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Underfunding In PJM
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Andrew Hartshorn Senior Director, Head of Trading

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PJM Has The Best Auction Structure

PJM has the best FTR auction structure of all the ISOs:

1. Liquid long term auction going out three full years with multiple rounds
2. Annual auction with multiple rounds
3. Monthly auctions that allow balance of planning year reconfiguration

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Underfunding - Major Concern

Underfunding has been a constant issue and at times a major problem:

1. Market to market concerns with MISO
2. Transmission outage modeling in annual and monthly auctions
3. Shortfalls created by infeasible stage 1 ARRs causing lines to be modeled with increased limits in the annual auction
4. RT congestion shortfalls being included in the DA FTR settlement account – this should be fixed – we should resolve the real problem not argue about allocating the cost a different way.

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Underfunding Cost Allocation

A recent suggestion to use the sum of the absolute revenues of each market participants FTR revenues to allocate underfunding would be particularly problematic for auction liquidity and is not consistent with the principles of underfunding:

1. An MP with net $0 revenue in the FTR has no impact on underfunding. They are paying into the congestion balancing account the same amount as they are withdrawing
   - Money is collected from day-ahead schedules for generation, load, imports, exports, virtual transactions and UTCs
   - Money is also collected from entities with counterflow FTRs. Each MW of counterflow fully funds any additional flow in the positive direction on any interface, at any time.
   - The presence of counterflow does not change the magnitude of the underfunding. The underfunding is a function of the magnitude of the DAM transfer capability derate.

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Underfunding Cost Allocation (cont'd)

2. The ability to offset flows on constraints you do not want exposure to is a critical part of the auction functionality
   - In tightly interconnected grids like PJMs it is very difficult to get long a particular congestion without getting short other congestion
   - A second FTR can be purchased to offset the short risk
   - If the absolute value formulation for underfunding is used the risk cannot be neutralized because you will be exposed to both the long and short underfunding risk on a path you have no net flow on
   - The more explosive the congestion potential, the more you want to cover it and the more the absolute value underfunding rule makes it impossible to do so.
   - Using the absolute value will not only affect liquidity on the counterflow path but also all interfaces that cannot be purchased without associated short congestion risk

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Underfunding Cost Allocation (cont'd)

3. The existing rule targets positive revenues on underfunded paths
   - Underfunding tends to occur on paths where DAM transfer capability is reduced relative to the amount auctioned
   - Those MPs that provide counterflow on these paths have already been penalized by the fact that the interface was derated in the DAM and that the congestion rents that they need to pay in the DAM are higher than they would have been but for the Interface X derate.
   - Each MW of counterflow fully funds any additional flow in the positive direction. The counterflow should not also have to pay for underfunding.
   - The net revenue formulation currently used places a higher share of the underfunding responsibility on FTRs that are long the underfunded constraint

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Underfunding Cost Allocation (cont'd)

4. Allocating underfunding based on the absolute value of revenues will impact liquidity
   - Assume the expected underfunding is 10%. If underfunding is allocated based on absolute revenue, then a perfectly efficient market would yield a 20% bid-ask spread

     —90% @ 110%
   - If underfunding is based on net revenue, the bid-ask spread is halved to

     —90% @ 100%
   - The more important the constraint, i.e. the higher the inherent cost of congestion the bigger the liquidity impact
   - Due to the high level of connectivity of the grid, paths targeting a specific congestion will have exposure to untargeted congestions. If those paths pick up both long and short underfunding exposure then liquidity will be negatively impacted

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Case 1

Case 1: No Counterflow in Auction

Interface X is Binding in auction	100	MW net FTRs Awarded
MP A	40	MW FTRs Awarded
MP B	60	MW FTRs Awarded

DAM Outcome: Interface X is derated by 30 MW

Interface X is Binding in DAM	70	MW of transfer capability available
Shadow price of constraint	$10	Congestion differential across interface
Congestion Rents Collected	$700	Assumes a closed interface
MP A Settlement	$400	40 MW * $10
MP B Settlement	$600	60 MW * $10
	$1,000	FTRs will be 30% underfunded ($300/$1000)

