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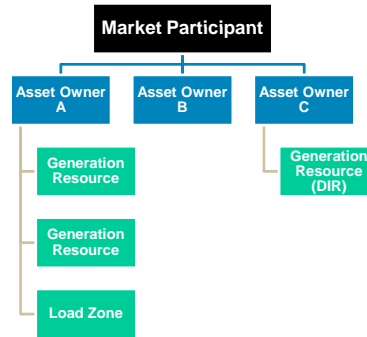# Dispatchable Intermittent Resource (DIR) Workshop

April 13, 2011

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DIR Registration

April Peterson

Market Participant v. Asset Owner

- **Market Participant** represents the highest-level data component of Commercial Model
  - Financially obligated to Midwest ISO for Settlements
  - Must have associations with at least one Asset Owner
  - Responsible for establishing security roles for its Asset Owners to submit all operating information
  - Point of contact for all Asset related questions and is responsible for submitting registration documentation

- **Asset Owner** is next level of data in Commercial Model
  - Must be represented by one MP, but one MP may have multiple Asset Owners
  - All Market transactions are settled to the level of the Asset Owner and then invoiced to the MP
  - Not all Asset Owners must have physical assets of load or generation
  - Provides MP full flexibility to manage user access, separate internal business units, or provide services for multiple entities with separate settlements for each

Market Participant

| Asset Owner A | Asset Owner B | Asset Owner C |

Generation Resource

Generation Resource (DIR)

Generation Resource

Load Zone

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Intermittent v. Dispatchable

- Beginning March 1, 2013, a resource can ONLY register as <u>Intermittent</u> if it meets one of the following scenarios:

  - It is powered by a fuel other than wind;
    - **OR**
  - It began commercial operation prior to 4/1/2005;
    - **OR**
  - a) It has Network Resource Interconnection Service (NRIS) for 100% of its capacity
  - b) It has Network Integration Transmission Service (NITS) for 100% of its capacity
  - c) It has Long-Term Firm Point-to-Point Transmission Service for 100% of its capacity
  - d) It has any combination of a) through c) that sums to 100% of its capacity, without double counting

- Once a resource registers as DIR, it is no longer eligible to register as Intermittent, regardless of its status against these exemptions

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DIR Registration Requirements

- Similar to Generator Registration

Document	Description / Requirements
Attachment B – Change of Information Form	• Signed by authorized contact from Market Participant • Submit to register@midwestiso.org by Quarterly Topology Deadline
Generator Template (.csv)	Complete <u>all</u> required fields, including: • Intermittent Flag *(No, Intermittent, or DIR)* • DIR Forecast Feasibility Limit *(If DIR, Max Resource Output Capability)* • Interconnection Agreement Number *(e.g. G123)*
MDMA Template (.csv)	Additional data on Meter Data Management Agent (MDMA) for the CPNode
Wind Forecast Template	Required for ALL wind generation; will be covered during Wind Forecast session
Asset Owner Template (.csv)	Required if creating new Asset Owner
Section XI	Required to show resource ownership relationship
Section XIV	Required if MDMA is an entity other than the Market Participant

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DIR Registration Deadlines

- Follows standard Quarterly Commercial Model Topology Timelines
- Asset Confirmation also required
  - Customer Service sends notification when confirmation period begins

Submission Deadline	Model Effective Date
December 15	March 1
March 15	June 1
June 15	September 1
September 15	December 1

