Two Settlement - Virtual Bidding and Transactions

(Fall 2009)
- Two-Settlement Overview
- Two-Settlement Features & System
- Two-Settlement Business Rules
- Two-Settlement Data Requirements
- Two-Settlement Statistics
What is Two-Settlement?

- It provides PJM Market Participants with the **option** to participate in a forward market for electric energy in PJM
  
  - Consists of **two** markets
  
  - **Separate** settlements performed for each market
Two-Settlement Markets

• **Day-ahead Market**
  – develop day-ahead **schedule** using least-cost security constrained unit commitment and security constrained economic dispatch programs
  – calculate **hourly** LMPs for next Operating Day using generation offers, demand bids, and bilateral transaction schedules

• **Real-time or Balancing Energy Market**
  – calculate hourly LMPs based on actual operating conditions

(LMP calculated every 5 minutes / Settlements performed on hourly integrated LMP)
Two Settlements

• **Day-ahead Market Settlement**
  – based on **scheduled** hourly quantities and **day-ahead** hourly LMPs

• **Real-time or Balancing Market Settlement**
  – based on actual hourly quantity **deviations** from day-ahead schedule hourly quantities priced at **real-time** LMPs
Why Implement Two-Settlement?

- To enhance robust & competitive market in PJM Control Area
- To provide additional price certainty to Market Participants by allowing them to ...
  - commit & obtain commitments to energy prices & transmission congestion charges in advance of real-time dispatch (forward energy prices)
  - submit price sensitive demand bids
  - inform PJM of maximum congestion charges it is willing to pay
  - submit increment offers & decrement bids
• Two-Settlement Overview
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• Demand **may** specify fixed quantity and location

• Price sensitive demand **may** specify reservation price above which it wishes to be removed from day-ahead schedule

• PJM Capacity Resources **must** submit offers, if available, or may self schedule

• Non-Capacity Resources **may** submit offers or may self schedule
• Transactions (internal or external) may submit schedules into the day-ahead market

• External Transactions may specify maximum amount of congestion they are willing to pay
  – maximum amount can be $50/MWh
  – minimum amount can be -$50/MWh

• All external day-ahead transactions must be associated with transmission service that is designated willing to pay congestion charges

• Market Participants may also specify increment offers & decrement bids
Day-Ahead Market Timeline

**Up to 12:00 noon**
PJM receives bids and offers for energy next Operating Day

**12:00 noon**
Day-ahead market is closed for evaluation by PJM

**12:00 - 4:00 pm**
Re-bidding period

**4:00 pm**
PJM posts day-ahead LMPs & hourly schedules

**4:00 - 6:00 pm**
Throughout Operating Day
PJM continually re-evaluates and sends out individual generation schedule updates, as required

**6:00 pm**

**Note:** All times are Eastern Prevailing Time
Day-Ahead Market closes

First Commitment
- determines commitment profile that satisfies fixed demand, price sensitive demand bids, virtual bids and offers, and PJM Operating Reserve Objectives
- minimizes total production cost

Day-ahead Results Posted & Balancing Market Bid period opens

Reserve Adequacy Assessment
- focus is reliability
- updated unit offers and availability
- Based on PJM load forecast
- minimizes startup and cost to run units at minimum

Balancing Market Bid period closes

Transmission Security Assessment
- focus is reliability
- performed as necessary starting two days prior to the operating day
- Based on PJM Load Forecast
Based on PJM load forecast, physical generation assets, actual transaction schedules (net tie schedules) and full PJM operating reserve requirements

Virtual bids and offers not included

To preserve economic incentives, any additional unit commitment is based on minimizing cost to provide additional reserves (minimize startup and cost to operate at minimum output)
Agenda

• Two-Settlement Overview
• Two-Settlement Features & System
• Two-Settlement Business Rules
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• Two-Settlement Statistics
‘Up to’ congestion bids shall be no larger than $50/MWh

Internal bilateral transactions may be designated as day-ahead or balancing market in PJM eSchedules

Day-ahead automatically also entered in real time

Up-to congestion bids, increment offers, and decrement bids are supported in day-ahead market only
Two-Settlement Data Flow

PJM EMS
- Network Model
- Transmission Outages
- Default Distributions
- Equipment Ratings

