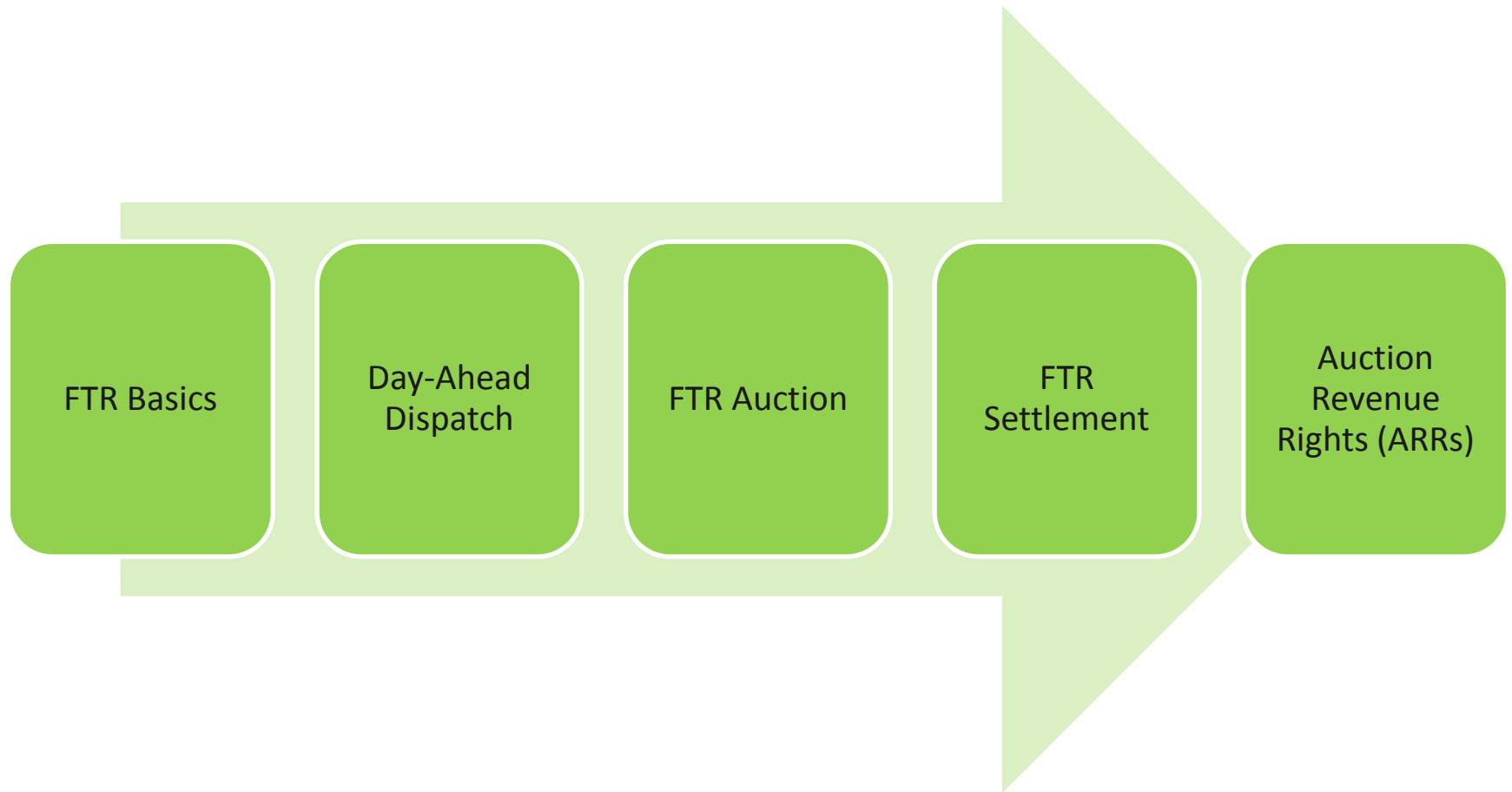


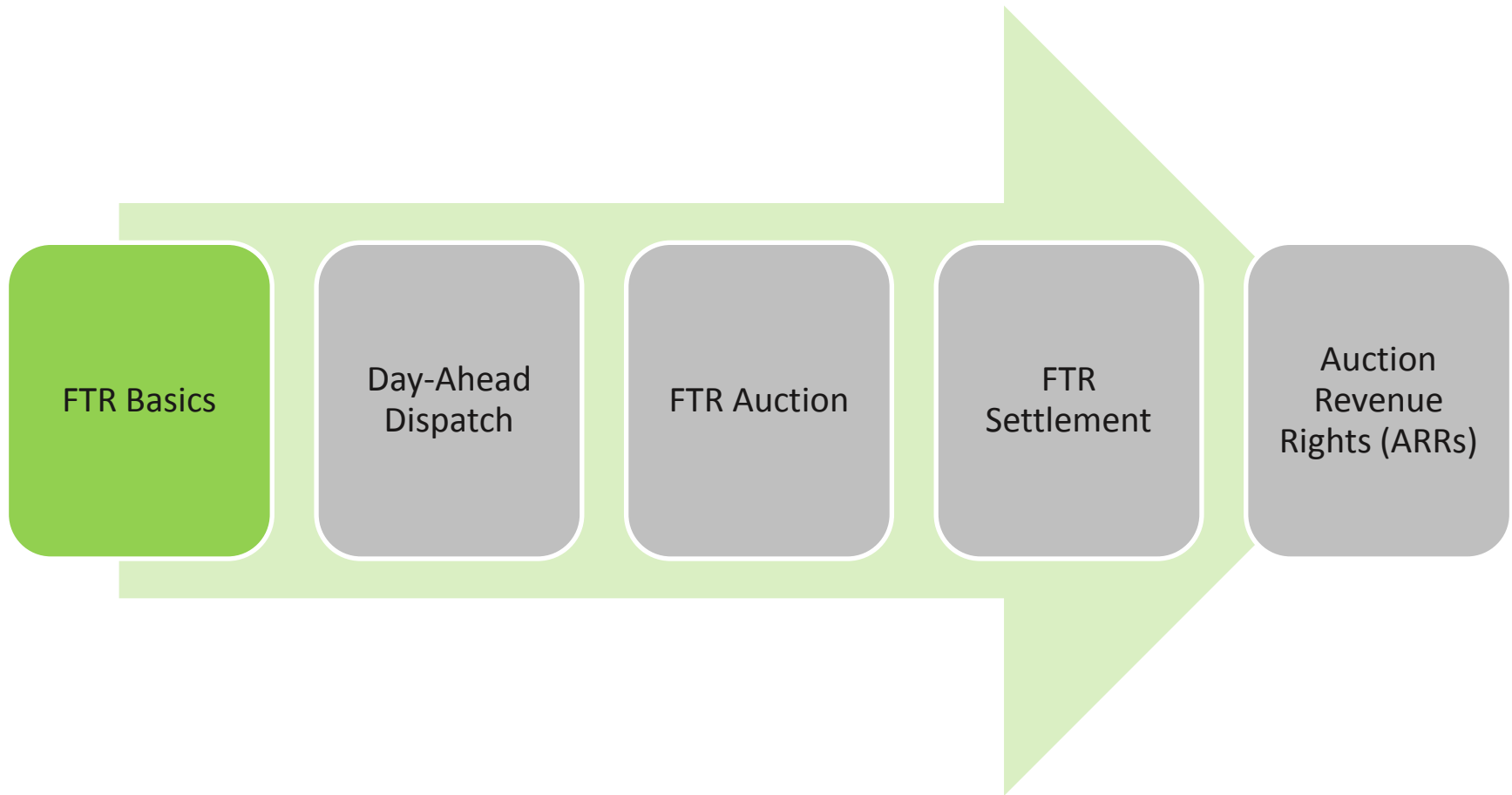
# Financial Transmission Rights (FTRs)

John Lally

Senior Engineer, Monthly Market Operations Department

# Topics Covered in this Module





# What are Financial Transmission Rights?

- Financial Transmission Right is a financial instrument
- Half of the transmission is auctioned annually and the balance up to 95% is auctioned monthly
- FTRs are valued on differences in the congestion component of the Day-Ahead Locational Marginal Price between designated source and sink pnode locations
- When combined with participation in Day-Ahead Market gives price certainty in Real-Time Market
- Does not represent a right for physical delivery of power
- Participants and Non-Participants can register to acquire FTRs

# FTR Risks?

- Significant losses can accrue by making poor decisions in the FTR market
- 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
- FTRs with negative price paths in the Day-Ahead Energy Market create funding obligations to the FTR holder
- Revenue adequacy for FTR holders with positive price paths is dependent on collections from FTRs holders with negative price paths

# FTR Bid/Offer Characteristics

- Quote
  - Buy bid (charge per bid)
  - Sell offer (FTRs from the annual auction can be sold in the monthly auction)
- MW quantity (minimum quantity is 0.10 MW)
- Dollar value per MW (one value for the entire auction period)
- Class
  - On-Peak
    - Hours ending 08:00 through 23:00 on weekdays
  - Off-Peak
    - Hours ending 24:00 through 07:00 on weekdays
    - Hours ending 01:00 through 24:00 on weekends and NERC holidays
- FTR path (from a Source to a Sink Location)
  - Between any two locations
    - Any Node, Zone, or the Hub

# Auction Business Rules

## *FTR Customer*

- Satisfy Financial Assurance
- A FTR must be owned for entire period to submit an offer to sell.
- 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.
- Bids incur a charge.