Submit all documentation by above deadlines to:

register@midwestiso.org
or via fax to
317-249-5361

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ICCP Infrastructure

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Keith Mitchell

ICCP Infrastructure

- Midwest ISO offers a program to extend the Midwest ISO WAN to market participants which is called Operating Reserve Provider (ORP) which is required for DIRs
  - Installation and monthly maintenance costs are covered by Midwest ISO
  - Requires a one year commitment due to circuit installation requirements
- DIR Participant Requirements
  - Provide switch and firewall for each Midwest ISO router
  - ICCP is required, suggest a clustered configuration
  - DIR is to follow Set Point measurement received via ICCP
    - Measurement is sent in block format
  - Each DIR is to provide the following:
    - Resource output MW and Mvar(if available)
    - Resource control mode
    - Resource generation breaker status
  - XML backup should be implemented in the event ICCP is not available
    - Can use Internet or Midwest ISO WAN for this listener – strongly suggest resources implement both
  - ICCP real-time specification is located under DIR information on Midwest ISO portal

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DIR Market Participation
Market Portal
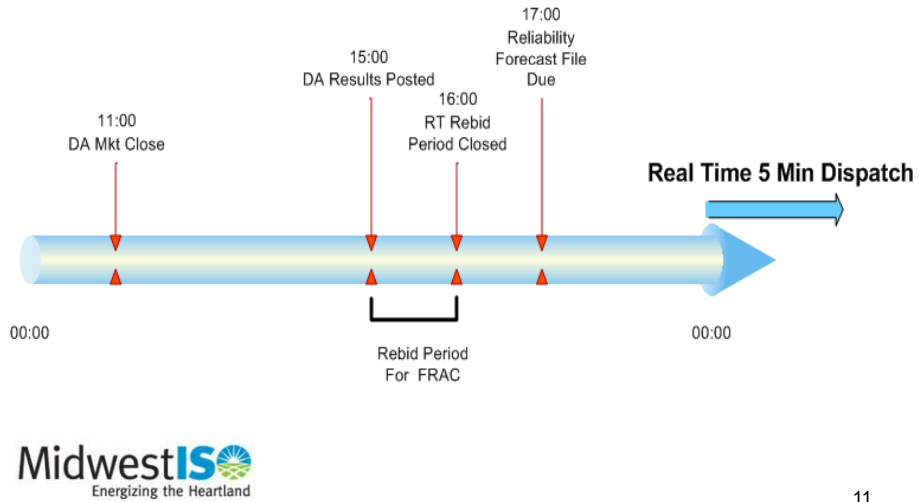## Day Ahead Markets
Real Time Markets

Sandhya Duggirala

Presentation Overview

➢ DIR Participation Highlights

➢ Day Ahead (DA) Market Participation

➢ Reliability Forecast

➢ Forward RAC Participation

➢ Notification Deadline

➢ Real Time (RT) Market Participation

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Market Operations Timeline

General DIR Market Rules

➤ DIRs are eligible to supply Energy, but not Operating Reserves (Regulating, Spinning, or Supplemental)

➤ DIRs and traditional generation have same market behavior in Day-Ahead Market (DA)

➤ DIRs can offer with the Commit Status in both DA and RT markets
  ▪ Economic
  ▪ Emergency
  ▪ Must Run
  ▪ Outage
  ▪ Not Participating

➤ Primary difference between DIRs and traditional generation in RT is source of Maximum Limit

➤ DIRs can Self-Schedule Energy (self-schedule will be reduced if greater than RT capability)

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Day Ahead Market Timeline

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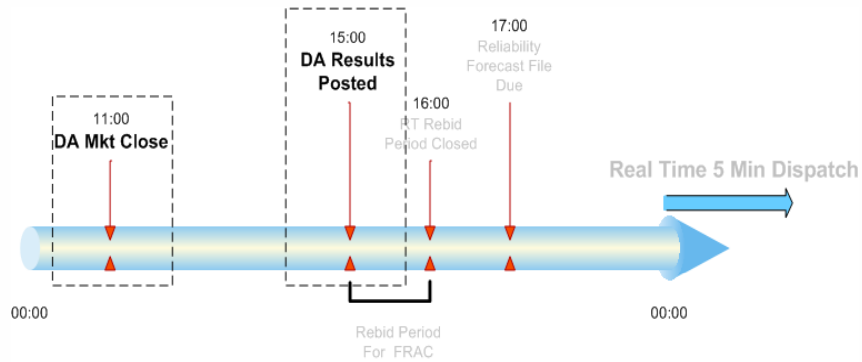
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Day-Ahead Market