Other PJM Systems
- PJM Load Forecast
- Hydro Schedules
- Reserve Requirements

Market User Interface
- Generation Offer Data
- Demand Schedules & Bids
- Incr Offers/Dec Bids
- Agg. Bus Distributions

Two-Settlement Software
Settlements

PJM EES
- Energy Transaction Schedules
- External Energy Schedules
- Net Tie Schedules

PJM OASIS
- Energy Transactions
- External Energy Offers
- Net Tie Schedules
is an internet application that allows PJM Market Participants to participate in PJM’s:

- Forward Energy Market
- Synchronized Reserve Market
- Regulation Market
- Day-ahead Scheduling Reserve Market
1) What is the deadline for submitting demand bids?
   A) 1600 EPT
   B) 1200 EPT
   C) 1400 EPT

2) What PJM eTool is used for submitting day-ahead demand bids?
   A) eMKT
   B) EES
   C) eSchedules
3) Demand is required to bid into the day-ahead market.
   A) True
   B) False

4) Demand may re-bid into the day-ahead market between 1600 (EPT) and 1800 (EPT).
   A) True
   B) False
5) Day-ahead Market results are posted to eMKT at:
   A) 1200 EPT
   B) 1600 EPT
   C) 1800 EPT

6) If the day-ahead LMP is higher than the specified price for price sensitive demand; what happens?
   A) Demand must be curtailed in real-time
   B) Demand clears in day-ahead market
   C) Demand does not clear in day-ahead market
7) Day-ahead Market Settlements are based on:
   A) Scheduled quantities at Real-time LMP
   B) Scheduled quantities at Day-ahead LMP
   C) Deviations from scheduled quantities at Day-ahead LMP

8) Balancing Market Settlements are based on:
   A) Deviations from scheduled quantities at Day-ahead LMP
   B) Deviations from scheduled quantities at Real-time LMP
   C) Actual quantities at Real-time LMP
• Two-Settlement Overview
• Two-Settlement Features & System
• Two-Settlement Business Rules
• Two-Settlement Data Requirements
• Two-Settlement Statistics
• Generator Offers
• Demand Bids
• Aggregate Bus Distributions
• Demand Forecasts
• Bilateral Transactions
• Increment Offers & Decrement Bids
Input: Increment Offers & Decrement Bids

- Available to all Market Participants
- Indicate prices at which participant is willing to increase injection (inc offer) or decrease withdrawal (dec bid) in response to PJM’s dispatch
- Very important financial instrument
- Do not require physical generation or load
  – aka “Virtual Bids”
• Consist of:
  – MW offer or bid
  – price of offer or bid (May be negative)
• Submitted at any hub, transmission zone, aggregate, or single bus for which LMP is calculated
• Supported in *day-ahead market* only
  – Almost always a deviation in Real-time *(more to follow)*
• Operating Reserve Charge Implications
  – Cleared Decrement Bids subject to Day-ahead and Balancing Operating Reserve charges
  – Cleared Increment Offers subject to Balancing Operating Reserve charges
Increment Offers

• Looks like a spot sale or dispatchable resource
• “If the price goes above X, then I will sell to the day-ahead PJM spot market”

Decrement Bids

• Looks like spot purchase or price sensitive demand
• “If price goes below X then I will buy from the day-ahead PJM spot market”
Increment Offer at Zone “X” Example:

<table>
<thead>
<tr>
<th>Day-ahead LMP at Zone “X”</th>
<th>Cleared MW of Increment Offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>17</td>
<td>25</td>
</tr>
<tr>
<td>21</td>
<td>30</td>
</tr>
</tbody>
</table>

Results:
Decrement Bid at Zone “X” Example:

Results:

<table>
<thead>
<tr>
<th>Day-ahead LMP at Zone “X”</th>
<th>Cleared MW of Decrement Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>30</td>
<td>0</td>
</tr>
</tbody>
</table>
Why Use an Inc or Dec?

