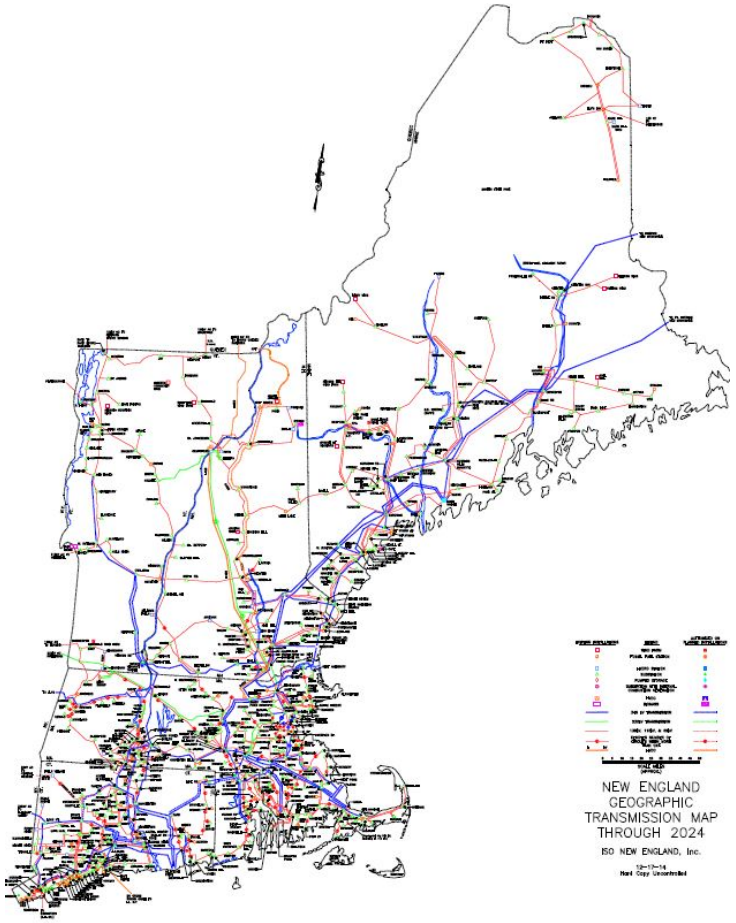
Day-ahead hedges real-time

FTRs hedge DAM congestion

Why Do We Have FTRs?

Congestion Management / Investment

- FTRs hedge congestion uncertainty
  - Loss of transmission lines
  - Loss of generation
- FTRs provide a long-term hedge
  - Annual or monthly
- Investors bring liquidity to market

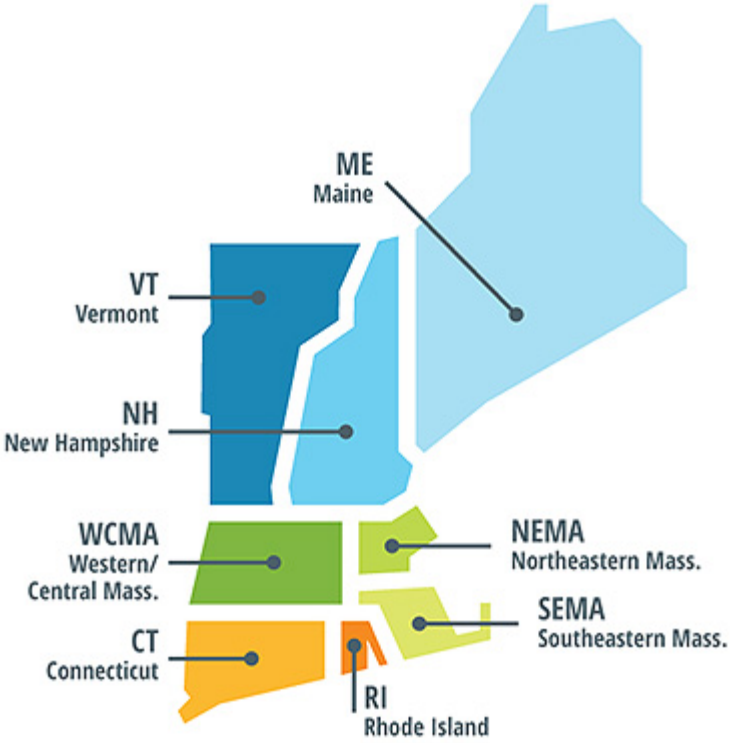


Load Settles on Zonal LMP

Recall that LMP has three components:

1. Energy component
2. Congestion component
3. Loss component

	LMP Components			
	Energy	Congestion	Losses	LMP
Rhode Island	174.57	**61.97**	4.86	241.40
SE Mass	174.57	**23.14**	3.57	201.28
NE Mass	174.57	**10.45**	1.46	186.48
Maine	174.57	**-2.19**	-6.34	166.04
Internal Hub	174.57	**-5.55**	0.82	169.84
New Hampshire	174.57	**-6.38**	-1.74	166.45
WC Mass	174.57	**-17.69**	0.99	157.87
Vermont	174.57	**-23.56**	-3.06	147.95
Connecticut	174.57	**-29.33**	-2.60	142.64



Wholesale Load Zones in New England

Generation Settles on Nodal LMP

These generators are among the largest in New England

Unit Name	MW	Dispatch Zone	LMP Components			LMP
			Energy	Congestion	Losses	
Montville 6	410	Eastern CT	174.57	485.76	-4.44	655.89
Lake Road	897	Rhode Island	174.57	73.33	2.2	250.1
Manchester CC	510	Rhode Island	174.57	50.21	4.16	228.94
Pilgrim	709	SEMA	174.57	21.21	0.83	196.61
Kendall CT	187	Boston	174.57	17.22	1.1	192.89
Mystic 8	842	Boston	174.57	6.88	0.79	182.24
Rumford Power	275	Maine	174.57	-1.6	-1.52	171.45
MIS	563	Bangor Hydro	174.57	-2.3	-12.48	159.79
Seabrook	1257	New Hampshire	174.57	-2.72	-3.85	168
Mystic 9	858	Boston	174.57	-7.56	0.6	167.61
Stony Brook Station	550	Western MA	174.57	-51.6	-2.05	120.92
Berkshire Power	284	Springfield MA	174.57	-58.77	-1.38	114.42
New Haven Harbor	466	Western CT	174.57	-94.99	-3.04	76.54
Millstone Point	2151	Eastern CT	174.57	-129.77	-6.36	38.44