➤ Intermittent Resources, DIRs and Generation Resources have identical treatment in DA Market
➤ DA Market closes at 1100EST, results posted at 1500EST
➤ DA Parameters
  ▪ Energy Offer ($/MW), Ramp Rate (MW/min), Commit Status and costs, **Min and Max** Limits (MW), etc
  ▪ DA Max Limit, entered by Asset Owner, reflects the maximum capability of the DIR for each Operating Hour

Startup Costs	No Load Costs	Daily Runtimes	Hourly Runtimes	Commit Status
Unit Limits		Ramp Rates		Energy Offer

Expand quick limits entry template

Unit Limits

Hour Ending	Economic Min	Economic Max	Emergency Min	Emergency Max	Regulation Min	Regulation Max	Offline Resource Max
01	0.0	17.9	0.0	17.9	(null)	(null)	(null)
02	0.0	19.4	0.0	19.4	(null)	(null)	(null)
03	0.0	29.3	0.0	29.3	(null)	(null)	(null)
04	0.0	47.1	0.0	47.1	(null)	(null)	(null)
05	0.0	54.2	0.0	54.2	(null)	(null)	(null)
06	0.0	55.0	0.0	55.0	(null)	(null)	(null)

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Day-Ahead Results

➤ If committed, all Resources receive DA results:

   ▪ START notification, including time of commitment

      <u>Portal Location</u>
      DART Tab → Operational Information → **Query Resource Start Stop**
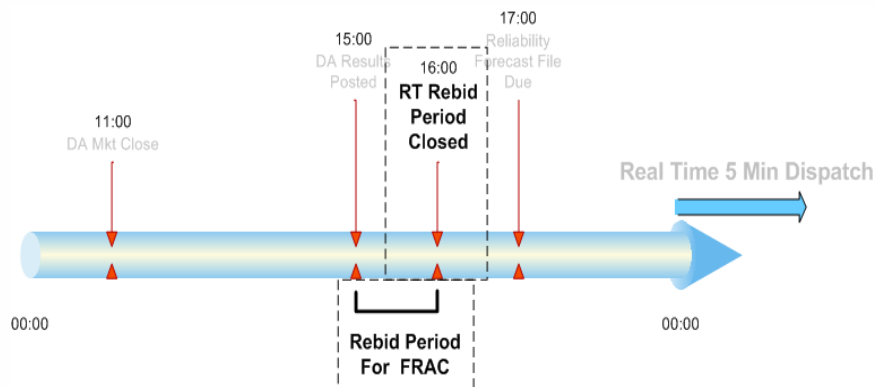
   ▪ Energy clearing and pricing

      <u>Portal Location</u>
      DART Tab → Day Ahead Market → **Query Locational Results**

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FRAC Timeline

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Forward RAC and Intra-Day RAC Process

➢ DIRs are eligible for the F-RAC rebid process
- RT Offers for next day submitted between 1500 and 1600 EST
- DIRs not committed in DA may be committed in F-RAC/I-RAC

➢ **F-RAC/I-RAC Parameters**
- Energy Offer ($/MW), Ramp Rate (MW/min), Commit Status and costs, **Minimum Limits (MW)**, etc
- F-RAC/I-RAC Ramp Rate is "Real Time Studies Ramp Rate"
- F-RAC/I-RAC maximum limit is Midwest ISO hourly wind forecast

➢ Real-Time Limit screenshot
- <u>Portal Location</u>
  DART Tab → Resource Information → **Manage Schedule Offer**

Startup Costs	No Load Costs	Daily Runtimes	Hourly Runtimes	Commit Status
Unit Limits		Ramp Rates		Energy Offer