# Winning Quotes are...

- The set of simultaneously feasible FTRs with highest total Auction Bid Value
  - Determined by bids of buyers and sell offers
  - Reserve (maximum) prices of buyers respected
  - Reserve (minimum) prices of sellers respected
  - Transmission limits respected
    - Normal limits during all lines in conditions
    - Emergency limits during contingency analysis
  - Minimum FTR Award is to a tenth of a megawatt
  - Awarded FTRs incur a charge

# FTR Auction Calendar



## 2011 Annual FTR Auction Calendar

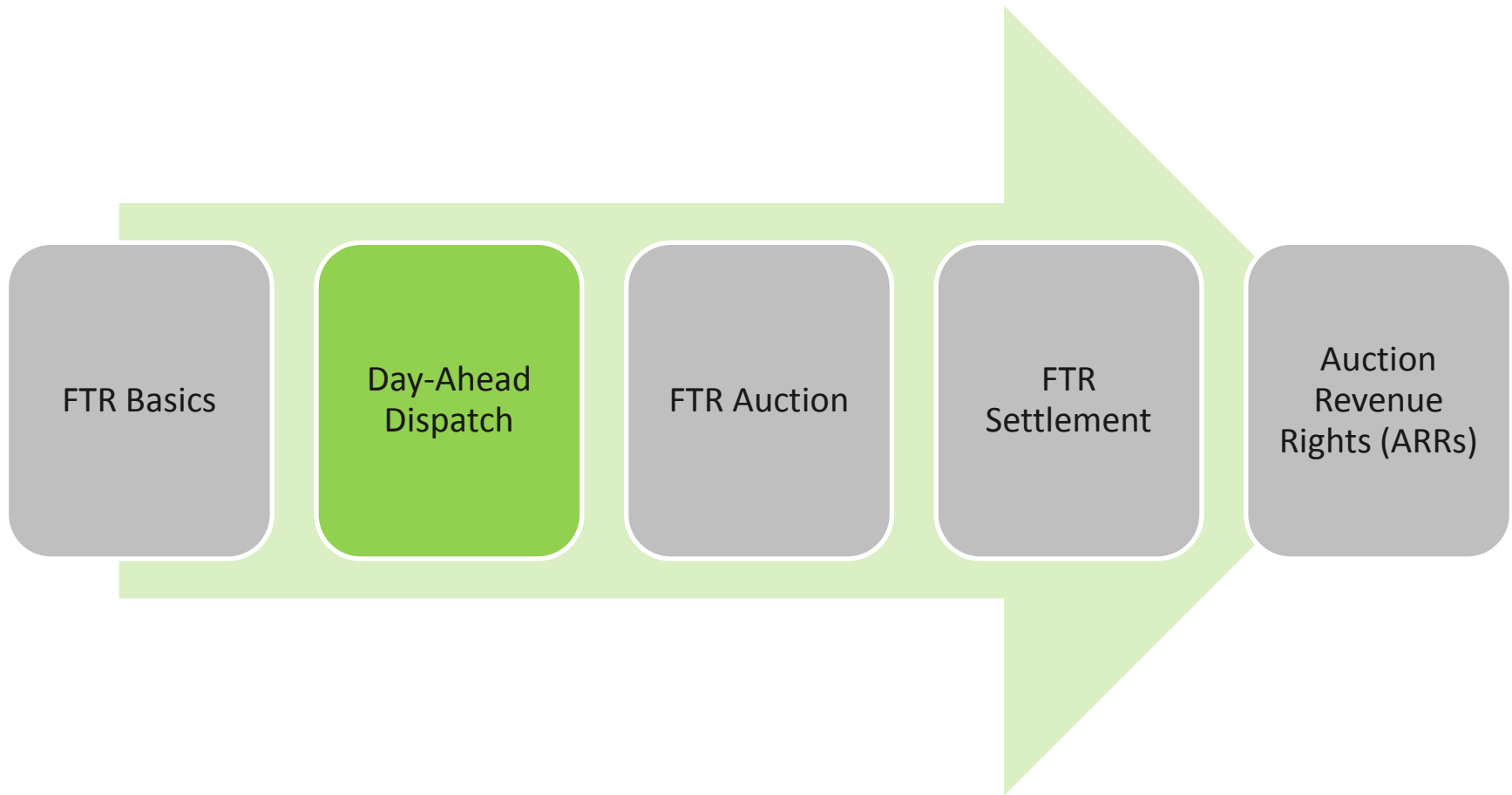
Auction Period	January 1 to December 31, 2011
Event	
Post Auction Model & Assumptions	October 7, 2010
Auction Opens	November 22, 2010
Auction Closes	November 30, 2010
Results Posted	December 8, 2010

## 2011 Monthly FTR Auction Calendar

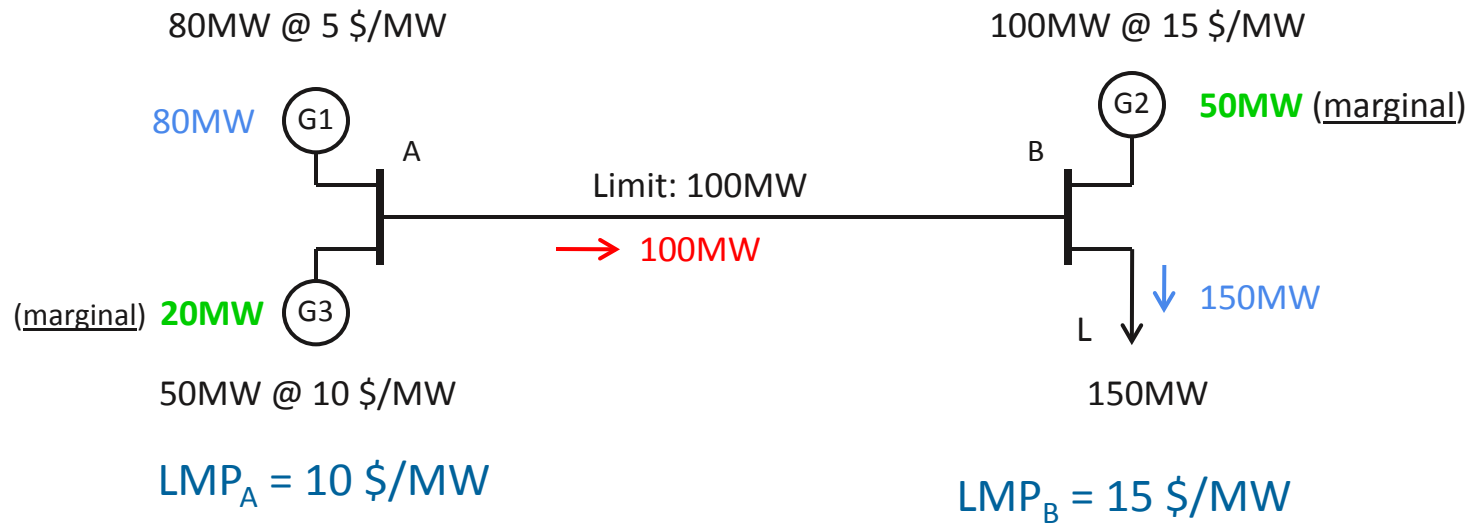
Auction Month	January	February	March	April	May	June	July	August	September	October	November	December
Event												
Post Auction Model & Assumptions	Nov 23	Dec 23	Jan 24	Feb 25	Mar 24	Apr 26	May 26	Jun 24	Jul 28	Aug 26	Sep 26	Oct 24
Auction Opens	Dec 9	Jan 10	Feb 7	Mar 11	Apr 7	May 10	Jun 10	Jul 11	Aug 11	Sep 12	Oct 11	Nov 7
Auction Closes	Dec 15	Jan 14	Feb 11	Mar 17	Apr 13	May 14	Jun 16	Jul 15	Aug 17	Sep 16	Oct 17	Nov 14
Results Posted	Dec 21	Jan 21	Feb 17	Mar 23	Apr 20	May 20	Jun 22	Jul 21	Aug 23	Sep 22	Oct 21	Nov 18

**Note:** The auctions are scheduled to open at 00:00 hours and close at 12:00 hours on the days indicated. For example, when the monthly auction is held for January, the auction opens on December 9, 2010 at 00:00 hours and remains open until the auction closes on December 15, 2010 at 12:00 hours.

