# Advanced Scheduling Design Options

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# Advanced Scheduling

- **PJM has historically scheduled units in advance of the day-ahead energy market when steam units with long lead times are needed for reliability (typically related to transmission constraints including low voltage but also during conservative operations).**

- **Post Winter Storm Elliott in 2022, PJM has increased the use of this process to address generation performance. Generation performance improves when units are:**

  - **Committed before cold weather arrives.**

  - **Committed while gas trading is liquid.**

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# Advanced Scheduling

- **In order to manage these risks, PJM is committing units in advance of the DAM.**
  - **For all thermal units using fossil fuels, these commitments are a day or days in advance of the DAM. The goal is to have these units online before the cold temperatures arrive in order to avoid freezing or other unexpected issues.**
  - **For all gas units, these commitments are a day or days in advance of DAM, depending on how natural gas is trading (i.e. single day or weekend package). The goal is to have these units purchase natural gas when the market is liquid.**

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# Issues

- **The IMM has raised concerns about the lack of transparency regarding the process of scheduling resources prior to the Day-Ahead Energy Market. These concerns include communication process, offers used for commitment evaluation, use of operating parameters, and financial consequences of commitment.**

- **Generators have raised concerns about gas purchases that resulted in losses from unburned fuel.**

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# Goal

- **The goal is to have a transparent process in which units are committed economically based on the known constraints and given explicit commitment instructions.**

- **Areas of interest:**
  - **Communications**
  - **Offers and FCPs**
  - **Tools, inputs (including generator constraint modeling)**
  - **Uplift**
  - **Transparency**

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# COMMUNICATIONS

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# Communications

- **PJM will post in advance when these commitments will take place based on Operations system assessment.**
  - **Preferably new market alert.**
  - **The alert should contain a deadline at which units' information must be updated.**
  - **A second notification should be sent notifying that commitments are posted.**
- **PJM will provide electronic commitments (same as DA).**
  - **The commitments will include start and end times.**
  - **The commitments will include MW profile.**
  - **Information will be posted in Markets Gateway.**

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# OFFERS AND FUEL COST POLICIES

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# Offers – Status Quo

- **Offers prior to the DAM are only binding if a resource has a start time or notification time greater than 24 hours.**

- **Resources with start times and notification times of 24 hours or less make nonbinding offers.**

- **The offers used for uplift are based on the committed offer.**

- **PJM's interpretation is that:**

  - **For units that clear DAM, the committed offer is the DA offer.**

  - **For units that do not clear the DAM, the committed offer is the offer at the time dispatch logs the unit.**

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# Offers for advanced scheduling

- **Today, offers are due at 11:00 the day before the operating day.**

- **PJM is making commitment decisions prior to the DA deadline.**

- **In order to make economic commitments, PJM will need offers before the DA deadline.**

- **This can be accomplished based on estimated gas costs.**

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# Estimated Gas Cost

- **Develop a method to estimate gas costs by PJM that can be used by generators to calculate energy offers.**

- **Generators will submit these offers into Markets Gateway in advance of the DAM based on defined communication triggers.**

- **Offers must be calculated following Manual 15 (e.g. heat rates, VOM, etc.).**

  - **Offers must use adders effective at the time (e.g. OC adders).**

- **The only difference will be the fuel cost.**

- **Indicative Offers: Offers calculated using the estimated gas cost.**

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# Estimated Gas Cost

- **These indicative offers will not be used in the DA market.**

- **Generators will continue to submit offers by the DA deadline, rebid and intraday following their approved fuel cost policies.**

- **Indicative offers will have to be submitted before a deadline defined in PJM's communication (e.g. 8 AM before the DAM).**

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# Estimated Gas Cost

- **Generators will have the option to increase / decrease the estimated gas cost in their indicative offer.**

  - **TBD: Bounds around the increase or decrease.**

- **Using a lower estimated gas cost will result in the offer becoming binding.**