FTR Settles on the LMP Congestion Component

Let's represent congestion with a thermometer

	LMP Congestion Component
Rhode Island	61.97
SE Mass	23.14
NE Mass	10.45
Maine	-2.19
Internal Hub	-5.55
New Hampshire	-6.38
WC Mass	-17.69
Vermont	-23.56
Connecticut	-29.33

Quiz

0 ^{0}C

100 ^{0}C

-40 ^{0}

0 ^{0}F

RTM and DAM

Energy Flows from Source to Sink

Generation Source

Transmission

Load Sink

FTRs – Hedge Any Source to Sink Combination

Sources

Sinks

FTR Settles on the LMP Congestion Component

FTR Value = [Sink Price - Source Price] X MW

Unit Name	LMP Congestion Component
Montville 6	485.76
Lake Road	73.33
Manchester CC	50.21
Pilgrim	21.21
Kendall CT	17.22
Mystic 8	6.88
Rumford Power	-1.6
MIS	-2.3
Seabrook	-2.72
Internal Hub	-5.55
Mystic 9	-7.56
Stony Brook Station	-51.6
Berkshire Power	-58.77
New Haven Harbor	-94.99
Millstone Point	-129.77

LMP Congestion Component	Load Zone
61.97	Rhode Island
23.14	SE Mass
10.45	NE Mass
-2.19	Maine
-5.55	Internal Hub
-6.38	New Hampshire
-17.69	WC Mass
-23.56	Vermont
-29.33	Connecticut

FTR as a Financial Investment

FTR Value = [61.97 - (-129.77)] X MW = 191.74 $/MW

Unit Name	LMP Congestion Component
Montville 6	485.76
Lake Road	73.33
Manchester CC	50.21
Pilgrim	21.21
Kendall CT	17.22
Mystic 8	6.88
Rumford Power	-1.6
MIS	-2.3
Seabrook	-2.72
Internal Hub	-5.55
Mystic 9	-7.56
Stony Brook Station	-51.6
Berkshire Power	-58.77
New Haven Harbor	-94.99
Millstone Point	-129.77

LMP Congestion Component	Load Zone
61.97	**Rhode Island**
23.14	SE Mass
10.45	NE Mass
-2.19	Maine
-5.55	Internal Hub
-6.38	New Hampshire
-17.69	WC Mass
-23.56	Vermont
-29.33	Connecticut

FTR as a Financial Liability

FTR Value = [-29.33 - 485.76] X MW = -515.09 $/MW

Unit Name	LMP Congestion Component
Montville 6	**485.76**
Lake Road	**73.33**
Manchester CC	**50.21**
Pilgrim	**21.21**
Kendall CT	**17.22**
Mystic 8	**6.88**
Rumford Power	**-1.6**
MIS	**-2.3**
Seabrook	**-2.72**
Internal Hub	**-5.55**
Mystic 9	**-7.56**
Stony Brook Station	**-51.6**
Berkshire Power	**-58.77**
New Haven Harbor	**-94.99**
Millstone Point	**-129.77**

LMP Congestion Component	Load Zone
61.97	Rhode Island
23.14	SE Mass
10.45	NE Mass
-2.19	Maine
-5.55	Internal Hub
-6.38	New Hampshire
-17.69	WC Mass
-23.56	Vermont
-29.33	**Connecticut**

A Generator Using an FTR for Delivery to the Hub

FTR Value = [-5.55 - (-129.77)] X MW = 124.22 $/MW

Unit Name	LMP Congestion Component
Montville 6	485.76
Lake Road	73.33
Manchester CC	50.21
Pilgrim	21.21
Kendall CT	17.22
Mystic 8	6.88
Rumford Power	-1.6
MIS	-2.3
Seabrook	-2.72
Internal Hub	-5.55
Mystic 9	-7.56
Stony Brook Station	-51.6
Berkshire Power	-58.77
New Haven Harbor	-94.99
Millstone Point	-129.77

LMP Congestion Component	Load Zone
61.97	Rhode Island
23.14	SE Mass
10.45	NE Mass
-2.19	Maine
-5.55	**Internal Hub**
-6.38	New Hampshire
-17.69	WC Mass
-23.56	Vermont
-29.33	Connecticut

An LSE Using an FTR to Take Delivery From the Hub

FTR Value = [61.97 - (-5.55)] X MW = 67.52 $/MW

Unit Name	LMP Congestion Component
Montville 6	485.76
Lake Road	73.33
Manchester CC	50.21
Pilgrim	21.21
Kendall CT	17.22
Mystic 8	6.88
Rumford Power	-1.6
MIS	-2.3
Seabrook	-2.72
Internal Hub	-5.55
Mystic 9	-7.56
Stony Brook Station	-51.6
Berkshire Power	-58.77
New Haven Harbor	-94.99
Millstone Point	-129.77

LMP Congestion Component	Load Zone
61.97	Rhode Island
23.14	SE Mass
10.45	NE Mass
-2.19	Maine
-5.55	Internal Hub
-6.38	New Hampshire
-17.69	WC Mass
-23.56	Vermont
-29.33	Connecticut

Purpose of Financial Transmission Rights

Financial instrument

- Provides congestion management
- Financial investment
- No physical rights

Charge or payment in day-ahead market based on differences in the congestion component of locational marginal prices