• Cover one side of a bilateral transaction
• Cover eSchedules deal
  – allows opposite party access to real-time LMP while you participate in day-ahead
• Protect a day-ahead generation offer
  – Use a decrement bid
• Arbitrage Day ahead to Real-time pricing
  – Use an increment offer or decrement bid
• Hedge Day ahead Demand bid
• Hedge Operating Reserve Charges
Example #1 - Increment Offer

Day-ahead

Participant offers 100 MW at $30
Assume Day ahead LMP= $25
Increment Offer does not clear
Day-ahead position is 0

Real-time

Increment Offer did not clear
Balancing Settlement = 0 (no deviation)

Net position = 0
Participant offers 100 MW at $30

Assume Day ahead LMP = $35

Day ahead Settlement = 100 MW * $35 = $3500 credit

Assume Real-time LMP = $20

Deviation from DA schedule = -100 MW

Balancing Settlement = -100 MW * $20 = $2000 charge

Net position = $3500-$2000 = $1500 credit
Example #3 - Increment Offer

Day-ahead

Participant offers 100 MW at $30

Assume Day ahead LMP = $35

Day ahead Settlement = 100 MW * $35 = $3500 credit

Real-time

Assume Real-time LMP = $40

Deviation from DA schedule = -100 MW

Balancing Settlement = -100 MW * $40 = $4000 charge

Net position = $3500-$4000 = $500 charge
Day-ahead

Participant bids 100 MW at $20

Assume Day ahead LMP = $25

Decrement bid does not clear

Day-ahead position is 0

Real-time

Decrement bid did not clear

Balancing Settlement = 0 (no deviation)

Net position = 0
Example #2 - Decrement Bid

**Day-ahead**

Participant bids 100 MW at $20

Assume Day ahead LMP = $15

Day ahead Settlement = 100 MW * $15 = $1500 charge

**Real-time**

Assume Real-time LMP = $25

Deviation from DA schedule = 100 MW

Balancing Settlement = 100 MW * $25 = $2500 credit

Net position = -$1500 + $2500 = $1000 credit
Example #3 - Decrement Bid

Day-ahead

Participant bids 100 MW at $20
Assume Day ahead LMP = $15
Day ahead Settlement = 100 MW * $15 = $1500 charge

Real-time

Assume Real-time LMP = $10
Deviation from DA schedule = 100 MW
Balancing Settlement = 100 MW * $10 = $1000 credit

Net position = -$1500+$1000 = $500 charge
Self-scheduled generator (200 MW) wants to see Real-time pricing

Day-ahead

Generator self-schedules unit at 200MW
Decrement bid at same bus for 200 MW at $100
Assume Day ahead LMP= $30
Day ahead Settlement (Gen) = 200 MW * $30 = $6000 credit
Day ahead Settlement (Dec) = 200 MW * $30 = $6000 charge

Net Day ahead Position = 0

Real-time

Assume Generator produces 200 MW
Assume Real-time LMP = $35
Deviation from DA schedule (Gen) = 0 MW
Deviation from DA schedule (Dec) = 200 MW
Balancing Settlement (Gen) = 0 MW * $35 = 0
Balancing Settlement (Dec) = 200 MW * $35 = $7000 credit
Balancing Position = $7000 credit

Net position = 0 + $7000 = $7000 credit
Internal Bilateral – Seller wants RT Pricing, Buyer wants DA pricing

**Day-ahead Buyer**

- 100 MW Transaction entered as DA in eSchedules
- Assume Day ahead LMP = $40

**Real-time Buyer**

- 100 MW transaction carries over to RT
- Assume Real-time LMP = $50

Deviations:
- Deviation from DA schedule (Sale) = 0 MW
- Balancing Settlement (Sale) = 0 MW

Calculations:
- Day ahead Settlement (Purchase) = 100 MW * $40 = $4000 credit
- Net Day ahead Position = $4000

Net position = $4000 + $0 = $4000 credit
Internal Bilateral – Seller wants RT Pricing, Buyer wants DA pricing

**Day-ahead Seller**

100 MW Transaction entered as DA in eSchedules
Seller enters Increment offer at same location for 100 MW at low price

Assume Day ahead LMP= $40

Day ahead Settlement (Inc) = 100 MW * $40 = $4000 credit

Day ahead Settlement (Sale) = 100 MW * $40 = $4000 charge

Net Day ahead Position = 0

**Real-time Seller**

100 MW transaction carries over to RT

Assume Real-time LMP = $50

Deviation from DA schedule (INC) = -100 MW
Deviation from DA schedule (Sale) = 0 MW

Balancing Settlement (INC) = -100 MW * $50 = $5000 charge
Balancing Settlement (Sale) = 0 MW * $50 = $0

Balancing Position = $5000 charge

**Net position**

= 0 + $5000

= $5000 charge
Example - Decrement Bid with Generator

Generator in danger of a forced reduction in real-time (i.e. mech. Failure)