Expand quick limits entry template

Unit Limits

| Hour Ending	Economic Min	Economic Max	Emergency Min	Emergency Max	Regulation Min	Regulation Max	Offline Resource Max
01	0.0	(null)	0.0	(null)	(null)	(null)	(null)
02	0.0	(null)	0.0	(null)	(null)	(null)	(null)
03	0.0	(null)	0.0	(null)	(null)	(null)	(null)
04	0.0	(null)	0.0	(null)	(null)	(null)	(null)

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F-RAC/I-RAC Results

➢ Results of F-RAC/I-RAC are Commitment notifications
- DA commitment extension
- Commitment of non-DA committed resources

➢ F-RAC notifications issued at 2000+ hours

➢ I-RAC notifications issued throughout the Operating Day

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Reliability Forecast Timeline
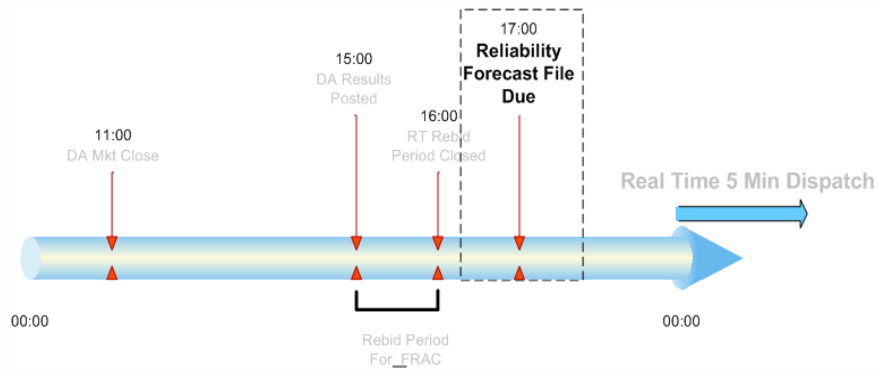
Day-Ahead Reliability Forecast

- ➢ Tariff requires submittal by 1700 EST
- ➢ Hourly Forecast
- ➢ <u>Portal Location</u>
  - DART Tab → DA Market → **Submit IR Forecast**
    - ▪ Required for Wind Resources, both Intermittent and DIR

Notification Deadline Forecast

➢ Optional forecast for Settlements use
➢ Data submission accepted up to four hours prior to Operating Hour
➢ Null value is considered same as DA value
➢ Screen capture:
  ▪ Portal Location
    DART Tab → Resource Information → **Real Time Demand Forecast**
➢ This page also used by Intermittent Resources and Loads
➢ More Info about this page later in the session

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RT Demand/Intermittent/DIR Forecast Search		
Portfolio: ALL ASSETS ▾		Locat

RT Demand/Intermittent/DIR Forecast
Submit
Expand quick demand forecast entry template

Hour Ending	MW	Hour Ending	MW
01	(null)	13	(null)
02	(null)	14	(null)
03	(null)	15	(null)
04	(null)	16	(null)
05	(null)	17	(null)
06	(null)	18	(null)
07	(null)	19	(null)
08	(null)	20	(null)
09	(null)	21	(null)
10	(null)	22	(null)
11	(null)	23	(null)
12	(null)	24	(null)

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Real-Time Market Resource Comparison

Type of Resource → Operational Parameters ↓	Intermittent	Generation	DIRs
Offers	No Offers	Energy and OR Offers ($/MW)	Energy Offers ($/MW)
Ramp Rates	No Ramp Rates	Ramp Rates	Ramp Rates
Limits	No Limits MW(t0) = SE(t-12)	Hourly Max and Min Limits	Hourly Min Limit 5-Min Forecast Max Limit
Marginal	Cannot be Marginal	Can be Marginal	Can be Marginal
Dispatchable	No (Manual Only)	Yes	Yes