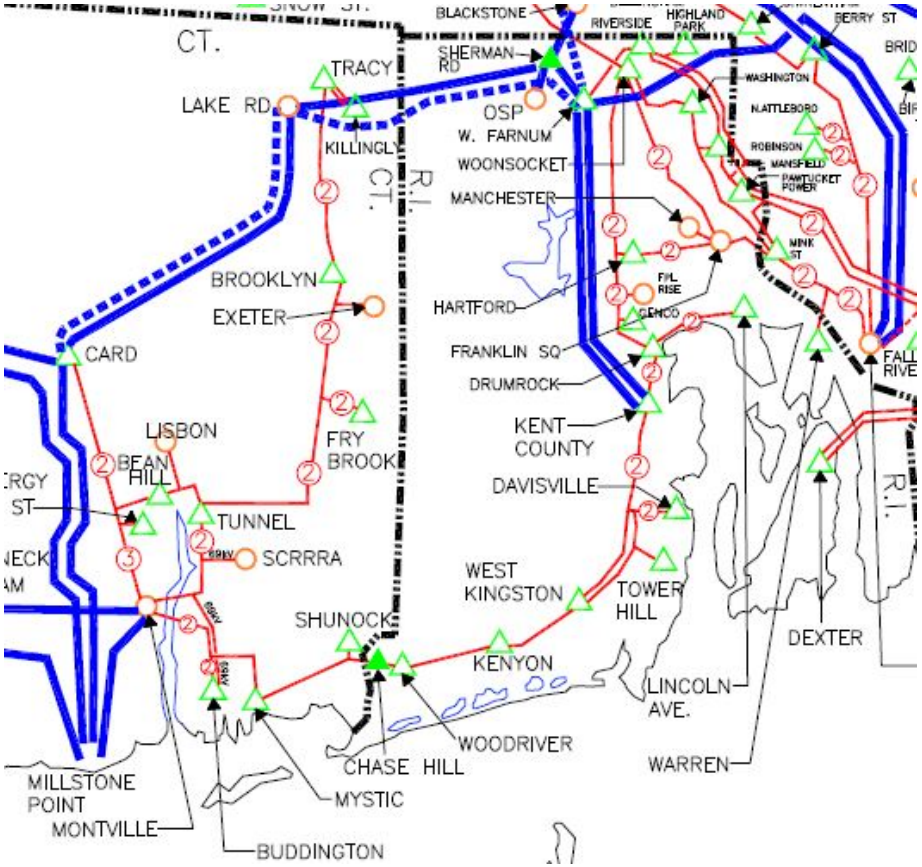
Questions

FTR Basics

FTR Risks

FTR Risks

Decision to seek FTRs requires a forward view of the market and an understanding of expected power flows through the transmission network under various topologies and patterns of load and dispatch



FTR Risks *(continued)*

FTRs with negative price paths in the Day-Ahead Energy Market create funding obligations to the FTR holder

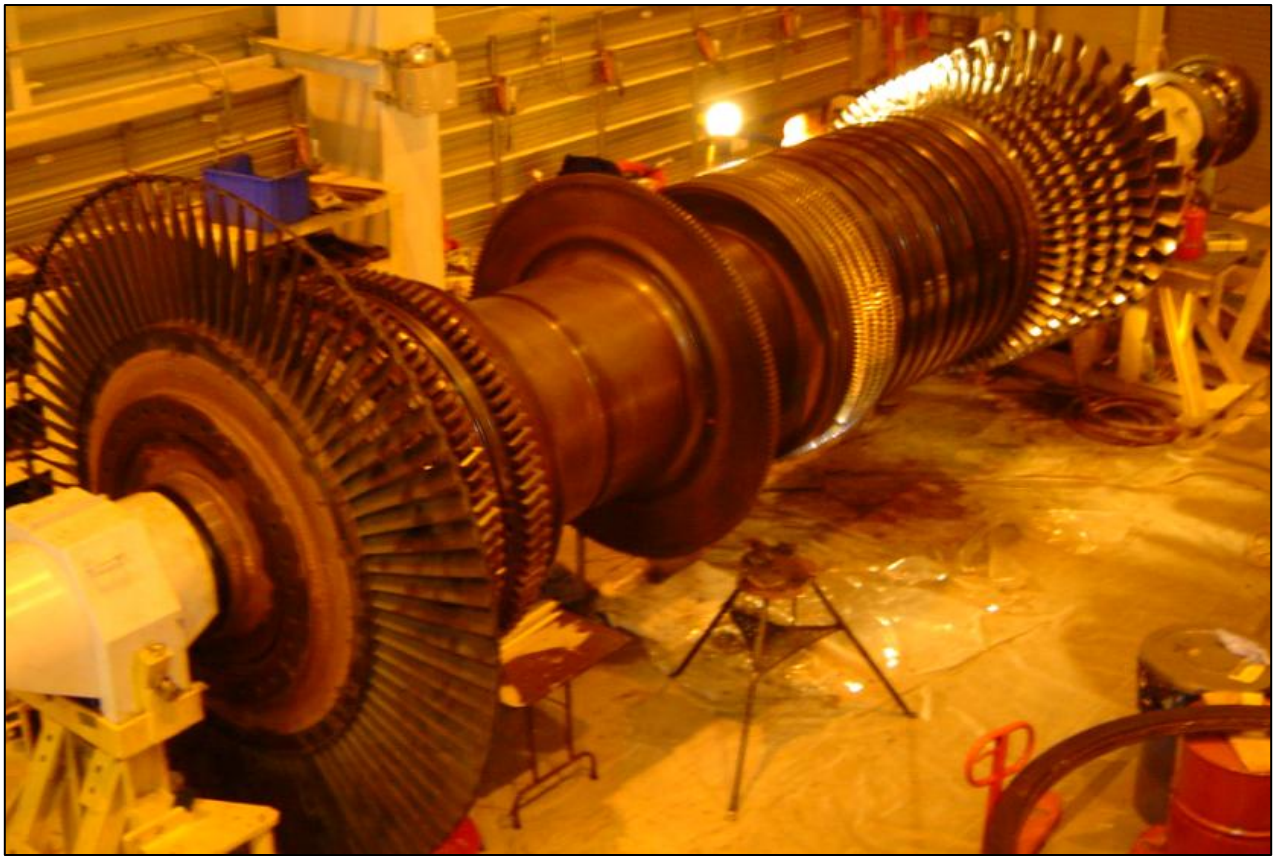
FTR Risks *(continued)*

Revenue adequacy for FTR holders with positive price paths is dependent on collections from FTR holders with negative price paths