**Day-ahead Generator**
- 200 MW Scheduled Generation
- Dec bid 100 MW @ $20
- Assume Day ahead LMP = $15

Day ahead Settlement (Gen) = 200 MW * $15 = $3000 credit

Day ahead Settlement (DEC) = 100 MW * $15 = $1500 charge

Net Day ahead Position = 1500 credit

**Real-time Generator**
- Generator produces 100 MW
- Assume Real-time LMP = $20
- Deviation from DA schedule (GEN) = -100 MW
- Deviation from DA schedule (DEC) = 100 MW

Balancing Settlement (GEN) = -100 MW * $20 = $2000 charge

Balancing Settlement (DEC) = 100 MW * $20 = $2000 credit

Balancing Position = $0

Net position = $1500 + $0 = $1500 credit

Without DEC
Net credit = $1000
Example - Hedge Day-ahead Demand Bid

Demand bid hedged with a Decrement Bid

**Day-ahead Demand**

- 100 MW Scheduled Demand
- Dec bid 20 MW @ $20
- Assume Day ahead LMP = $15
- Day ahead Settlement (Demand) = 100 MW * $15 = $1500 charge
- Day ahead Settlement (DEC) = 20 MW * $15 = $300 charge

**Net Day ahead Position** = 1800 charge

**Real-time Demand**

- Real-time Demand = 110 MW
- Assume Real-time LMP = $20
- Deviation from DA schedule (DEMAND) = 10 MW
- Deviation from DA schedule (DEC) = 20 MW
- Balancing Settlement (DEMAND) = 10 MW * $20 = $200 charge
- Balancing Settlement (DEC) = 20 MW * $20 = $400 credit

**Balancing Position** = 200 credit

**Net position** = $1800 - $200 = $1600 charge

**Without DEC**

Net charge = $1700
### Example – Hedging Operating Reserve Charges

#### Balancing Operating Reserve Charges Applied to:

<table>
<thead>
<tr>
<th>Day Ahead</th>
<th>Balancing Market</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cleared Decrements, DA Load, Sales/Export</strong></td>
<td><strong>“Bucket 1”</strong></td>
</tr>
<tr>
<td></td>
<td>Net Deviation of total</td>
</tr>
<tr>
<td><strong>Cleared Increments, Purchases/Imports</strong></td>
<td><strong>“Bucket 2”</strong></td>
</tr>
<tr>
<td></td>
<td>Net Deviation of total</td>
</tr>
<tr>
<td><strong>DA Scheduled Generation</strong></td>
<td><strong>“Bucket 3”</strong></td>
</tr>
<tr>
<td></td>
<td>Individual deviation on each generator not following dispatch</td>
</tr>
</tbody>
</table>

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Parties choose to complete a real-time internal bilateral energy transaction.

**Party A sells Party B 10 mw**

| Transaction Without Any Day-ahead Component | Both parties would be subjected to Balancing Operating Reserve Charges on 10 MW as a deviation from their day-ahead position. |

Assume Party A and Party B have no other activity:

- **Party A Buys From** PJM Real-Time Spot Market to Supply IBT
- **Party A Sells to** Party B
- **Party B Buys From** Party A
- **Party B Sells To** PJM Real-Time Spot Market

To avoid Balancing Operating Reserve Charges:

- Party A needs to purchase from the PJM Day-ahead Spot Market
- And:
- Party B needs to sell to the PJM Day-ahead Spot Market
Parties choose to complete a real-time internal bilateral energy transaction.

**Party A sells Party B 10 mw**

To avoid Balancing Operating Reserve Charges:

Party A needs to purchase from the PJM Day-ahead Spot Market

And:

Party B needs to sell to the PJM Day-ahead Spot Market

---

**Party A: 10 MW Decrement Bid In Day-Ahead Market**

**Party A Buys From PJM Real-Time Spot Market to Supply IBT**

**Party A Sells to Party B**

**Party B Buys From Party A**

**Party B: 10 MW Increment Offer In Day-Ahead Market**

**Party B Sells To PJM Real-Time Spot Market**
Parties choose to complete a real-time internal bilateral energy transaction.