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Real Time Market Timeline
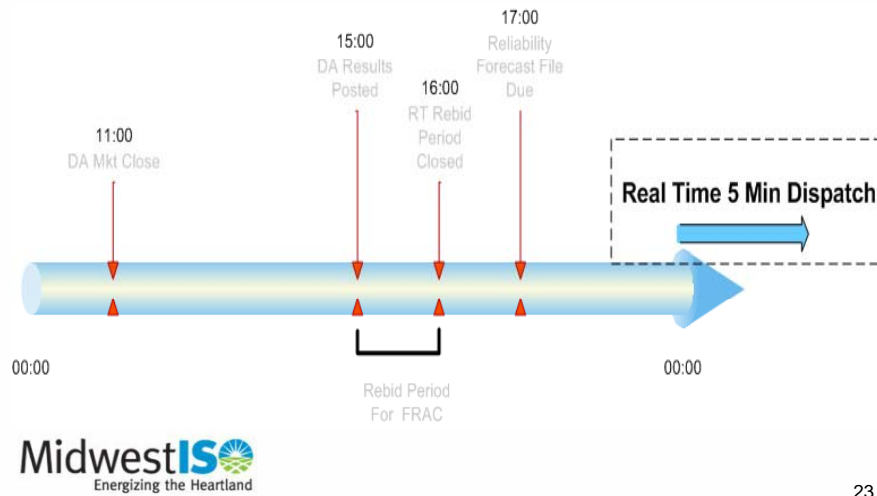
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Forecast Maximum Limit

➢ The following will determine the maximum limit for each DIR in each RT Interval
  ▪ Participant forecast will be used if it exists
    • Must be received less than 30 minutes from end time of interval
    • Must be less than feasibility limit * technical margin
  ▪ Else, Midwest ISO forecast will be used***
    • Must be calculated less than 30 minutes from end time of interval
    • Must be less than feasibility limit * technical margin
  ▪ Else, State Estimator value will be used

*** Additional functionality exists, that, when enabled, replaces Midwest ISO forecast with State Estimator if Midwest ISO Forecast < State Estimator

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Forecast Maximum Limit
Participant 5 min Forecast Submittal

- New Portal Page
- Primary source of Forecast Maximum Limit is participant-submitted value
- Up to 12 five-minute periods accepted
- First time-period submitted must be less than 10 minutes from submittal time
- Values over Feasibility Limit will be rejected
- Forecast needs to be independent of dispatch.

<u>Portal Location</u>
DART Tab → Resource Information
→ **Manage DIR 5-Min Forecast**

Date: 4/5/2011   Hour: 0 ▼   Minutes: 0 ▼
(mm/dd/yyyy)   Change Date

DIR 5-Min Forecast
Submit
Expand quick DIR 5-min forecast entry template

Offset	MW
00	(null)
05	(null)
10	(null)
15	(null)
20	(null)
25	(null)
30	(null)
35	(null)
40	(null)
45	(null)
50	(null)
55	(null)

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Participant Forecast Submittal Example

<u>Manage DIR 5-Min Forecast Example</u>
First time period submitted must be < 10mins from submittal time
At 13:11, 12 contiguous forecast values for 13:15 and 13:20 can be submitted

At 13:11 For 13:15			At 13:11 For 13:20			At 13:11 For 13:25		
Offset	Time	MW Submittal?	Offset	Time	MW Submittal?	Offset	Time	MW Submittal?
00	13:15	√	00	13:20	√	00	13:25	x
05	13:20	√	05	13:25	√	05	13:30	x
10	13:25	√	10	13:30	√	10	13:35	x
15	13:30	√	15	13:35	√	15	13:40	x
20	13:35	√	20	13:40	√	20	13:45	x
25	13:40	√	25	13:45	√	25	13:50	x
30	13:45	√	30	13:50	√	30	13:55	x
35	13:50	√	35	13:55	√	35	14:00	x
40	13:55	√	40	14:00	√	40	14:05	x
45	14:00	√	45	14:05	√	45	14:10	x
50	14:05	√	50	14:10	√	50	14:15	x
55	14:10	√	55	14:15	√	55	14:20	x