  - **TBD: Use or not of 10% adder or other allowable costs.**

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# Indicative Offers

- **The goal of indicative offers is to develop an economic merit order that PJM can use in their scheduling process.**

- **The goal is to have an idea of the supply curve across the PJM footprint in order to make an economic assessment of which units will need to be committed in advance of the DAM.**

- **DA and RT cost offers will continue to be submitted by Market Participants following their FCPs.**

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# Estimated Gas Cost Method

- **Develop regression analysis of relationship between gas indices and temperature.**

- **Tasks:**

  - **Select the appropriate weather station or stations for each gas index used in PJM (e.g. Transco Z6 NY to Newark Airport).**

  - **Select the data period (e.g. 12 months, 5 years).**

  - **Select data that represents cold weather operation (e.g. P10).**

  - **Use a statistical metric to select the station and period (e.g. root mean square error, P value).**

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# Weather Station Assignment

- ## Example:

| Gas Index | Weather Station |
|---|---|
| Chicago city-gates | Chicago O'Hare International Airport |
| Columbia Gas, App. | Columbus Port Columbus International Airport |
| Transco, Leidy Line receipts | Wilkes-Barre Scranton International Airport |
| Transco, zone 5 del. North | Washington Dulles International Airport |
| Transco, zone 6 N.Y. | Newark International Airport |
| Transco, zone 6 non-N.Y. | Philadelphia International Airport |
| Tx. Eastern, M-3 | Allentown Lehigh Valley International Airport |

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# Estimation Example

| Gas Index | Degrees Fahrenheit | | | | |
|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 |
| Chicago city-gates | 8.82 | 7.65 | 6.49 | 5.32 | 4.16 |
| Columbia Gas, App. | 7.23 | 6.50 | 5.78 | 5.05 | 4.32 |
| Columbia Gulf, mainline | 8.30 | 7.59 | 6.89 | 6.19 | 5.48 |
| Consumers city-gate | 6.97 | 6.20 | 5.43 | 4.66 | 3.89 |
| Eastern Gas, North Point | 6.43 | 5.92 | 5.40 | 4.89 | 4.37 |
| Eastern Gas, South Point | 6.38 | 5.86 | 5.34 | 4.81 | 4.29 |
| Henry Hub | 8.21 | 7.55 | 6.89 | 6.23 | 5.57 |
| Lebanon Hub | 8.00 | 7.15 | 6.30 | 5.46 | 4.61 |
| Mich Con city-gate | 4.71 | 4.40 | 4.10 | 3.79 | 3.49 |
| Northern Bdr., Ventura TP | 11.33 | 9.68 | 8.03 | 6.38 | 4.73 |
| Northern, Ventura | 11.94 | 10.17 | 8.39 | 6.62 | 4.84 |
| Tennessee, 500 Leg | 8.39 | 7.72 | 7.05 | 6.38 | 5.71 |
| Tennessee, 800 Leg | 7.56 | 6.97 | 6.37 | 5.77 | 5.18 |
| Tennessee, zone 4-200 leg | 6.85 | 6.17 | 5.50 | 4.82 | 4.14 |
| Tennessee, zone 4-300 leg | 6.47 | 5.83 | 5.19 | 4.56 | 3.92 |
| Tennessee, zone 4-313 pool | 6.57 | 5.92 | 5.26 | 4.61 | 3.96 |
| Texas Eastern, M-2 receipts | 6.84 | 6.18 | 5.52 | 4.86 | 4.20 |
| Transco, Leidy Line receipts | 7.23 | 6.48 | 5.72 | 4.96 | 4.21 |
| Transco, zone 5 del. North | 30.47 | 26.64 | 22.81 | 18.98 | 15.15 |
| Transco, zone 5 del. South | 32.42 | 28.36 | 24.30 | 20.23 | 16.17 |
| Transco, zone 6 N.Y. | 53.10 | 45.95 | 38.81 | 31.66 | 24.52 |
| Transco, zone 6 non-N.Y. | 34.40 | 29.91 | 25.42 | 20.92 | 16.43 |
| Transco, zone 6 non-N.Y. North | 34.13 | 29.68 | 25.23 | 20.78 | 16.33 |
| Tx. Eastern, ELA | 7.98 | 7.33 | 6.68 | 6.02 | 5.37 |
| Tx. Eastern, M-3 | 31.83 | 27.08 | 22.32 | 17.57 | 12.82 |
| Tx. Gas, zone 1 | 9.21 | 8.38 | 7.55 | 6.72 | 5.90 |