[Home > Markets > Other Markets Data > Financial Transmission Rights > FTR Auction Calendars](#)

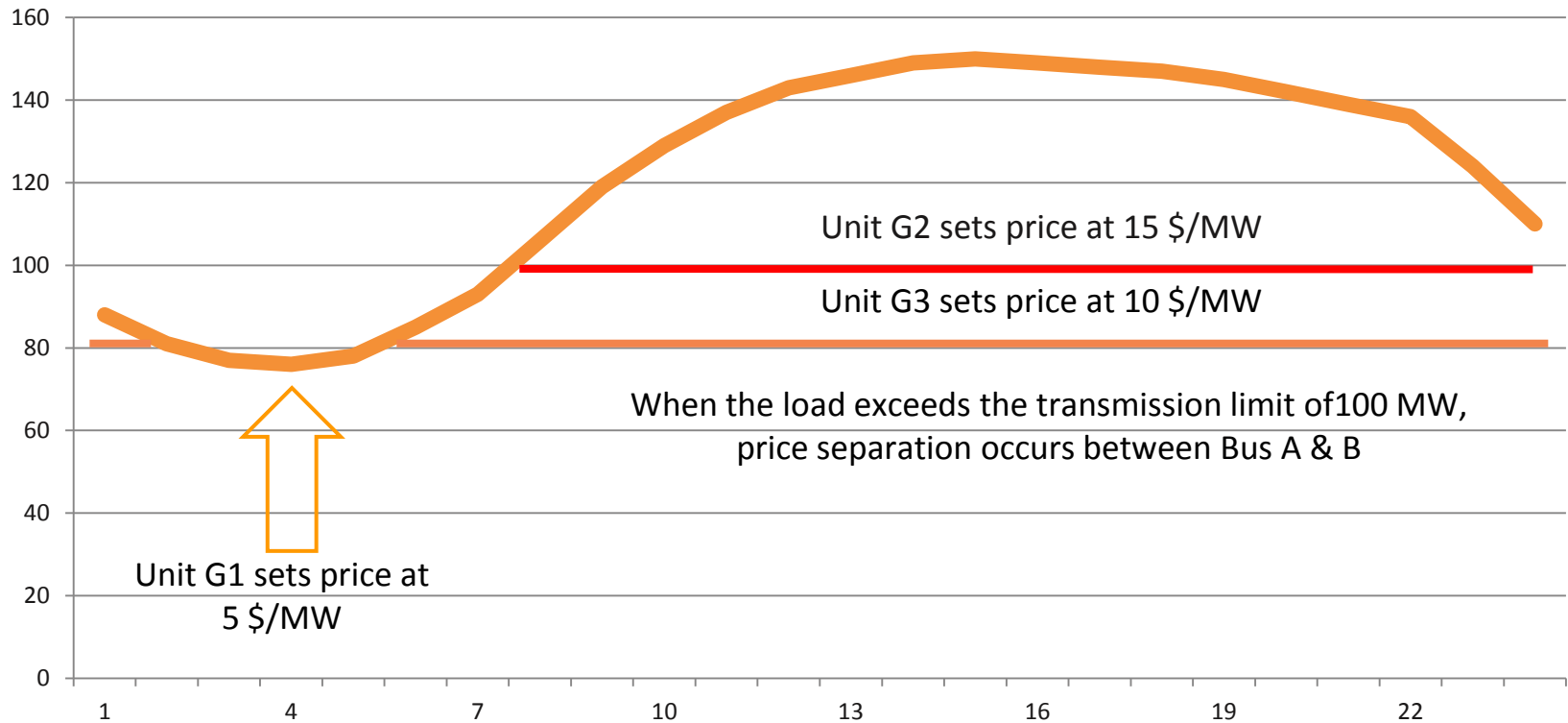


# Day-Ahead 2 Bus Dispatch Example



What price would  $LMP_A$  and  $LMP_B$  be if load were less than 100 MW?

# Daily Load Profile for a Peak Summer Day



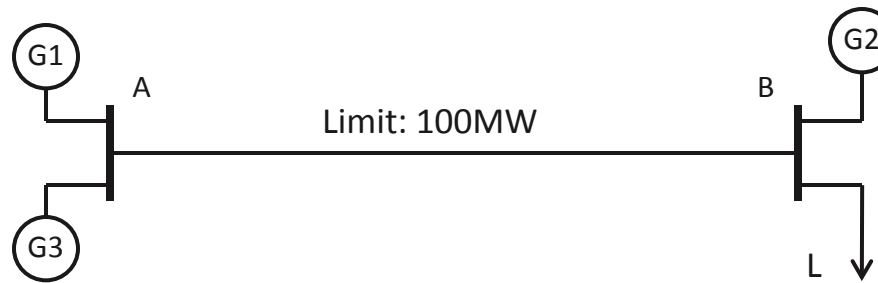
See Appendix A on the last slide for hourly detail.

# Day-Ahead 2 Bus

## Peak Day Settlement

Paid \$17,955 for 1,911 MWh

Paid \$9,285 for 619 MWh

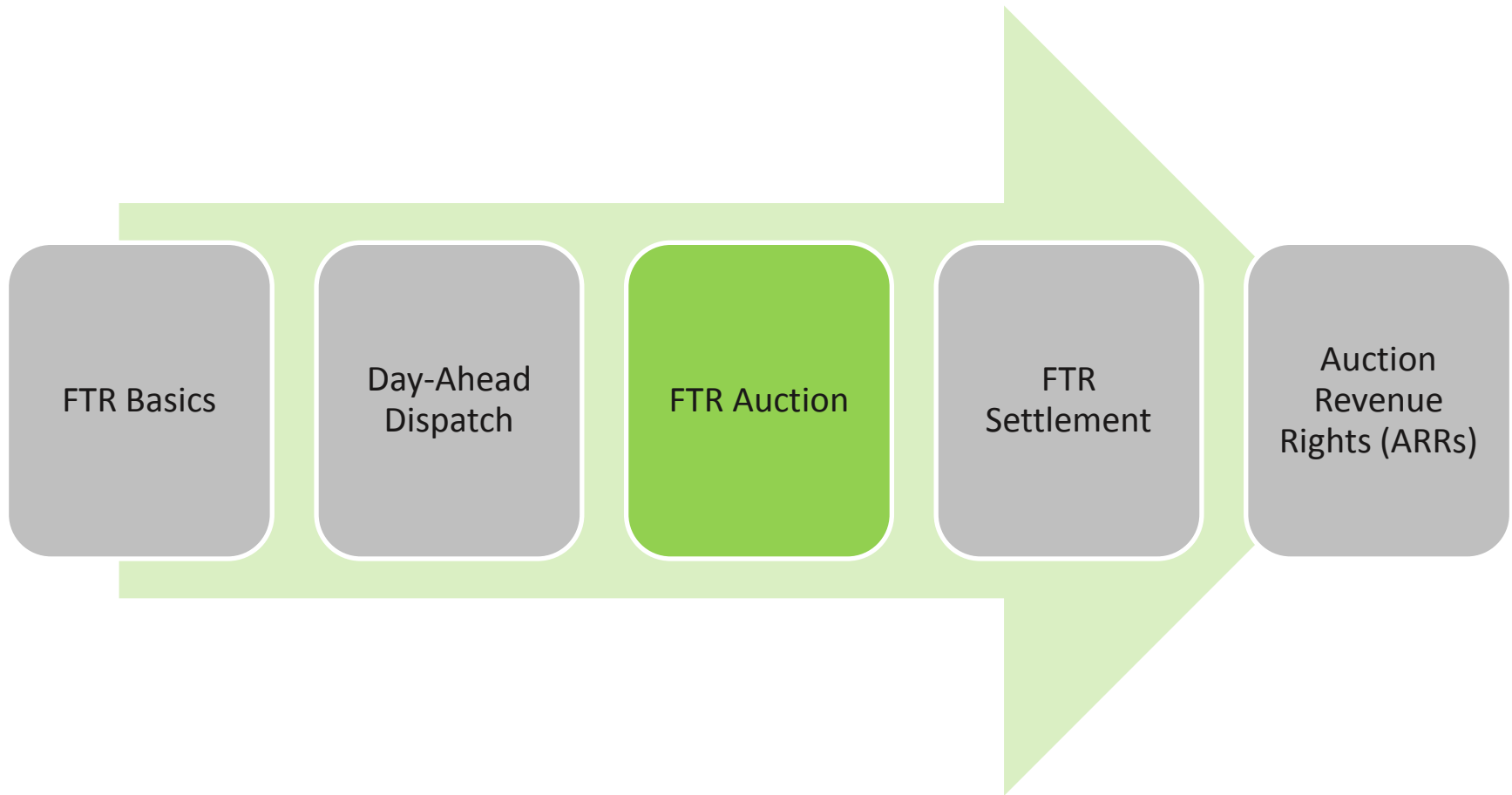


Paid \$3,670 for 367 MWh

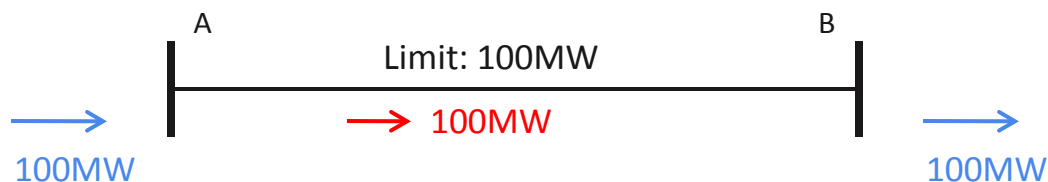
Pays \$39,410 for 2,897 MWh

Congestion Revenue Fund receives \$8,500 from difference between what Load pays and what the Generators are paid.