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Midwest ISO 5 min Forecast

- ➢ New Portal Page
- ➢ Midwest ISO Forecast value will be used as Maximum Limit if/when Asset Owner does not submit
- ➢ This query is available to both DIRs and Intermittent Resources
- ➢ More detail on forecast (accuracy, etc) to be provided later this afternoon

Portal Location
DART Tab → Resource Information →
Query Resource 5-Min MISO Wind Forecast

Date: 4/5/2011   Hour: 0   Minutes: 0
(mm/dd/yyyy)   Change Date

5-Min MISO Wind Forecast

Offset	MW
00	10.3
05	11.1
10	10.8
15	10.7
20	11.1
25	11.3
30	10.8
35	10.4
40	9.7
45	9.6
50	9.3
55	8.7

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Real-Time Results

- ➢ Energy clearing (MW) and pricing (LMP)
  - ▪ Portal Location
    DART Tab → Real Time Market → **Query Dispatch & Query Real Time Prices**
  - ▪ Sent to Local Balancing Area and Asset Owner as Dispatch Notification

- ➢ Dispatch will respect Resource Offer parameters
  - ▪ Between Economic (or Emergency) Minimum, and Forecast Maximum
  - ▪ If dispatch changes, up/down ramp rates will be used

- ➢ DIR will be dispatched economically based on its offer price ($/MW), and LMP will reflect the dispatch

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References

- Wind Integration Page on website
  http://www.midwestiso.org/WhatWeDo/StrategicInitiatives/Pages/WindIntegration.aspx

- BPM 002 Energy and Operating Reserves Markets
  See link on Wind Integration Page

- Participant XML Spec and Schema
  See link on Wind Integration Page

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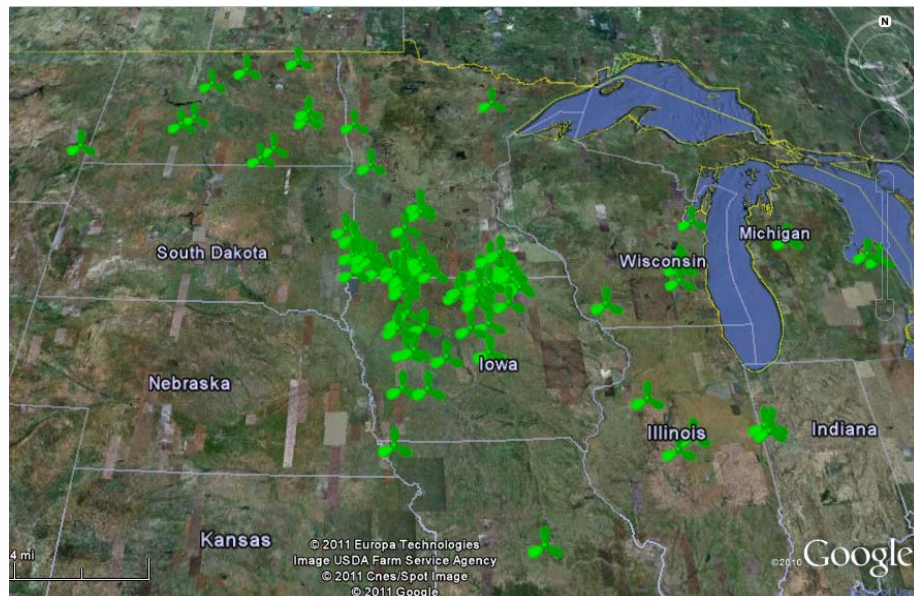
DIRs and Operations

Kris Ruud

Overview

- Wind Operations in MISO – Current State
- Operational Challenges
- DIR Operations in MISO
- Intermittent Curtailment vs. DIR Dispatch
- JOUs and DIRs

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Wind in MISO – Current State

- Wind farms are intermittent
  - MISO dispatch assumes 'persistence' of intermittent output
  - Cannot make economic offers/impact price
  - Any curtailments required for congestion are not accounted for in SCED
  - Curtailments are managed manually

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Operational Challenges

- Evaluating intra-day capacity sufficiency
- Manual action to mitigate wind impacted constraints
- Wind 'self curtailment' in response to price
- Poor correlation of wind/load peaks.