**Party A sells Party B 10 mw**

- **Party A:** 10 MW Decrement Bid In Day-Ahead Market
- **Party A Buys From PJM Real-Time Spot Market to Supply IBT**
- **Party A Sells to Party B**
- **Party A now has no deviation between day-ahead and real-time.**
- **No Balancing Operating Reserve Charges**

However Decrement Bid **does** incur Day-Ahead Operating Reserve Charges

- **Party B:** 10 MW Increment Offer In Day-Ahead Market
- **Party B Buys From Party A**
- **Party B Sells To PJM Real-Time Spot Market**
- **Party B now has no deviation between day-ahead and real-time.**
- **No Balancing Operating Reserve Charges**

Increment Offer **does not** incur Day-Ahead Operating Reserve Charges
Day-ahead

Fixed Demand = 100 MW
Inc Offer = 50 MW at $30
Dec Bid = 20 MW at $60
Price Sensitive load = 10 MW at $40

Assume Day ahead LMP= $50 at all locations

Day ahead Settlement =

Real-time

Assume Real-time LMP = $25
Real-time Load = 110 MW

Balancing Settlement =

Net position =
Increment Offers and Decrement Bids

Facilitated by eMKT
• Generator Offers
• Demand Bids
• Aggregate Bus Distributions
• Demand Forecasts
• **Bilateral Transactions**
  – types of transactions
• Increment Offers & Decrement Bids
Market User Interface - Demand/Transaction Tasks

Demand Tasks:
• Define Demand Portfolios - Once or As Needed
• Define Aggregate Bus Factors - LCC only - As needed
• Define Demand Bids - Daily
• Set up Increment Offers and Decrement Bids - As needed
• View Daily Cleared Demand - Daily

Transaction Tasks – EES:
• Submit Day-ahead Transactions - As needed
With Two-Settlement

• Basic Energy or “fixed”
• Price-based Energy or “dispatchable”
• ‘Up-to’ Congestion
Basic Energy or Fixed

• Can be ...
  – into PJM
  – out of PJM
  – through PJM

• Fixed MW schedule (no price) “Price Taker”

• Enter data & view results via EES
Price-based Energy or Dispatchable

• Can be …
  – into PJM (looks like dispatchable resource)
  – out of PJM (looks like price-sensitive demand)

• MW schedule determined by two-settlement software

• Enter data & view results via EES
‘Up to’ Congestion

• Can be …
  – into PJM
  – out of PJM
  – through PJM

• MW schedule determined by two-settlement software based on congestion you are willing to pay (−$50 to +$50 Limit)

• Enter data & view results via EES
Bilateral Transactions (continued)
Download Data from Markets Database

- Generation Offers
- Demand Bids
- Increment Offers & Decrement Bids
- Load Forecast
- Hydro Unit Schedules
- Scheduled Transmission Outages
- Bilateral Transactions
- Facility Ratings
- Net Tie Schedules
- PJM Network Model
- Aggregate Definitions

Two-Settlement Technical Software
Posting Two-Settlement Results

Two-Settlement Technical Software

- Schedules for Next Day (generation & demand)
- Transaction Schedules
- Day-ahead LMPs
- Day-ahead Binding Constraints
- Day-ahead Net Tie Schedules
- Day-ahead Reactive Interface Limits
- Day-ahead Summary
## Public Two-Settlement Results

### Market Prices Search

- **Portfolio**: HUBS
- **Date**: 06/05/2007

### Day-Ahead Prices For: 06/05/2007

<table>
<thead>
<tr>
<th>Location</th>
<th>1/13</th>
<th>2/14</th>
<th>3/15</th>
<th>4/16</th>
<th>5/17</th>
<th>6/18</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEP GEN HUB</td>
<td>15.40 -1.75  -10.95</td>
<td>11.63 -1.29  -11.22</td>
<td>7.92 -1.09  -11.99</td>
<td>5.47 -0.97  -12.67</td>
<td>5.30 -1.00  -13.17</td>
<td>13.88 -1.42  -10.37</td>
</tr>
<tr>
<td>CHICAGO GEN HUB</td>
<td>17.46 -1.20  -9.44</td>
<td>13.56 -0.84  -9.74</td>
<td>9.61 -0.70  -10.69</td>
<td>6.91 -0.62  -11.58</td>
<td>6.87 -0.65  -11.95</td>
<td>15.73 -0.91  -9.03</td>
</tr>
<tr>
<td>CHICAGO HUB</td>
<td>52.66 -4.12  -13.84</td>
<td>60.94 -4.60  -12.01</td>
<td>63.80 -4.81  -13.65</td>
<td>62.52 -4.75  -14.32</td>
<td>63.61 -4.80  -15.40</td>
<td>55.24 -4.30  -14.95</td>
</tr>
<tr>
<td>DOMINION</td>
<td>18.06 -1.30  -8.74</td>
<td>14.17 -0.97  -9.00</td>
<td>10.27 -0.79  -9.94</td>
<td>7.32 -0.72  -11.07</td>
<td>7.31 -0.76  -11.40</td>
<td>15.32 -1.06  -9.29</td>
</tr>
</tbody>
</table>