The Congestion Revenue Fund pays FTR Holders.



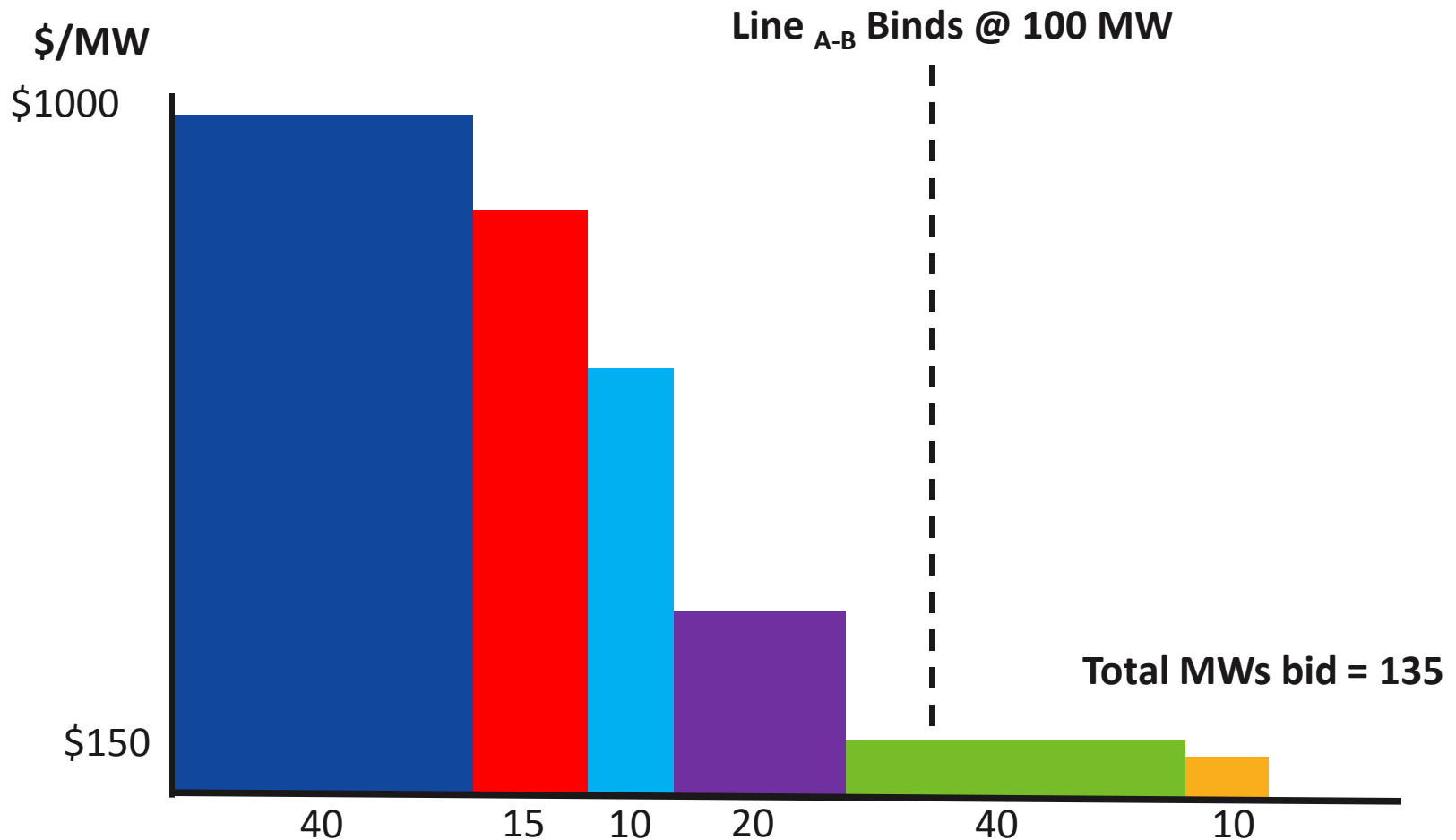
# FTR 2 Bus Auction Example



Bid #1	FTR <sub>A-B</sub>	40MW @ 1000 \$/MW	( <u>40 MW clears</u> )
Bid #2	FTR <sub>A-B</sub>	15MW @ 750 \$/MW	( <u>15 MW clears</u> )
Bid #3	FTR <sub>A-B</sub>	10MW @ 600 \$/MW	( <u>10 MW clears</u> )
Bid #4	FTR <sub>A-B</sub>	20MW @ 400 \$/MW	( <u>20 MW clears</u> )
Bid #5	FTR <sub>A-B</sub>	40MW @ 150 \$/MW	( <u>marginal 15 MW clears</u> )
Bid #6	FTR <sub>A-B</sub>	10MW @ 120 \$/MW	( <u>none clear</u> )

What is the path clearing price?