FTR Risks *(continued)*

- When low probability events occur such as this transmission outage, it can have severe consequences
- Unhedged load could be exposed to significant congestion (without an appropriate FTR portfolio)
- FTR holders without a forward view of the consequences of this type of event could be exposed to significant charges

FTR Risks *(continued)*



Unanticipated generation outages can also accrue significant losses

Questions

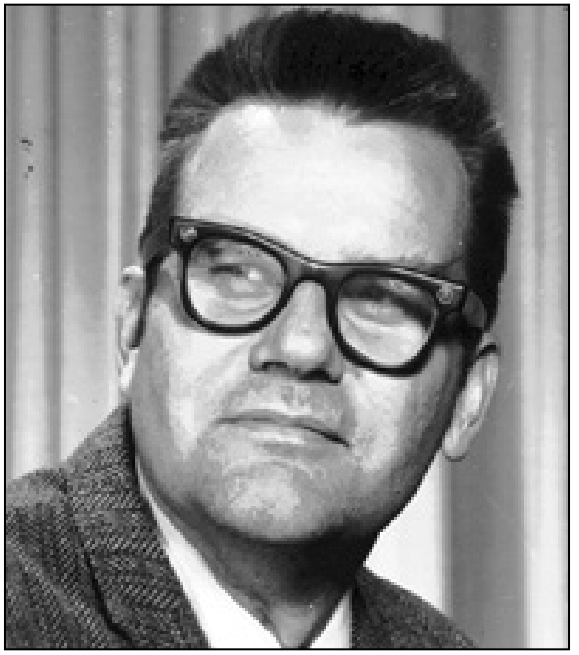
Day-Ahead Dispatch

Pioneer in Locational Marginal Pricing

Fred Charles Schweppe, Ph.D.

Authored key research that led to locational marginal pricing:

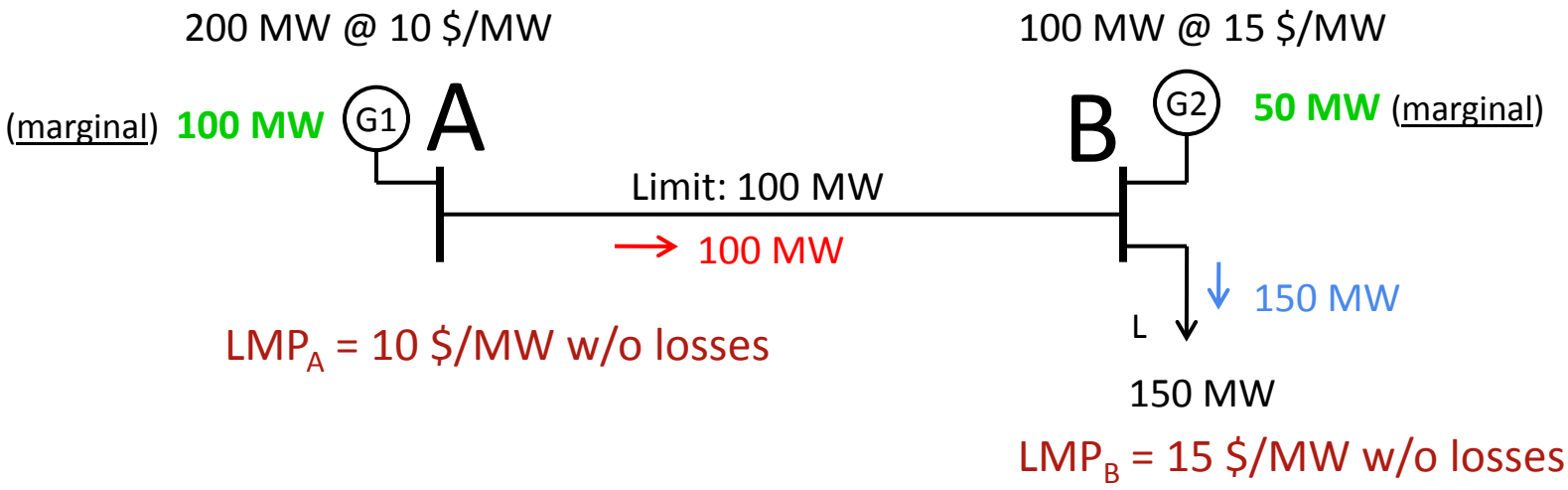
- Uncertain Dynamic Systems; published 1973
- Spot Pricing of Electricity; published 1988



Fred Charles Schweppe, Ph.D.
(1934-1988)
Professor of Electrical Engineering, MIT