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2009 vs. 2010 Curtailments

	2009 Total	2010 Total
No of Wind Curtailments	1,141	2,117
Estimated MWh Curtailed	292,000	824,000
Duration (Hours)	8,005	19,951

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DIRs in MISO

- DIRs will be able to:
  - Make Economic Offers
  - Submit an "Interval Forecast Limit"
  - Set price
- DIRs will be expected to follow dispatch:
  - Ramp across the 5-minute case interval
  - 'Hit' the Energy Target as the case ends
  - Must not be outside 8% of Energy Target for 4 consecutive intervals

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INTERMITTENT CURTAILMENT
VS.
DIR DISPATCH

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Intermittent Curtailment

- RC identifies constraint
- Recognizes that SCED is insufficient
- Recognizes that intermittent resources (usually wind) are aggravating the constraint
- Evaluates GSFs, and Firm Transmission
- Calculates needed reductions
- Phone call to impacted GOP, TOPs, and LBAs
- Continue to monitor constraint and update curtailments

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DIR Dispatch

- RC Identifies Constraint

- RC Activates Constraint in SCED

- GOP follows automated dispatch instruction

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JOUS AND DIRS

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Market Participant Registration & Services

Jointly Owned Units (JOU)

- BPM-002 Energy and Operating Reserve Markets BPM specifies two options for Jointly Owned Units*

  1. "Pseudo-Tie JOU" – Separate units modeled in the MISO EMS and Market for each commercial share

  2. "Combined Offer JOU" – Single unit defined in the MISO EMS and Market, MISO settles with a single entity, each owner settles with the registered MP outside the MISO Market.

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*Section 4.2.9.4   41

Pseudo-Tied JOU Option

- The MISO Market and Systems treat each Ownership Share as a distinct unit

  – As a result each JOU share will be dispatched independently of the others

  – Each JOU must independently follow the MISO dispatch instruction if DIR

  – When a JOU is created, the capacity is divided and can only be changed in accordance with Commercial Model update timeline

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DIR Settlements
Marc Keyser

Overview

- Real-Time RSG Provisions and DIRs
  - Deviations
  - Notification Deadline
  - Real-Time Performance
    - Excessive/Deficient Energy
- Real-Time Make-Whole Payments
  - Day-Ahead Margin Assurance Payment
 - Real-Time Offer Revenue Sufficiency Payment

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Deviation Overview

- Must Run Volumes
  - A Must Run Volume occurs when the RT Economic Minimum Limit of a Resources exceeds the DA Schedule for Energy
- De-Rate Volumes and Capacity Decreases
  - Both use the Economic Maximum Limit and Economic Maximum Dispatch
  - A De-Rate volume occurs when the RT Economic Maximum Limit of a Resources drops below the DA Schedule for Energy
  - A capacity decrease occurs when the RT Economic Maximum Dispatch is less than the Economic Maximum Limit at the Notification Deadline

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Deviation Overview (continued)

- Resource deviations are calculated as forced capacity increases ("Must Run") or decreases ("De-Rate")
- They also incur deviations for Excessive (EXE) and Deficient Energy (DFE)