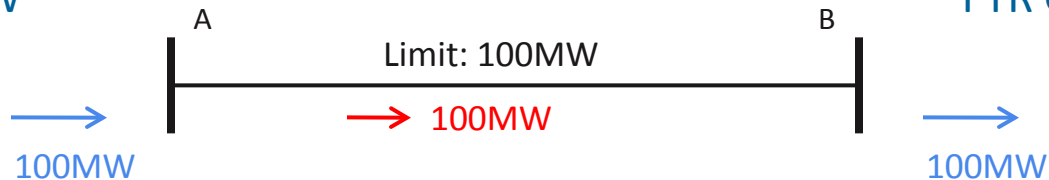
# Bid Selection and Binding Constraint



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

# FTR 2 Bus Auction Clearing

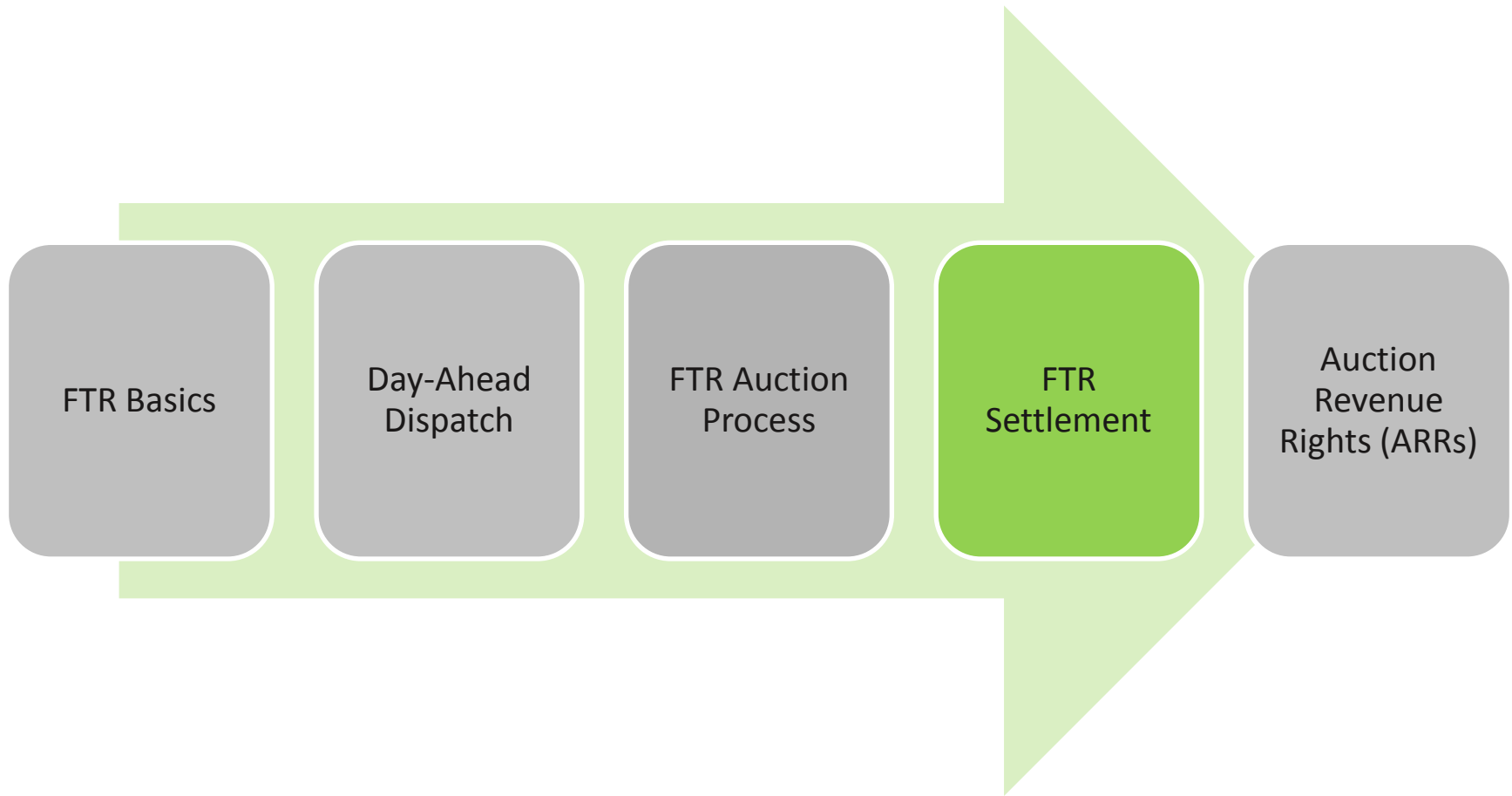
FTR  $CP_A = 0 \text{ \$/MW}$



FTR  $CP_B = 150 \text{ \$/MW}$

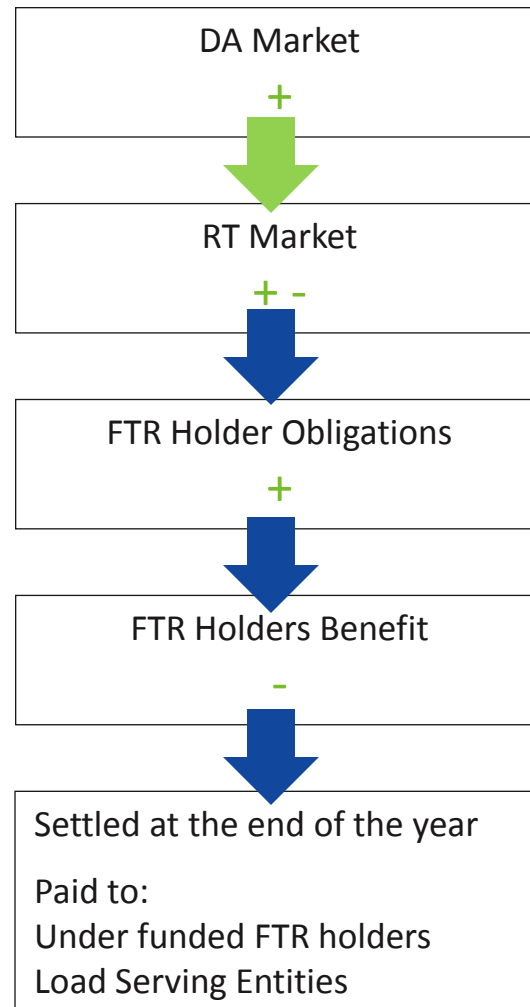
Bids	Source	Sink	Bid MW	Bid $\text{\$/MW}$	Cleared MW	Cleared $\text{\$/MW}$	Auction Revenue
1	Bus A	Bus B	40	1,000	40	150	6,000
2	Bus A	Bus B	15	750	15	150	2,250
3	Bus A	Bus B	10	600	10	150	1,500
4	Bus A	Bus B	20	400	20	150	3,000
5	Bus A	Bus B	40	150	15	150	2,250
6	Bus A	Bus B	10	120	0	150	0
					100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

Auction Revenue from FTR Awards are paid to QUAs and ARR Holders



# Congestion Revenue

## FTR Holders / Congestion Revenue Fund



# Monthly FTR Settlement

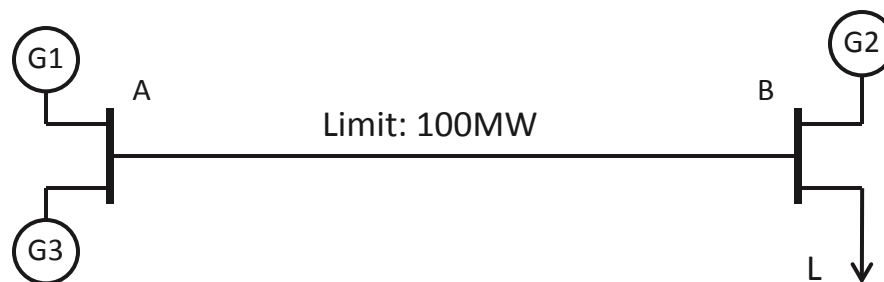
## Daily Summary Report

Beginning Balance CR Fund (BBCRF) =		\$0.00				
Day	Day Ahead CR (DACR)	Real Time CR (RTCR)	Negative Target Allocation (NTA)	DACR+RTCR+abs(NTA)+BBCRF	Positive Target Allocation (PTA)	CR Fund Balance
01-Jul	\$ 2,541,805.12	\$ 19,452.01	\$ (1,025,588.85)	\$ 3,586,845.98	\$ 2,984,860.72	\$ 601,985.26
02-Jul	\$ 1,079,449.07	\$ (2,204.87)	\$ (548,722.72)	\$ 1,625,966.92	\$ 1,177,522.35	\$ 448,444.57
03-Jul	\$ 329,598.88	\$ (1,349.01)	\$ (116,564.82)	\$ 444,814.69	\$ 297,542.73	\$ 147,271.96
04-Jul	\$ 4,249.93	\$ -	\$ (8,506.38)	\$ 12,756.31	\$ 10,190.36	\$ 2,565.95
05-Jul	\$ 11,387.21	\$ -	\$ (79,968.93)	\$ 91,356.14	\$ 53,314.27	\$ 38,041.87
06-Jul	\$ 7,737.11	\$ -	\$ (10,621.82)	\$ 18,358.93	\$ 17,759.63	\$ 599.30
07-Jul	\$ 584,378.12	\$ (27,783.32)	\$ (308,848.87)	\$ 865,443.67	\$ 668,548.04	\$ 196,895.63
08-Jul	\$ 1,011,717.72	\$ (16,717.40)	\$ (545,846.29)	\$ 1,540,846.61	\$ 1,300,106.75	\$ 240,739.86
09-Jul	\$ 1,110,764.47	\$ (2,478.27)	\$ (414,937.81)	\$ 1,523,224.01	\$ 1,034,205.24	\$ 489,018.77
10-Jul	\$ 920,704.39	\$ 17,394.02	\$ (565,236.37)	\$ 1,503,334.78	\$ 1,352,519.98	\$ 150,814.80
11-Jul	\$ 535,061.63	\$ 6,070.34	\$ (289,052.90)	\$ 830,184.87	\$ 693,387.81	\$ 136,797.06
12-Jul	\$ 34,962.65	\$ -	\$ (167,887.34)	\$ 202,849.99	\$ 125,843.09	\$ 77,006.90
13-Jul	\$ 61,172.75	\$ -	\$ (54,555.47)	\$ 115,728.22	\$ 78,827.44	\$ 36,900.78
14-Jul	\$ 566,776.01	\$ 5,118.69	\$ (238,235.78)	\$ 810,130.48	\$ 578,651.16	\$ 231,479.32
15-Jul	\$ 660,273.16	\$ 9,633.86	\$ (303,842.44)	\$ 973,749.46	\$ 825,251.29	\$ 148,498.17
16-Jul	\$ 520,583.30	\$ 261.66	\$ (221,861.70)	\$ 742,706.66	\$ 554,041.86	\$ 188,664.80
17-Jul	\$ 809,378.16	\$ (1,174.61)	\$ (384,529.48)	\$ 1,192,733.03	\$ 868,427.90	\$ 324,305.13
18-Jul	\$ 1,158,193.23	\$ 21,304.25	\$ (268,831.67)	\$ 1,448,329.15	\$ 1,011,668.98	\$ 436,660.17
19-Jul	\$ 1,465,861.87	\$ 2,169.67	\$ (534,100.05)	\$ 2,002,131.59	\$ 1,442,589.67	\$ 559,541.92
20-Jul	\$ 617,820.37	\$ 6,773.32	\$ (75,825.99)	\$ 700,419.68	\$ 411,974.74	\$ 288,444.94
21-Jul	\$ 1,139,916.53	\$ (38,902.67)	\$ (210,776.05)	\$ 1,311,789.91	\$ 928,739.08	\$ 383,050.83
22-Jul	\$ 951,342.73	\$ 21,431.02	\$ (318,311.92)	\$ 1,291,085.67	\$ 1,026,796.91	\$ 264,288.76
23-Jul	\$ 414,959.89	\$ -	\$ (200,884.16)	\$ 615,844.05	\$ 477,144.24	\$ 138,699.81
24-Jul	\$ 130,349.33	\$ (81.73)	\$ (52,350.38)	\$ 182,617.98	\$ 107,966.82	\$ 74,651.16
25-Jul	\$ 234,890.88	\$ -	\$ (278,110.91)	\$ 513,001.79	\$ 326,377.11	\$ 186,624.68
26-Jul	\$ 355,076.78	\$ (27,058.66)	\$ (40,524.39)	\$ 368,542.51	\$ 205,547.25	\$ 162,995.26
27-Jul	\$ 151,719.94	\$ -	\$ (14,222.81)	\$ 165,942.75	\$ 81,258.09	\$ 84,684.66
28-Jul	\$ 230,593.46	\$ (4,002.96)	\$ (133,748.16)	\$ 360,338.66	\$ 272,423.36	\$ 87,915.30
29-Jul	\$ 187,410.38	\$ 7,170.61	\$ (70,382.72)	\$ 264,963.71	\$ 164,176.25	\$ 100,787.46
30-Jul	\$ 535,576.20	\$ 20,699.03	\$ (279,374.10)	\$ 835,649.33	\$ 635,895.59	\$ 199,753.74
31-Jul	\$ 502,124.28	\$ (65,930.34)	\$ (244,526.01)	\$ 680,719.95	\$ 537,908.38	\$ 142,811.57
<b>Totals</b>	<b>\$ 18,865,835.55</b>	<b>\$ (50,205.36)</b>	<b>\$ (8,006,777.29)</b>	<b>\$ 26,822,407.48</b>	<b>\$ 20,251,467.09</b>	<b>\$ 6,570,940.39</b>

**Notes:** (1) Information for an operating day is only available when both the DA and RT Reports have been distributed.  
(2) This data is provisional and subject to verification. No liability for errors.