Day-Ahead Dispatch Example Without Losses

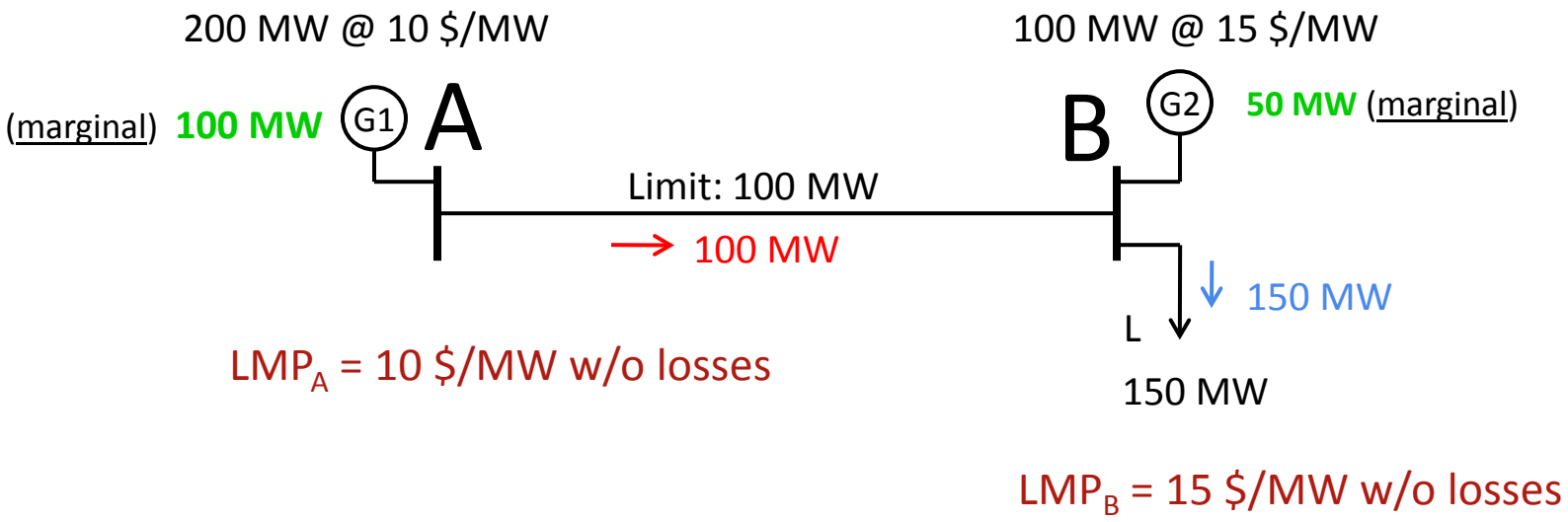
What Happens During Congestion?



- What is G1 paid? _____; G2? _____; Total? _____
- How much does load pay? _____
- What is the difference between what load pays and what generation is paid?

  _____

How is an FTR Valued in Day-Ahead Market?



FTR Value = [Sink Price - Source Price] x MW

- Assume you have a 100 MW FTR with Source at A and Sink at B:
  - What is the value of the FTR's path? _____ $/MW
  - What is the total value of the 100 MW FTR? $ _____

FTR Auction

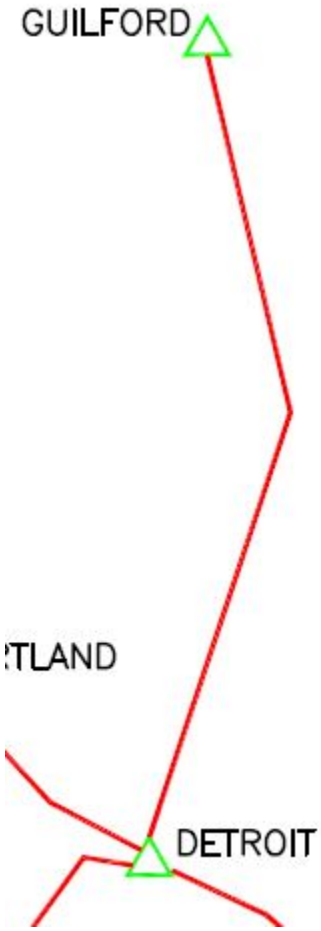
How Do You Get an FTR?

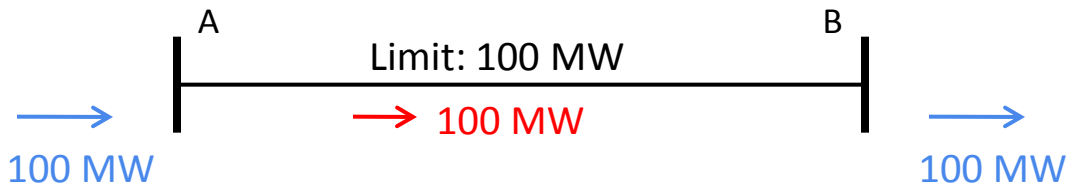
- FTRs are obtained in an FTR auction
- ISO New England operates the FTR auction
- Throughout the year, ISO New England oversees the process of participants buying and selling FTRs through FTR auctions:
  - Annual auction – Round 1 – 25% of transmission
  - Annual auction – Round 2 – balance of transmission to 50%
  - Monthly auctions – balance of transmission to 95%

FTR Characteristics

- MW quantity (minimum of 0.10 MW)
- Path (from source to sink location)
  - Between any two locations (any pricing node, zone, or the hub)
- Price
  - Buy bids and sell offers ($/MW- period)
- Class
  - On-peak period
    - Hours ending 8 through 23 – weekdays except NERC holidays
  - Off-peak period
    - Hours ending 24 through 7 – weekdays
    - Hours ending 1 through 24 – weekends
    - Hours ending 1 through 24 – NERC holidays