# FCP Changes

- **All units committed in advance of the DAM must reflect actual gas price paid by units in their offers prior to start of operating day.**

- **Volumes:**

  - **Actual gas price paid must be reflected in procured volume to meet PJM's MW commitment.**

  - **Any uncommitted MW can continue to reflect the existing FCP method.**

  - **For example, unit is committed to run 24h at eco min. Actual price is $15/MMBtu. Incremental gas can be bought at $25/MMBtu. Offer up to eco min should be based on $15/MMBtu gas. Offer beyond eco min can be based on $25/MMBtu gas.**

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# INPUTS AND TOOLS

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# Inputs and Models

- **Commitment will be the result of a commitment tool that looks ahead multiple days using:**
  - **PJM's load forecast**
  - **A defined assumption for interchanges**
  - **Generation availability from Markets Gateway**
  - **Generation limitations (e.g. inventories)**
  - **Demand response availability**

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# Gas Market / Temperature Constraints

- **Model must incorporate operating parameters that require advance commitments:**

  - **Notification time: Gas needs to be purchased hours prior to the timely nom deadline.**

  - **Extended min run time: Weekend packages require purchase of gas for multiple days.**

  - **Cold temperature operating limits: Units need to be started hours before temperature decrease below limits.**

- **TBD: New process that allows operating parameters that require advance commitments.**

  - **Current PLS exception process requires constraints to be physical, not financial.**

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# UPLIFT

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# Committed Offer

- **For resources that cannot be committed in the DAM based on their PLS parameters, the offer in the system at the time of commitment.**

- **For resources that submit an indicative offer using a gas cost below the PJM estimated gas cost, the indicative offer at the time of commitment.**

- **For all other resources (status quo):**
  - **If cleared in DAM: The offer at the time of the day-ahead market close.**
  - **If not cleared in DAM: The offer at the time the resource is logged by PJM Dispatch subsequent to day-ahead market clearing.**

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# Uplift

- **For units committed in advance of the DAM, uplift will be calculated for the entire commitment period (no longer daily or segmented).**
  - **This could include multiple days.**
- **All uplift will be allocated as reliability charges. Reliability charges are allocated to real time load plus exports.**

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# Stranded Gas Compensation

- **PJM will provide MW commitments, as done DA today.**

- **Units will have the ability to:**

  - **Set eco min to this MW level.**

  - **Leave eco min flexible.**

- **PJM can request units to operate below this eco min and/or decommit.**

  - **These actions will be taken for reliability only (e.g. emergency min events, constraint management) not based on economics.**

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# Stranded Gas Compensation

- **Develop after the fact process in which units provide PJM/IMM their invoices (purchases and sales) to be used by PJM/IMM to determine loss.**

- **This value will be included as a cost component in the uplift calculation.**

- **Only transactions that were the result of PJM's advanced commitment will be included.**

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# TRANSPARENCY

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# Data Posting

- **Post MWh by hour committed in advance of the DAM by reason.**
  - **Transmission constraints**
  - **Conservative operations**
  - **Other…**

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# OTHER ITEMS

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# Simulation

- **Simulation: In order to evaluate the efficacy of the proposal, PJM will model past events using the new method.**

- **Advanced scheduling outside of conservative operations: Need to discuss if same process should apply to units committed in advance due to congestion management or similar reliability needs.**

- **Binding versus committed offer.**

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