[Home > Markets > Other Markets Data > Congestion Revenue Summary](#)

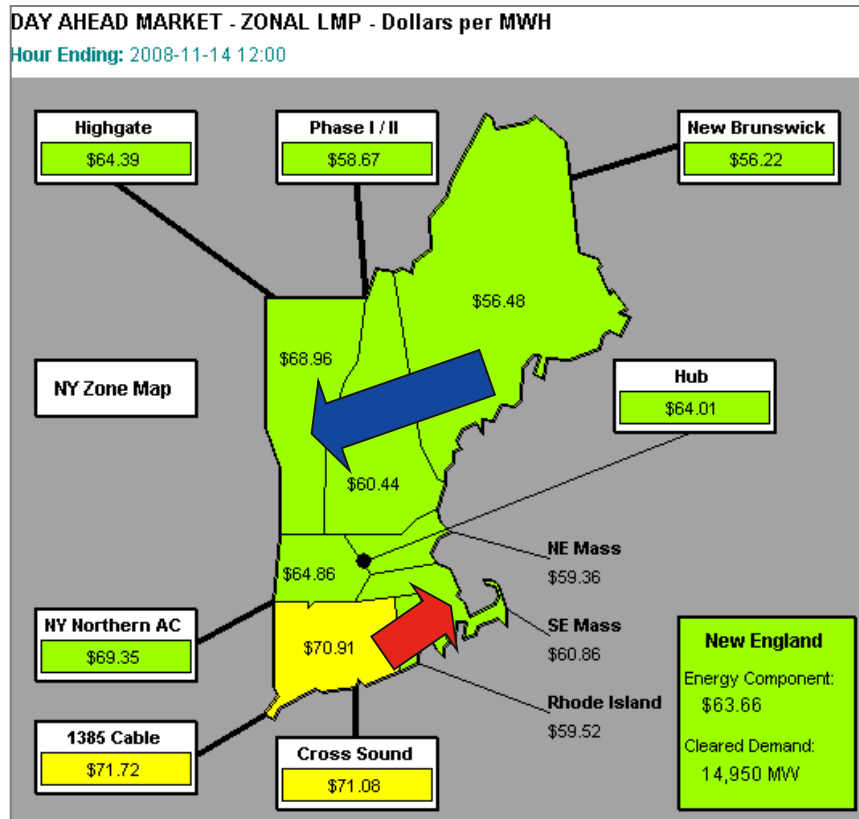
# FTR Settlement of Peak Day in Day-Ahead Market



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	17	40	3,400
2	Bus A	Bus B	10	15	5	17	15	1,275
3	Bus A	Bus B	10	15	5	17	10	850
4	Bus A	Bus B	10	15	5	17	20	1,700
5	Bus A	Bus B	10	15	5	17	15	1,275
							100	<b>8,500</b>

These FTRs are fully funded as the Congestion Revenue Fund from the Day-Ahead Market settlement exactly matches FTR Holders congestion revenue requirements.

# FTR Benefit or Liability



	LMP Components			LMP
	Energy	Congestion	Losses	
Maine	63.66	-3.84	-3.34	56.48
New Hampshire	63.66	-2.19	-1.03	60.44
Vermont	63.66	4.52	0.78	68.96
SE Mass	63.66	-2.33	-0.47	60.86
Rhode Island	63.66	-3.82	-0.32	59.52
Connecticut	63.66	5.44	1.81	70.91
Internal Hub	63.66	0.27	0.08	64.01

## Congestion Benefit

Sink Price - Source Price = Positive Value

$$FTR_{ME-VT} = FTR_{VT} - FTR_{ME}$$

$$= \$4.52/MW - (-\$3.84/MW) = \$8.36/MW$$

## Congestion Liability

Sink Price - Source Price = Negative Value

$$FTR_{CT-SE\ Mass} = FTR_{SE\ Mass} - FTR_{CT}$$

$$= -\$2.33/MW - \$5.44/MW = -\$7.77/MW$$

# Valuation of FTRs in Day-Ahead Market

- Determine the Path Price of the following FTRs:

Path for  $FTR_{NH-CT}$  is from NH (source) to CT (sink).

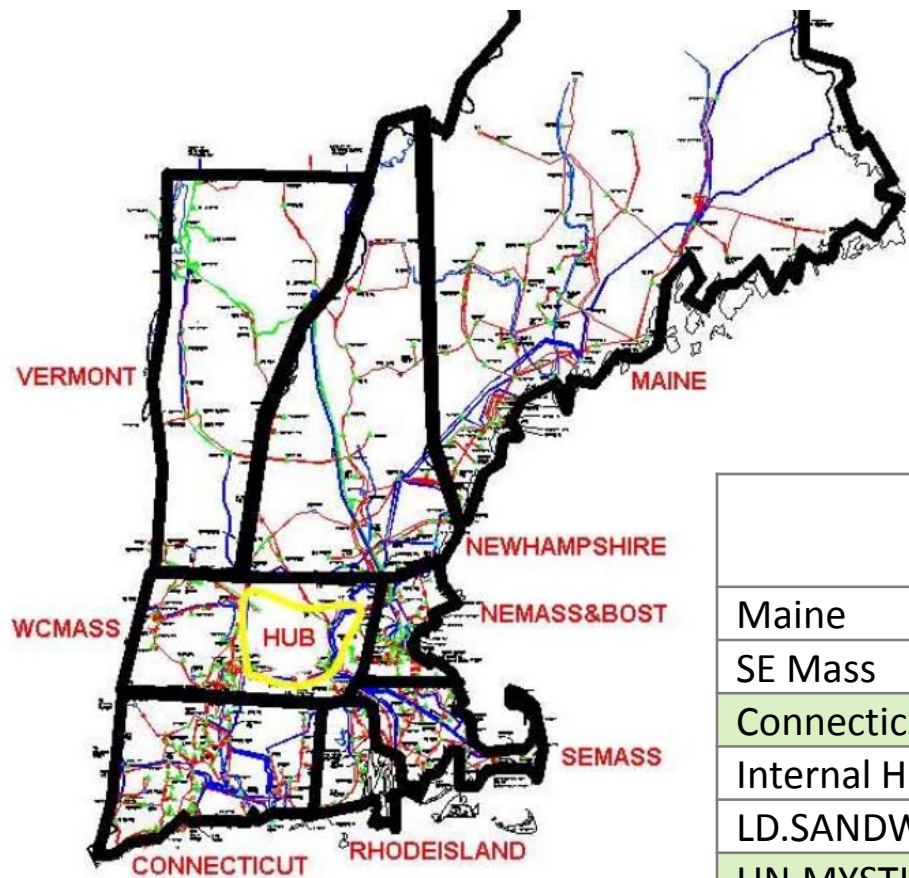
$$FTR_{NH-CT} = \underline{5.44} - \underline{-2.19} = \$7.63/\text{MW}$$

$$FTR_{RI-HUB} = \underline{0.27} - \underline{-3.82} = \$4.09/\text{MW}$$

- Determine the Hedge Provided by 10 MW of this FTR:

$$FTR_{HUB-CT} = (\$ 5.44 / \text{MW} - \$ 0.27 / \text{MW}) \times 10 \text{ MW} = \$ 51.70$$

# FTR Auction Clearing Prices



	FTR Auction Clearing Prices	
	On Peak Period	Off Peak Period
Maine	-60.01	93.12
SE Mass	367.37	115.3
Connecticut	575.56	80.82
Internal Hub	31.4	-0.38
LD.SANDWICH115	1280.11	398.28
UN.MYSTIC 18.1MYS8	-1.51	-1.7

# FTR Auction Clearing Exercise

- Determine the Path Clearing Price of the following FTRs:

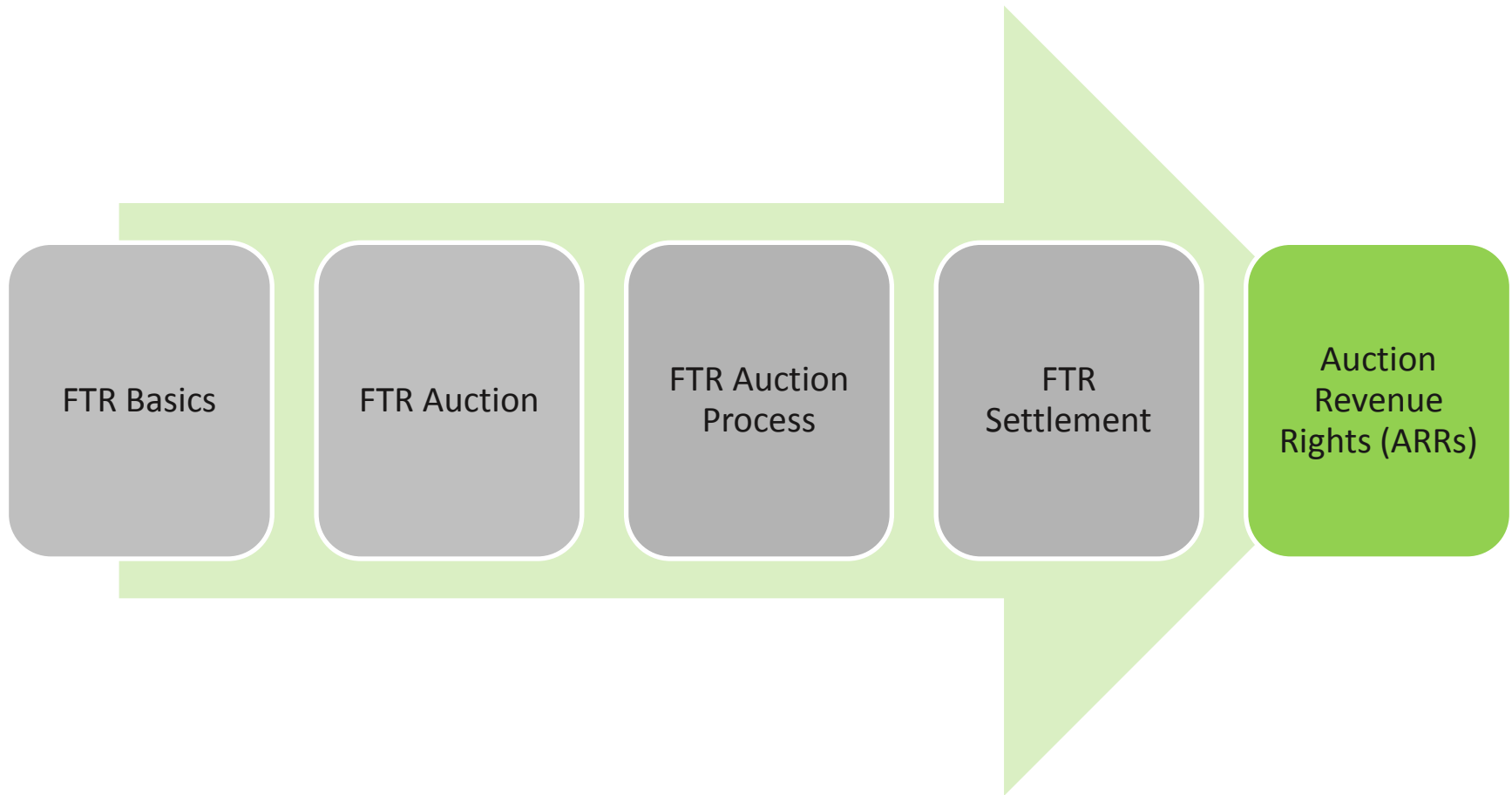
$$\text{On Peak FTR}_{\text{Mystic 8 - Connecticut}} = \underline{575.56} - \underline{-1.51} = \$577.07/\text{MW}$$

$$\text{Off Peak FTR}_{\text{HUB - Southeastern Massachusetts}} = \underline{115.3} - \underline{-0.38} = \$115.68/\text{MW}$$

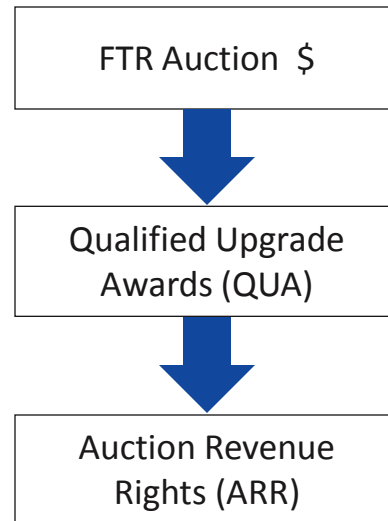
- Determine the Price of a 10 MW Award for this FTR:

$$\text{On Peak FTR}_{\text{Maine - Sandwich}} = (1280.11 - -60.01) \times 10 = \$ 13,401.20$$

Note: Path for FTR<sub>Maine - Sandwich</sub> is from Maine (source) to Sandwich (sink).



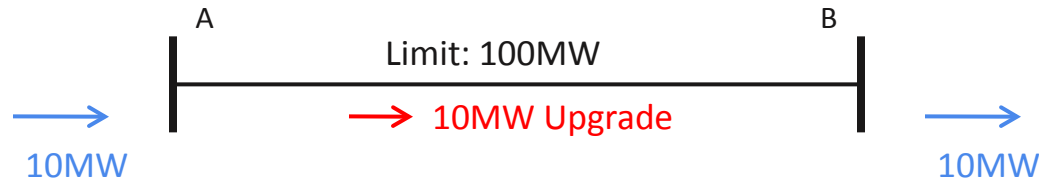
# Auction Revenues



# Qualified Upgrade Awards (QUAs)

- Qualified Upgrade Awards (QUAs)
  - New transmission upgrades that increase transfer capability
  - “New” upgrades placed in-service as of March 1, 1997
  - Additional FTRs possible due to upgrade
  - Award according to increased Auction Revenue and cost responsibility

# QUA Holder Allocation of ARR



- QUAs are paid the value of FTRs cleared due to upgrade.
  - Auction is rerun to determine the value of upgrades
  - Awarded in proportion to cost responsibility

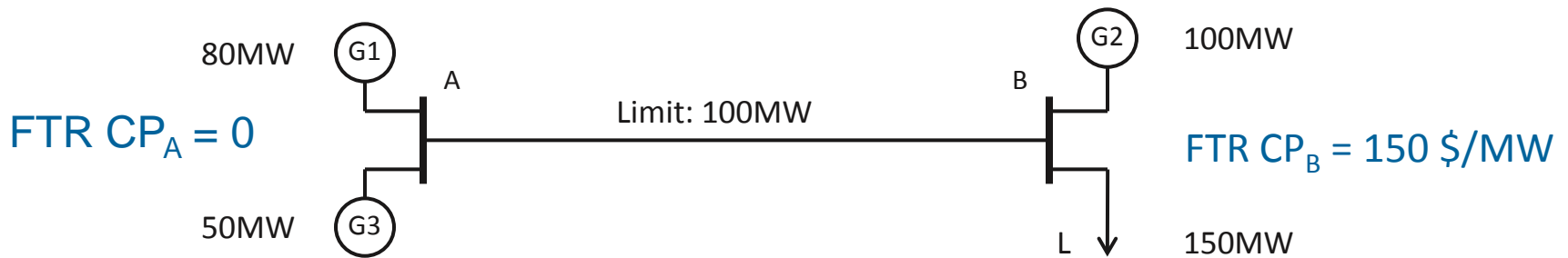
	FTR MW	FTR CP \$/MW	Funding Level	\$
QUA-A	10	150	100%	1,500

After QUA Holders receive their share the balance of FTR Auction Revenues are distributed to ARR Holders.