How an FTR Auction Works





Bid #1 FTR_{A-B} 40 MW @ 1000 $/MW **(40 MW clears)**

Bid #2 FTR_{A-B} 15 MW @ 750 $/MW **(15 MW clears)**

Bid #3 FTR_{A-B} 10 MW @ 600 $/MW **(10 MW clears)**

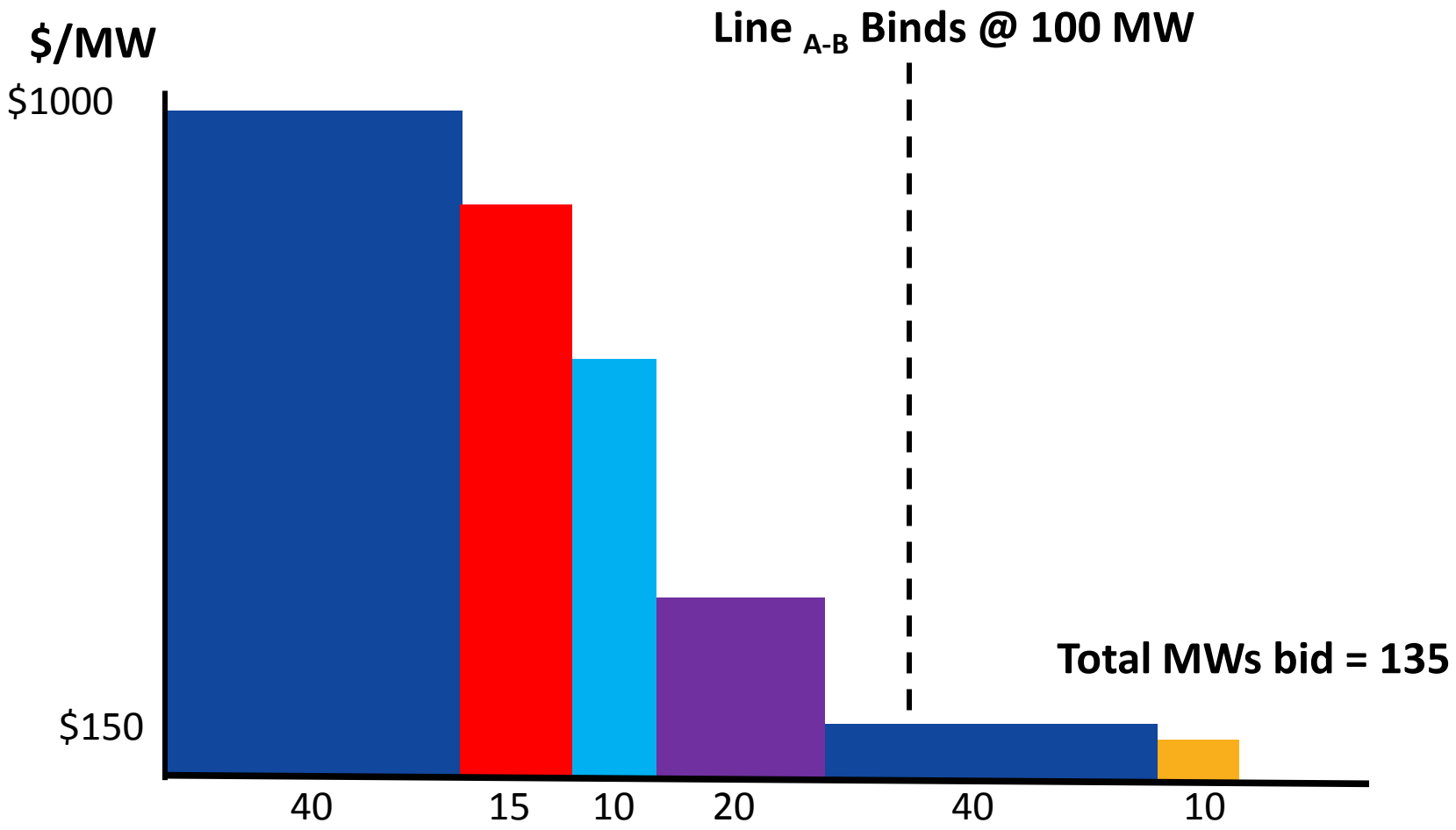
Bid #4 FTR_{A-B} 20 MW @ 400 $/MW **(20 MW clears)**

Bid #5 FTR_{A-B} 40 MW @ 150 $/MW **(marginal 15 MW clears)**

Bid #6 FTR_{A-B} 10 MW @ 120 $/MW **(none clear)**

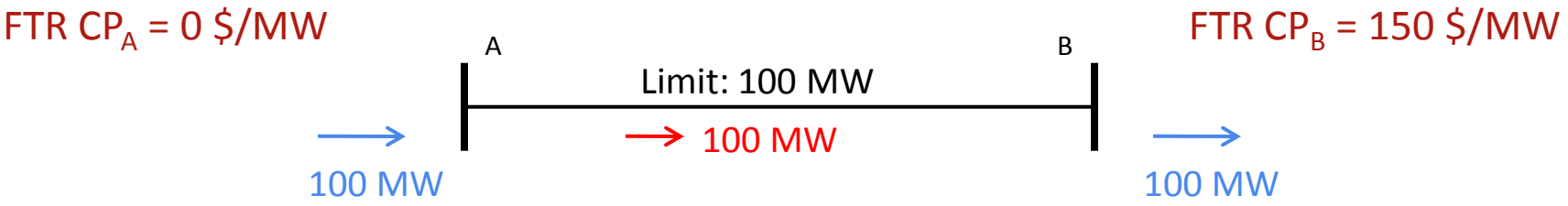
What is the path clearing price?

Bid Selection and Binding Constraint



What would the path clearing price be if the transmission limit were 25 MW?