**LMP Legend**
- xxx.xx yyy.yy zzz.zz
- LMP LOSS CONGESTION
Posting Two-Settlement Results
1) What tool is used for submitting Day-ahead external energy schedules?
   A) EES  
   B) eMKT  
   C) eSchedules

2) If an energy schedule is submitted into the Day-ahead market, what is subject to potential congestion charges in real-time?
   A) Amount of Day-ahead schedule  
   B) Amount of Real-time schedule  
   C) Difference between Day-ahead and Real-time schedule
3) What is the dollar limit on “Up-to congestion” transactions?
   A) +/-$50
   B) +/-$100
   C) +/-$1000

4) Which eTool does NOT contain day-ahead market results?
   A) eGADS
   B) eMKT
   C) eDATA
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<table>
<thead>
<tr>
<th></th>
<th>Day-Ahead</th>
<th>Real-Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Simple Average</strong></td>
<td>$66.12</td>
<td>$66.40</td>
</tr>
<tr>
<td><strong>Load-Weighted Average</strong></td>
<td>$70.25</td>
<td>$71.13</td>
</tr>
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</table>
Source: 2008 PJM State of the Market Report
### Table 2-49  PJM real-time, simple average LMP (Dollars per MWh):  Calendar years 1998 to 2008

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Year-to-Year Change</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Average</td>
</tr>
<tr>
<td></td>
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<td>Median</td>
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<tr>
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<td>Standard Deviation</td>
</tr>
<tr>
<td>1998</td>
<td>$21.72</td>
<td>$16.60</td>
<td>$31.45</td>
<td>NA</td>
</tr>
<tr>
<td>1999</td>
<td>$28.32</td>
<td>$17.88</td>
<td>$72.42</td>
<td>30.4%</td>
</tr>
<tr>
<td>2000</td>
<td>$28.14</td>
<td>$19.11</td>
<td>$25.69</td>
<td>(0.6%)</td>
</tr>
<tr>
<td>2001</td>
<td>$32.38</td>
<td>$22.98</td>
<td>$45.03</td>
<td>15.1%</td>
</tr>
<tr>
<td>2002</td>
<td>$28.30</td>
<td>$21.08</td>
<td>$22.41</td>
<td>(12.6%)</td>
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<tr>
<td>2003</td>
<td>$38.28</td>
<td>$30.79</td>
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<td>2004</td>
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<td>2005</td>
<td>$58.08</td>
<td>$47.18</td>
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<td>37.0%</td>
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<td>2006</td>
<td>$49.27</td>
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<td>(15.2%)</td>
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<tr>
<td>2007</td>
<td>$57.58</td>
<td>$49.92</td>
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<tr>
<td>2008</td>
<td>$66.40</td>
<td>$55.53</td>
<td>$38.62</td>
<td>15.3%</td>
</tr>
</tbody>
</table>

Source: 2008 PJM State of the Market Report
### Historical Day-ahead Average LMP

#### Table 2-61  PJM day-ahead, simple average LMP (Dollars per MWh): Calendar years 2004 to 2008

<table>
<thead>
<tr>
<th></th>
<th>Day-Ahead LMP</th>
<th></th>
<th>Year-to-Year Change</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Median</td>
<td>Standard Deviation</td>
<td>Average</td>
<td>Median</td>
</tr>
<tr>
<td>2004</td>
<td>$41.43</td>
<td>$40.36</td>
<td>$16.60</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>2005</td>
<td>$57.89</td>
<td>$50.08</td>
<td>$30.04</td>
<td>39.7%</td>
<td>24.1%</td>
</tr>
<tr>
<td>2006</td>
<td>$48.10</td>
<td>$44.21</td>
<td>$23.42</td>
<td>(16.9%)</td>
<td>(11.7%)</td>
</tr>
<tr>
<td>2007</td>
<td>$54.67</td>
<td>$52.34</td>
<td>$23.99</td>
<td>13.7%</td>
<td>18.4%</td>
</tr>
<tr>
<td>2008</td>
<td>$66.12</td>
<td>$58.93</td>
<td>$30.87</td>
<td>20.9%</td>
<td>12.6%</td>
</tr>
</tbody>
</table>