# Auction Revenue Rights (ARR)

- “ARRs are rights to receive FTR Auction Revenues from the sale of FTRs other than FTRs sold by FTR Holders”
- Four-Stage Process Allocates ARR (in MW)
  - Load ratio share of all internal and external sources
  - Special treatment of certain contracts
    - Excepted Transactions and NEMA Contracts
  - Resulting ARR are “simultaneously feasible”
- ARR allocation consistent with “congestion” as determined by the FTR Auction

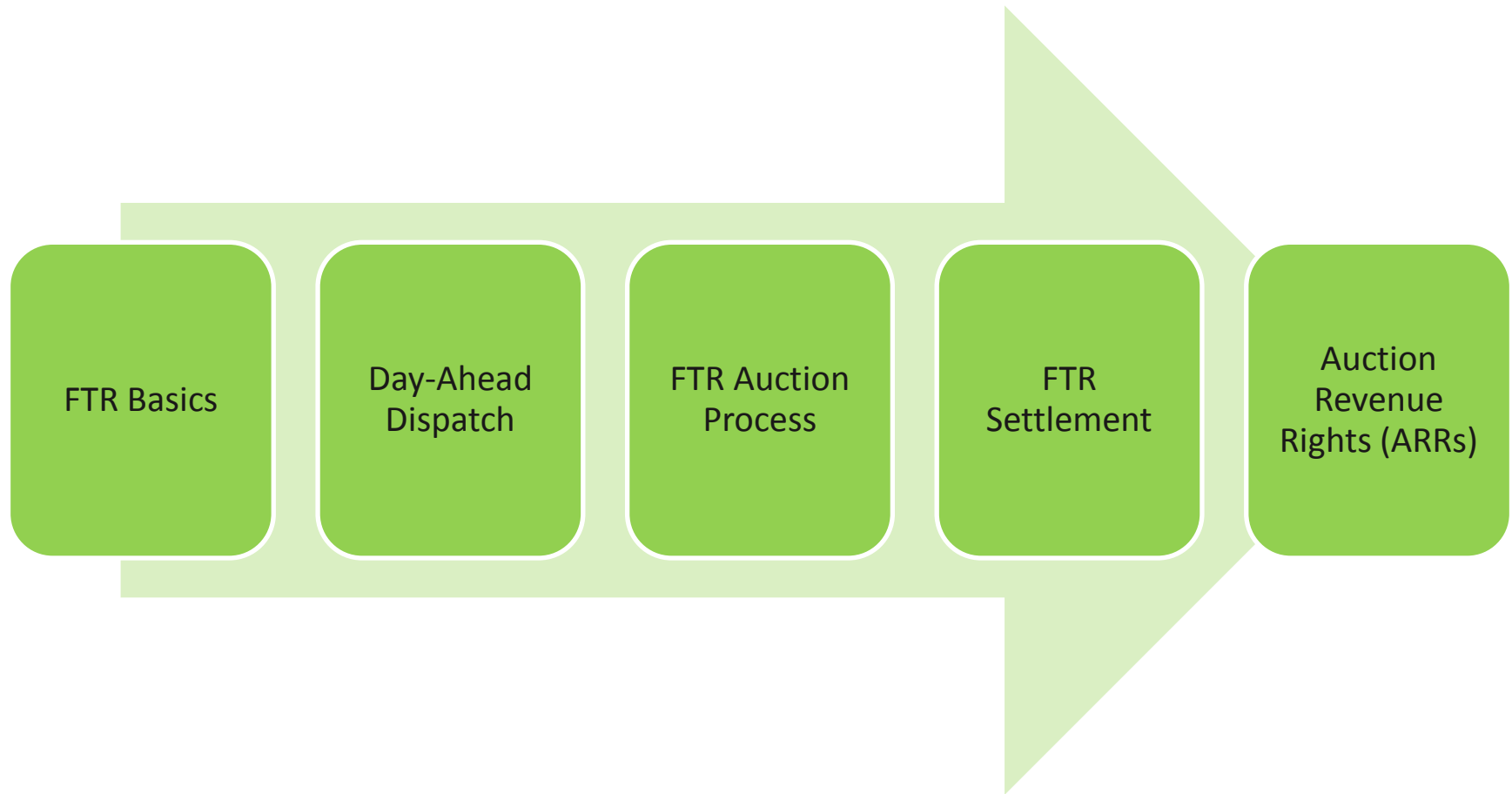
# ARR Allocation

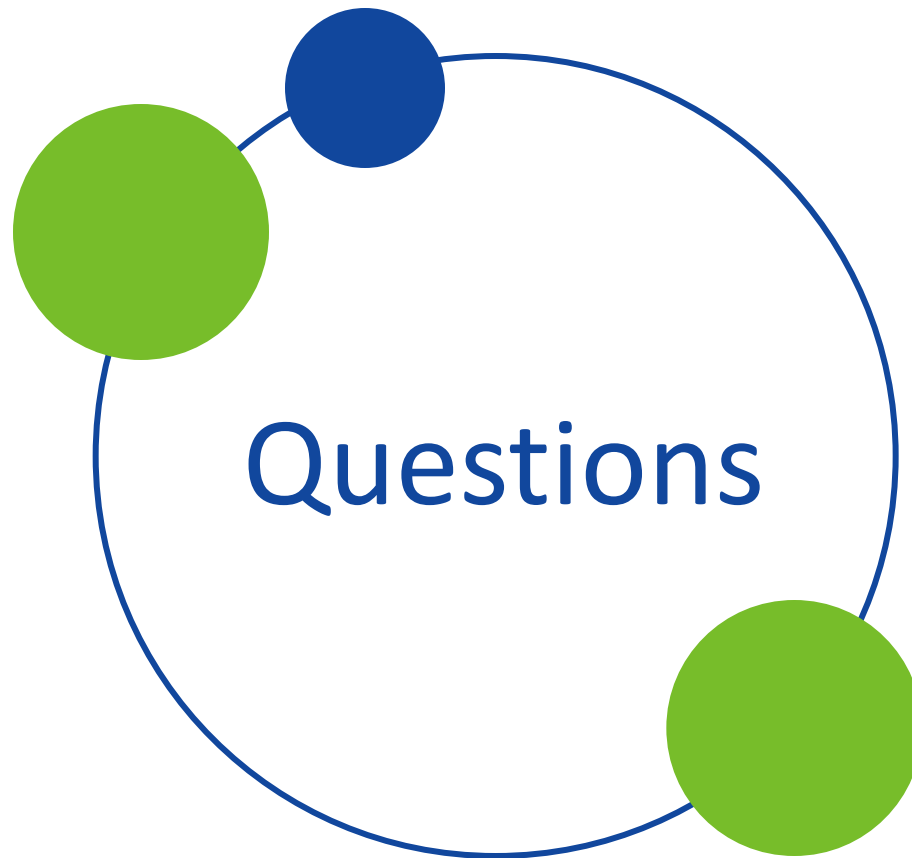


	Peak Load MW	Load Zone Allocator %	\$
LSE-A	10	6.67%	900
LSE-B	20	13.33%	1,800
LSE-C	30	20.00%	2,700
LSE-D	40	26.67%	3,600
LSE-E	50	33.33%	4,500
	150	100.00%	13,500

ARR Allocation distributes FTR Auction Revenues to Congestion Paying Load Serving Entities

# Module Review: Topics Covered







# Appendix A - Hourly Day-Ahead 2 Bus Dispatch

Hour Ending	Hourly Loads MWh	G1 80MW 5 \$/MW	G2 100MW 15 \$/MW	G3 50MW 10 \$/MW	Total Gen	Line A-B MW	LMP-A \$/MW	LMP-B \$/MW	G1 on Bus A	G2 on Bus B	G3 on Bus A	Load on Bus B
1	88	80	0	8	88	88	10	10	\$800	\$0	\$80	\$880
2	81	80	0	1	81	81	10	10	\$800	\$0	\$10	\$810
3	77	77	0	0	77	77	5	5	\$385	\$0	\$0	\$385
4	76	76	0	0	76	76	5	5	\$380	\$0	\$0	\$380
5	78	78	0	0	78	78	5	5	\$390	\$0	\$0	\$390
6	85	80	0	5	85	85	10	10	\$800	\$0	\$50	\$850
7	93	80	0	13	93	93	10	10	\$800	\$0	\$130	\$930
8	106	80	6	20	106	100	10	15	\$800	\$90	\$200	\$1,590
9	119	80	19	20	119	100	10	15	\$800	\$285	\$200	\$1,785
10	129	80	29	20	129	100	10	15	\$800	\$435	\$200	\$1,935
11	137	80	37	20	137	100	10	15	\$800	\$555	\$200	\$2,055
12	143	80	43	20	143	100	10	15	\$800	\$645	\$200	\$2,145
13	146	80	46	20	146	100	10	15	\$800	\$690	\$200	\$2,190
14	149	80	49	20	149	100	10	15	\$800	\$735	\$200	\$2,235
15	150	80	50	20	150	100	10	15	\$800	\$750	\$200	\$2,250
16	149	80	49	20	149	100	10	15	\$800	\$735	\$200	\$2,235
17	148	80	48	20	148	100	10	15	\$800	\$720	\$200	\$2,220
18	147	80	47	20	147	100	10	15	\$800	\$705	\$200	\$2,205
19	145	80	45	20	145	100	10	15	\$800	\$675	\$200	\$2,175
20	142	80	42	20	142	100	10	15	\$800	\$630	\$200	\$2,130
21	139	80	39	20	139	100	10	15	\$800	\$585	\$200	\$2,085
22	136	80	36	20	136	100	10	15	\$800	\$540	\$200	\$2,040
23	124	80	24	20	124	100	10	15	\$800	\$360	\$200	\$1,860
24	110	80	10	20	110	100	10	15	\$800	\$150	\$200	\$1,650
	2,897	1,911	619	367	2,897				\$17,955	\$9,285	\$3,670	\$39,410

Note price separation between  $LMP_A$  and  $LMP_B$  when Line  $A-B$  binds.