Virtual Transactions and Uplift in PJM

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Why do we have uplift?

1. The power system is not infinitely flexible.

   – Physical restrictions require running resources when they are not economic.
     - Minimum output
     - Minimum run time
     - Minimum down time
   – System and market conditions change more quickly than resources can respond.
   – To ensure resources following PJM direction recover their costs, uplift payments are needed.

2. LMPs are based on marginal costs.

- This pricing methodology links the market clearing price with the marginal cost of the generator.
- Best known method to incentivize resources to operate consistent with reliability needs.
- Three part bidding includes additional costs that don't vary with the output of the resource.
  - Startup Cost
  - No Load Cost
- A resource that is marginal for its entire run time could still require an uplift payment.

Example - Uplift Caused by an DEC

- DECs are price-sensitive load in the Day Ahead Market.
- Clearing a DEC requires a corresponding increase in supply to meet the additional demand.
- The least cost option to serve the DEC bid may create an uplift payment.

Example – Uplift Caused by an DEC

Hour Ending	16	17	18
LMP ($/MWh)	45	50	45
Offer ($/MWh)	50	50	50
MW Dispatch (MW)	75	75	75
Cost ($)	3,750	3,750	3,750
Payment ($)	3,375	3,750	3,375
Net Margin ($)	*-375*	0	*-375*
DEC Bid ($/MWh)		55	
DEC Cleared MW ($)		75	

A DEC bid was submitted and cleared in hour ending 1700.

To meet power balance, additional supply must be scheduled to meet the additional load created by the DEC.

The least cost option to meet power balance and serve the additional demand is to commit a resource with a 3 hour minimum run time.

The resource is marginal and sets the clearing price in the hour the DEC has cleared but it is uneconomic in the surrounding hours.

The additionally scheduled generator requires a $750 uplift payment to be made whole and it suppresses prices in hours ending 16 and 17 potentially creating additional uplift payments for other resources.

Underbidding demand in Day Ahead can have the opposite effect.

Example Resource Clearing - INC

Hour Ending	15	16	17	18	19
LMP ($/MWh)	50	50	50	50	50
Offer ($/MWh)	50	50	50	50	50
MW Dispatch (MW)	75	75	75	75	75
Cost ($)	3,750	3,750	3,750	3,750	3,750
Payment ($)	3,750	3,750	3,750	3,750	3,750
Net Margin ($)	0	0	0	0	0

Resource is marginal and setting the LMP.

** Assume the resource has min = max and that it has a 5 hour minimum run time.

If this generator has a start-up or no load it will receive an uplift payment already.

Inframarginal profits zero because the resource is setting the LMP.

Example – Uplift Caused by an INC

Hour Ending	15	16	17	18	19
LMP ($/MWh)	50	50	**48**	50	50
Offer ($/MWh)	50	50	**50**	50	50
MW Dispatch (MW)	75	75	**75**	75	75
Cost ($)	3,750	3,750	**3,750**	3,750	3,750
Payment ($)	3,750	3,750	**3,600**	3,750	3,750
Net Margin ($)	0	0	**-100**	0	0
INC Offer ($/MWh)			**35**		
INC Cleared MW ($)			**10**		

The INC has offered at a lower price than the inflexible generator and has cleared.

The increase in supply reduces. As a result, a flexible generator much be dispatched down to match supply in demand.

This lowers the LMP as it "frees up" low cost generation.

The reduction in LMP decreases the payments to the inflexible generator creating an uplift payment.

Impacts of UTCs

- UTCs have two major impacts on the market
  - Losses
  - Congestion
- A UTC can impose or remove flow from a congested facility depending on the direction as well as increase or decrease system losses.
- By impacting the flow, it also impacts
  - the relief needed to control the constraint,
  - the controlling action required to attain the relief,
  - the market clearing prices on the sending and receiving ends of the constraint (most directly), and
  - the revenues collected by affected resources and consequently their uplift payments.

Impacts of UTCs

- Because the UTC is essentially a paired injection and withdrawal, its impact on system-wide power balance is zero (absent losses).

- However, in local market areas created by congestion, they can have the same impact on uplift as an INC or a DEC.

Virtual Transactions in Real-Time

- Cleared virtual transactions can alter the resource commitments for real-time operations
  - If the total demand in the Day Ahead Market is more or less than what is needed in real-time it can lead to the over or under commitment of physical resources to meet real-time needs
  - If supply in the Day Ahead Market is offset by virtual transactions such that the most economic resources are not committed for real-time PJM may have to run a different set of resources in real-time which can create uplift
  - If flows in the Day Ahead Market are not representative of real-time flows, resource commitments to control transmission congestion can be different resulting in uplift
- This can also increase production costs in real-time.

- These examples are extremely simplistic.
- There are other scenarios where virtual transactions can create uplift.
  - There are other market activities that can also create uplift. This ability is not unique to virtual transactions.
- It is very difficult to identify these interactions at a level granular enough to allocate costs based on a specific transaction's impact.

General Rules for Uplift Allocation Today

Uplift incurred in the Day Ahead Market

- Allocated to cleared DAM withdrawals
  - Fixed Demand
  - Price-sensitive Demand
  - DECs
  - Export transactions

Uplift incurred in the Real-Time Market

- Allocated based on several factors
  - Economics (deviations) vs. Reliability (load + exports)
  - Regional vs. RTO-wide

Energy Market Uplift Senior Task Force (EMUSTF)

- Commenced in July 2013
  - 26 meetings to-date

- High-level allocation methodologies
  - Allocate as broadly as possible to minimize the impact to any one party.
  - Make adjustments to the current methodology to include UTCs.
  - Hybrid method that uses a fixed fee for virtual transactions and allocates the remainder to other parties.
  - Allocation similar to the MISO model.