Source: 2008 PJM State of the Market Report
### Table 2-68: Zonal real-time, simple average LMP components (Dollars per MWh): Calendar years 2007 and 2008

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<th></th>
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<th></th>
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<tbody>
<tr>
<td>AECO</td>
<td>$65.02</td>
<td>$56.56</td>
<td>$6.42</td>
<td>$2.04</td>
<td>$80.70</td>
<td>$66.29</td>
<td>$10.77</td>
<td>$3.64</td>
</tr>
<tr>
<td>AEP</td>
<td>$46.55</td>
<td>$56.56</td>
<td>$(8.80)</td>
<td>$(1.21)</td>
<td>$53.42</td>
<td>$66.29</td>
<td>$(10.46)</td>
<td>$(2.42)</td>
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<td>AP</td>
<td>$57.45</td>
<td>$56.56</td>
<td>$1.33</td>
<td>$(0.44)</td>
<td>$65.85</td>
<td>$66.29</td>
<td>$0.29</td>
<td>$(0.73)</td>
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<td>$12.08</td>
<td>$1.15</td>
<td>$80.05</td>
<td>$66.29</td>
<td>$11.06</td>
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</tr>
<tr>
<td>ComEd</td>
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<td>$56.56</td>
<td>$(9.42)</td>
<td>$(1.43)</td>
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Source: 2008 PJM State of the Market Report
**Table 2-72  Zonal day-ahead, simple average LMP components (Dollars per MWh): 2007 and 2008**

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<th></th>
</tr>
</thead>
<tbody>
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<td>Day-Ahead LMP</td>
<td>Energy Component</td>
<td>Congestion Component</td>
<td>Loss Component</td>
<td>Day-Ahead LMP</td>
<td>Energy Component</td>
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<td>$66.43</td>
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<td>$66.43</td>
</tr>
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<td>$66.43</td>
</tr>
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<td>PENELEC</td>
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<td>$(1.14)</td>
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<td>$7.05</td>
<td>$2.29</td>
<td>$79.77</td>
<td>$66.43</td>
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<tr>
<td>RECO</td>
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<td>$54.60</td>
<td>$6.77</td>
<td>$2.00</td>
<td>$78.08</td>
<td>$66.43</td>
</tr>
</tbody>
</table>

Source: 2008 PJM State of the Market Report
Figure 2-2  PJM summer peak-load comparison: Monday, June 9, 2008, and Wednesday, August 8, 2007

Source: 2008 PJM State of the Market Report
• Generation and demand are scheduled and settled at Day-ahead LMPs
• Real-time deviations from day-ahead scheduled quantities are settled at real-time LMPs
• The day-ahead market allows for a variety of options for bidding of load, generation and transactions
• There are specific rules governing the bidding of load, generation and transactions that must be followed
Questions?
PJM Member Relations
Telephone: (610) 666-8980
Toll Free Telephone: 866-400-8980
Fax: (610) 666-4379
World wide web: www.pjm.com
email: http://www.pjm.com/about-pjm/who-we-are/contact-us.aspx
**Day-ahead**

- Fixed Demand = 100 MW = $5000
- Inc Offer = 50 MW at $30 = ($2500)
- Dec Bid = 20 MW at $60 = $1000
- Price Sensitive load = 10 MW at $40 = 0 (does not clear)

Assume Day ahead LMP= $50 at all locations

**Day ahead Settlement = $3500 charge**

---

**Real-time**

- Real-time Load = 110 MW

  **Assume Real-time LMP = $25**

  - Load Deviation = 10 MW @ $25 = $250
  - Inc Offer Deviation = 50 MW @ $25 = $1250
  - Dec Bid Deviation = -20 MW @ $25 = ($500)

**Balancing Settlement = $1000 charge**

---

**Net position = $3500 + $1000 = $4500**