FTR Auction Clearing and Revenue Collection

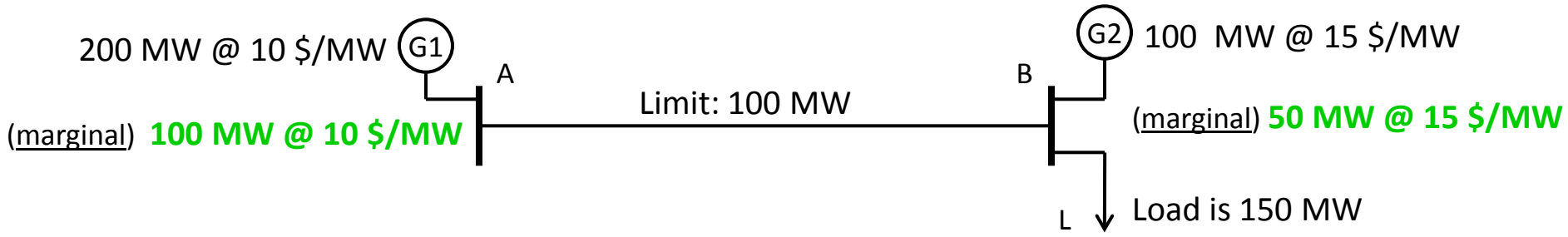


Bids	Source	Sink	Bid MW	Bid $/MW	Cleared MW	Cleared $/MW	Auction Revenue
1	Bus A	Bus B	40	1,000	40	150	6,000
2	Bus A	Bus B	15	750	15	150	2,250
3	Bus A	Bus B	10	600	10	150	1,500
4	Bus A	Bus B	20	400	20	150	3,000
5	Bus A	Bus B	40	150	15	150	2,250
6	Bus A	Bus B	10	120	0	150	0
					100		**15,000**

Auction revenue from FTR awards are paid to IARR and ARR holders

FTR Settlements in Day-Ahead

FTR Settlement of a Congested Hour in DAM



FTR Holders	Source	Sink	LMP-A $/MW	LMP-B $/MW	Path CP	Congested Hours	Awarded MW	Congestion Revenue
1	Bus A	Bus B	10	15	5	1	40	200
2	Bus A	Bus B	10	15	5	1	15	75
3	Bus A	Bus B	10	15	5	1	10	50
4	Bus A	Bus B	10	15	5	1	20	100
5	Bus A	Bus B	10	15	5	1	15	75
							100	**500**

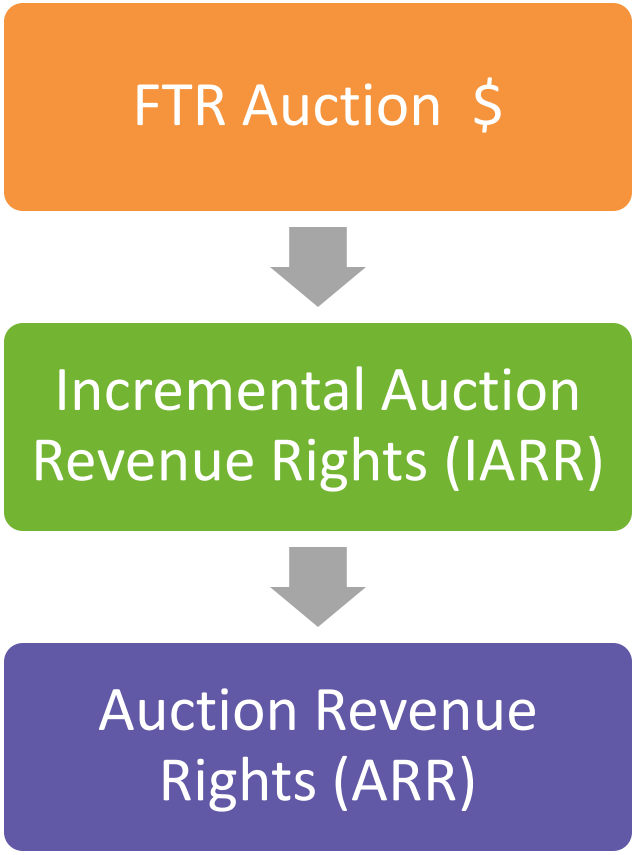
These FTRs are fully funded as the congestion revenue fund from the DAM settlement exactly matches FTR holders congestion revenue requirements

Auction Revenue Rights (ARR) / Incremental Auction Revenue Rights (IARR)

Section Topics

- Auction revenue stream
- Incremental auction revenue rights (IARR)
- Auction revenue rights (ARR)

Auction Revenues

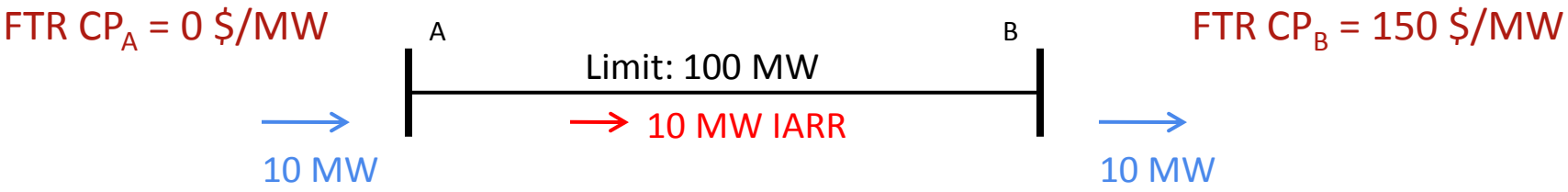


Incremental Auction Revenue Rights (IARR)

Incremental auction revenue rights (IARR)

- Transmission upgrades that increase transfer capability
- Upgrades placed in-service on or after March 1, 1997
- Additional FTRs made possible due to upgrade
- Award according to cost responsibility
- Upgrades compensated through the Pool PTF rate are **ineligible** for IARR treatment

IARR Allocation for Eligible Upgrades



Incremental auction revenue rights (IARR) are paid the FTR path clearing price from the auction