Case 1: Settlement	MP A settlement with Underfunding	MP B settlement with Underfunding	Total Payout
Raw Payout	$400	$600	$1,000
Underfunding Charge	$120	$180	$300
Net Payout	$280	$420	$700

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Case 1 Notes

- 100 MW closed interface is binding in the auction
- 30% derate on the interface in the DAM
- Constraint binds with a cost of $10 in the DAM
- $700 of congestion rents are collected in the DAM settlement
- $1000 of FTR settlements would be paid out if the FTRs were fully funded
- $300 of underfunding is collected from MP A and MP B so that the net FTR payout matches the congestion rents collected

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Case 2

Case 2: Some Counterflow

Interface X is Binding in auction	100	MW net FTRs Awarded
MP A	40	MW FTRs Awarded
MP B	60	MW FTRs Awarded
MP C	10	MW FTRs Awarded
MP D	-10	MW FTRs Awarded - Counterflow

DAM Outcome: Interface X is derated by 30 MW

Interface X is Binding in DAM	70	MW of transfer capability available
Shadow price of constraint	$10	Congestion differential across interface
Congestion Rents Collected	$700	Assumes a closed interface
MP A Settlement	$400	40 MW * $10
MP B Settlement	$600	60 MW * $10
MP C Settlement	$100	60 MW * $10
MP D Settlement	($100)	60 MW * $10
	$1,000	FTRs in aggregate will still be 30% underfunded ($300/$1000)

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Case 2 Notes

- Same 100 MW closed interface is binding in the auction
- Same 30% derate on the interface in the DAM
- 10 MW of counterflow FTRs allow an additional 10 MW of positive FTRs to be awarded in the auction
- No change to the DAM outcome
- Constraint binds with a cost of $10 in the DAM
- $700 of congestion rents are collected in the DAM settlement
- $1000 of FTR settlements would be paid out if the FTRs were fully funded
- **Importantly: The presence of counterflow FTRs make no difference to the magnitude of the congestion rents collected ($700) or the congestion rents that should be paid out ($1000)**

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Case 2 Notes

- The same $300 of underfunding need to be collected from the FTR holders. ***No additional underfunding is created by the counterflow FTRs so there is no cost causation linkage to suggest that counterflow FTRs should pay for underfunding.*** They already provide more than sufficient congestion rents to pay for any additional positive flow FTRs that are awarded. They do not get a discount on revenues they pay when underfunding occurs.
- It is also reasonable to argue that the counterflow FTRs have already been penalized by the fact that the interface was derated in the DAM and that the congestion rents that they need to pay in the DAM are higher than they would have been but for the Interface X derate.

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Case 2 Settlements Compared

Raw FTR Settlement	Net Revenue	Abs(Revenue)	Net Positive Revenue
MP A Settlement	$400	$400	$400
MP B Settlement	$600	$600	$600
MP C Settlement	$100	$100	$100
MP D Settlement	($100)	$100	$0
	$1,000	$1,200	$1,100

Case 1: Settlement	MP A settlement with Underfunding	MP B settlement with Underfunding	Total Payout
Raw Payout	$400	$600	$1,000
Underfunding Charge	$120	$180	$300
Net Payout	$280	$420	$700
Effective Payout	70%	70%	70%

Case 2: Absolute Revenue	MP A settlement with Underfunding	MP B settlement with Underfunding	MP C settlement with Underfunding	MP D settlement with Underfunding	Total Payout
Raw Payout	$400	$600	$100	($100)	$1,000
Underfunding Charge	$100	$150	$25	$25	$300
Net Payout	$300	$450	$75	($125)	$700
Effective Payout	75%	75%	75%	125%	70%

Case 2: Net Revenue	MP A settlement with Underfunding	MP B settlement with Underfunding	MP C settlement with Underfunding	MP D settlement with Underfunding	Total Payout
Raw Payout	$400	$600	$100	($100)	$1,000
Underfunding Charge	$109.09	$163.64	$27.27	$0	$300
Net Payout	$290.91	$436.36	$72.73	($100)	$700
Effective Payout	73%	73%	73%	100%	70%