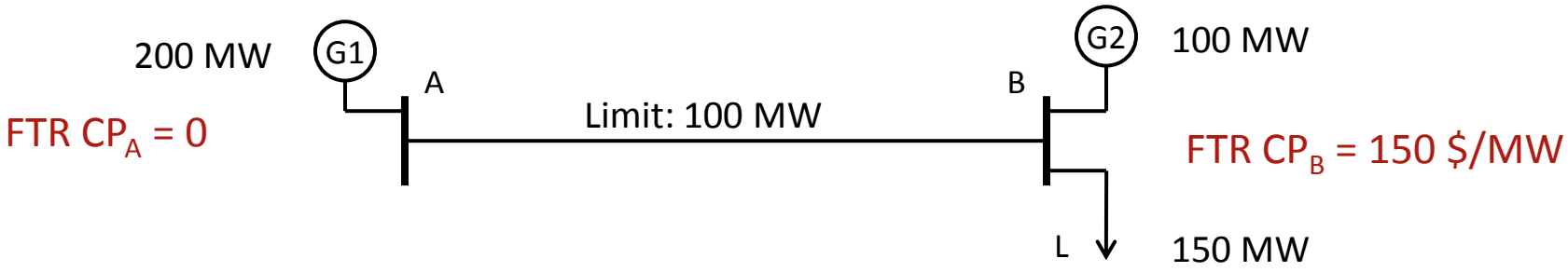
	IARR MW	FTR Path Clearing Price $/MW	$
IARR-A	10	150	1,500

After IARR holders receive their share of ARRs, the balance of FTR auction revenues are distributed to ARR holders

Auction Revenue Rights (ARR)

- ARR allocation process
  - Load ratio share of all internal and external sources
  - Special treatment of grandfathered contracts
  - ARR allocations to load zone are distributed to participants by percent of load served in the zone
- ARR allocation consistent with *congestion* in FTR auction

ARR Allocation



	Peak Load MW	Load Zone Allocator %	$
LSE-A	10	6.67%	900
LSE-B	20	13.33%	1,800
LSE-C	30	20.00%	2,700
LSE-D	40	26.67%	3,600
LSE-E	50	33.33%	4,500
	150	100.00%	13,500

ARR allocation distributes FTR auction revenues to congestion paying load serving entities

Questions

Business Requirements

Governance Documents

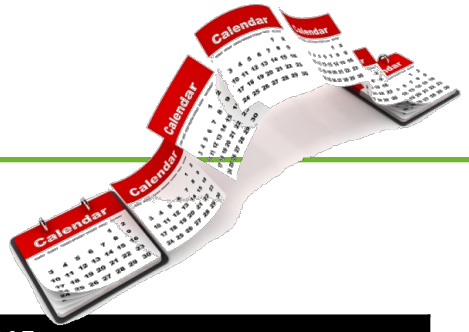
ISO New England Transmission, Markets & Services Tariff

- Section I – Exhibit IA Financial Assurance Policy: Part II.A.2
- Section II – Open Access Transmission Tariff: Parts 41, 42, and 43
- Section III – Market Rule 1: Parts 5 and 7, Appendix C

Manuals

- Manual 6 – Financial Transmission Rights
- Manual 28 – Market Rule 1, Accounting

FTR Auction Calendar



2015 Annual FTR Auction Calendar

Auction Period	January 1 to December 31, 2015	
Post Auction Model & Assumptions	October 1, 2014	
Event	Round 1	Round 2
Auction Opened	October 28, 2014	December 1, 2014
Auction Closed	October 30, 2014	December 3, 2014
Results Posted	November 10, 2014	December 15, 2014

2015 Monthly FTR Auction Calendar

Auction Month	January	February	March	April	May	June	July	August	September	October	November	December
Event												
Post Auction Model & Assumptions	Nov 21	Dec 23	Jan 20	Feb 20	Mar 20	Apr 22	May 22	Jun 22	Jul 23	Aug 21	Sep 22	Oct 22
Auction Opens	Dec 16	Jan 13	Feb 10	Mar 17	Apr 14	May 12	Jun 16	Jul 14	Aug 11	Sep 15	Oct 13	Nov 10
Auction Closes	Dec 18	Jan 15	Feb 12	Mar 19	Apr 16	May 14	Jun 18	Jul 16	Aug 13	Sep 17	Oct 15	Nov 13
Results Posted	Dec 29	Jan 26	Feb 23	Mar 30	Apr 27	May 26	Jun 29	Jul 27	Aug 24	Sep 28	Oct 26	Nov 24

Note: The auctions are scheduled to open at 00:00 hours and close at 11:00 hours on the days indicated. For example, when the monthly auction is held for January, the auction opens on December 16, 2014 at 00:00 hours and remains open until the auction closes on December 18, 2014, at 11:00 hours.

Markets and Operations > Markets Data and Information > Financial Transmission Rights > FTR Calendars

Auction Business Rules

FTR Customer

- Bids must satisfy financial assurance
- A bid to purchase is deemed a bid to purchase that MW amount or less for less than or equal to the bid price
- An offer to sell is deemed an offer to sell that MW amount or less for greater than or equal to the offer price
- A sell offer requires ownership of the FTR being sold
- Bids and offers incur a charge
- Customer Support Hotline – (413) 540-4220
  - Monday through Friday | 8:00 AM – 5:00 PM Eastern Time

Summary

In this module, you learned about:

- The relationship of DA LMPs to the FTR market
- The role of FTRs in congestion management
- The creation of FTRs
- The calculation of FTR congestion revenues
- The relation of FTR auction revenues and how they are allocated through the ARR process
- The risks FTRs incur as they manage congestion
- The need for risk management training prior to FTR participation

FTRs Have Many Names

Products Matched with Market Operator

Market Operator	Product
California ISO	Congestion Revenue Rights
ERCOT	Congestion Revenue Rights
Independent Electricity System Operator	Transmission Rights
ISO New England	Financial Transmission Rights
Midwest ISO	Financial Transmission Rights
New York Independent System Operator	Transmission Congestion Contracts
PJM Interconnection	Financial Transmission Rights
Southwest Power Pool	Transmission Congestion Rights