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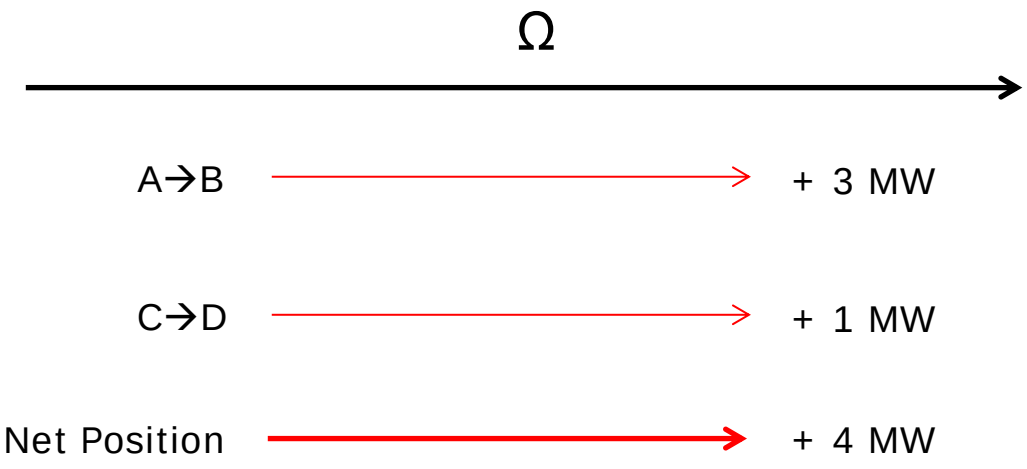
Case 2 Settlement Notes

- The Case 1 settlement shows an effective payout of 70% for positive flow FTRs
- The Absolute revenue rule shows a 75% effective payout for positive flow FTRs but it does so on the back of a 125% charge to the counterflow FTRs. This only works so long as the counterflow FTR stays in the market after the rule change.
- ***The existing settlement rule which allocates based on net positive FTR revenues shows that the presence of counterflow transactions increases the effective payout from 70% in Case 1 up to 73% in Case 2.*** The effective payout increases because the counterflow continues to pays 100% of the actual cost of the congestion. The money collected from the counterflow is more than enough to cover the effective payout to the same number of positive flow FTRs. ($100 is collected from MP D's 10 MW of counterflow and only $73 is paid out to MP C's 10 MW of positive flow FTRs increasing the effective payout to MP A and B relative to Case 1)
- If liquidity falls and the counterflow is not present the example would revert back to Case 1 70% effective payout

Case 3: Equitable Allocation: Red Entity

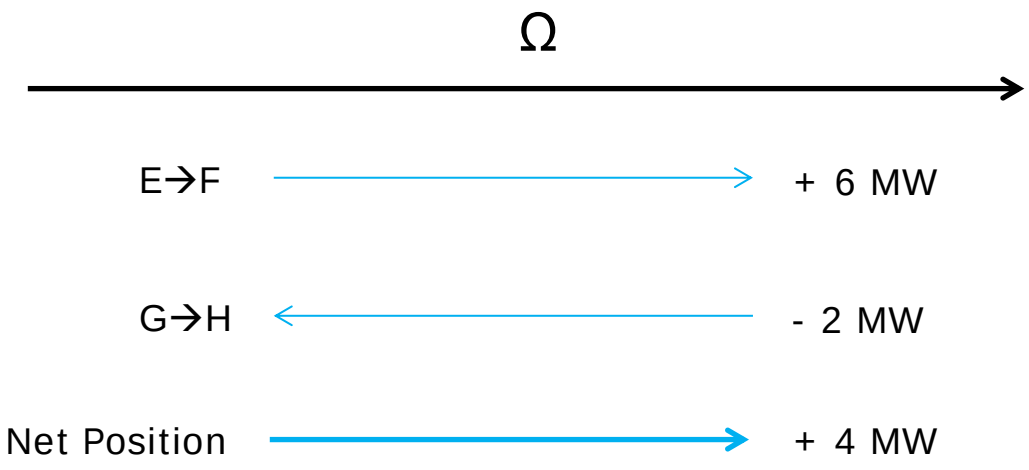
- Consider a market with two participants: Red and Blue
- Suppose the system has 8 settlement locations,

  {A, B, C, D, E, F, G},
- and a single flowgate, Ω,with a specified from and to direction.
- Assume Entity Red owns a 10 MW path from A→B with a 0.3 shift factor on Ω.
- In addition, assume entity Red owns a 10 MW path from C→D with a 0.1 shift factor on Ω.



Case 3: Equitable Allocation: Blue Entity

- Assume Entity Blue owns a 20 MW path from E→F with a 0.3 shift factor on Ω.
- In addition, assume entity Blue owns a 20 MW path from G→H with a -0.1 shift factor on Ω.



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Case 3: Equitable Allocation

- Now let us assume that for a specified time period that Ω binds for an average shadow price of $100 per MW, with a forced outage driving the congestion.
- The fact that the outage is forced, results in a 30% underfunding.
- Since the net revenue of both entities is the same

$100 per MW x 4 MW = $400

$100 per MW x 4 MW = $400

- However, the absolute revenue of the entities differs greatly,

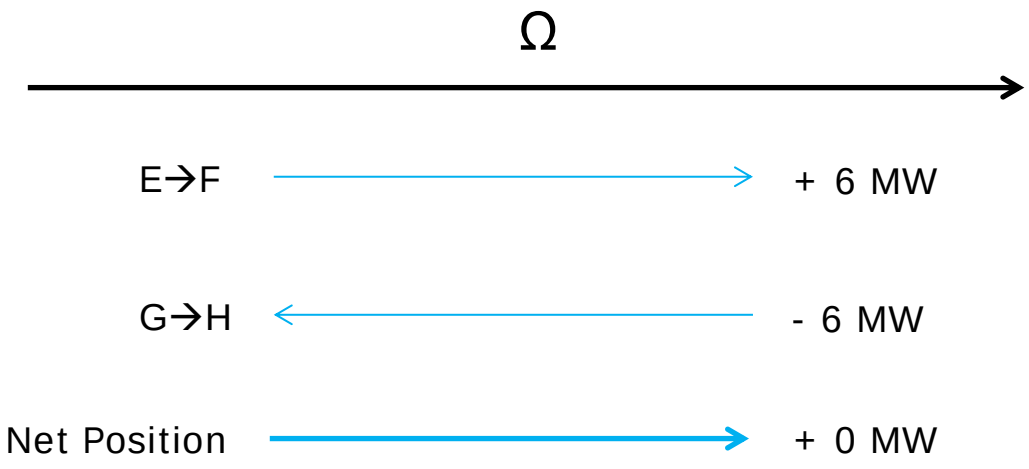
$100 x 3 + $100 x 1 = $400

$100 x 6 + abs(-$100) x 2 = $800

- If underfunding is based on absolute revenue, the Blue Entity pays twice the underfunding for the same flow impact (4 MW) on the underfunded constraint.

Case 3: Blue Entity – no net flow

- Assume Entity Blue owns a 20 MW path from E→F with a 0.3 shift factor on Ω.
- Now assume entity Blue buys a 60 MW of path G→H with a -0.1 shift factor on Ω to neutralize the net flow.
- The absolute revenue formulation will now charge blue three times as much as Red even though Blue has no net flow on the underfunded interface.



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Cases 1-3: Simplified

- It is worth noting that Cases 1 – 3 are simplified to involve just a single constraint.
- The simplification is only for illustration's sake.
- The examples can be generalized to include many constraints simultaneously and both open and closed interfaces without changing any of the conclusions
- Congestion rents collected in the DAM are a summation across all constraints of the net flow across each line multiplied by the shadow price of the constraint. Similarly, the payout to each FTR is the sum across all constraints of the shift factor of that FTR on the binding constraint (net flow) multiplied by the shadow price of the constraint. What is true for one constraint individually can be summed up across multiple constraints and is still true.