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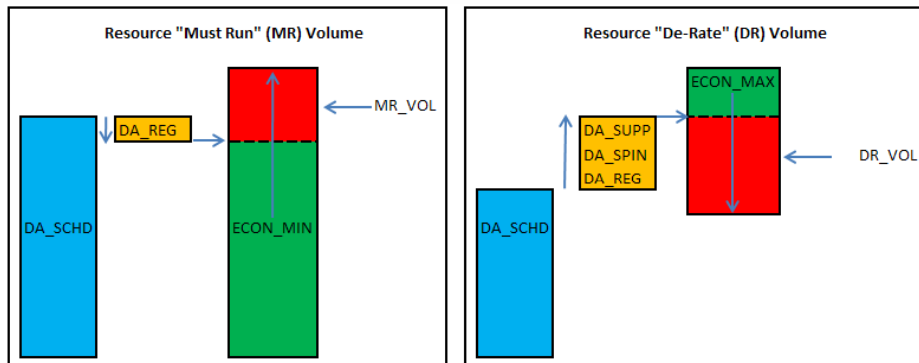
Notification Deadline (NDL)

- The Notification Deadline is 4 hours prior to each Market Hour
  - Provides sufficient time to perform Intra-Day Reliability Assessment Commitment (I-RAC)
- There are various ways that NDL information is provided, depending on the type of Commercial Pricing Node or Schedule
  - Both DIRs and Intermittent Resources use "RT Demand Forecast" page on Portal/MUI
  - Provides the ability to submit a forecast of expected Real-Time Injection

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Notification Deadlines

- The first set of calculated deviations compare DA values to NDL values, and can often result in positive or negative values
  - Constraint Management Charge (CMC)
  - Day-Ahead Deviation and Headroom Charge (DDC)
  - Positive and negative deviations across assets/positions are netted against each other
- Other deviations compares NDL values to RT values, and only consider cost causing deviations
  - Primary example: Must-Run and De-Rate Volumes, as in Deviation Overview above

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Real-Time RSG First Pass

- RT RSG First Pass Distribution
  - DIRs are subject to RT RSG Distribution charges for 5 categories
    - De-Rate Volume (Post-NDL changes)
    - Must Run (Post-NDL changes)
    - Decreased Capacity (Pre-NDL changes)
    - EXE (Real-Time over-performance)
    - DFE (Real-Time under-performance)

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De-Rate and Capacity Decrease Details

- NDL Forecast is used for Resource Deviation calculations
- Given the 5-minute variability in the Forecast Max the 5-min Forecast Max values used in the UDS will be integrated for each Operating Hour and substituted for the Economic Maximum Dispatch for these calculations

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RT RSG Continued

- EXE, DFE and Must Run Volumes are all calculated the same as Generation Resources
    - Must Run Volume uses Hourly Economic Minimum Limit
    - EXE is energy produced above the Excessive Energy Threshold (108% of the Dispatch Target for Energy with a min of 6 MWh and a max of 30 MWh)
    - DFE is energy produced below the Deficient Energy Threshold (92% of the Dispatch Target for Energy with a Min of 6 MWh and a max of 30 Mwh)
    - Note: Both EXE and DFE are calculated for each 5 minute dispatch interval and integrated to an hourly value
- A Resource outside of the Excessive/Deficient Tolerance Band during four consecutive intervals in a clock hour is subject to Failure to Follow Dispatch (FFDF)

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Implications of FFDF

- Excessive Energy Charge if output is above tolerance
    - Energy produced above the tolerance level subject to
        - RT-RSG
        - Receives lesser of Offer Cost and LMP as payment
- Deficient Energy Charge if output is below tolerance
    - Energy produced below the tolerance level subject to
        - RT-RSG
- The energy above or below the tolerance is also charged EDEDC, which is a pro-rated share of the system regulation cost

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Exemption from Real-Time Performance Charges

- A Resource can ask for Excessive/Deficient Energy Exemption (EEE) under certain conditions:
  - Extremely high wind or other weather-related conditions materially impacting a DIR's ability to provide Energy and resulting in a substantial reduction or cessation of wind generation activities

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Intermittent Resources and Real-Time RSG

- For Intermittent Resources, any deviation between NDL and Real-Time are charged RT-RSG
  - Exception: Recent FERC Order exempts periods of manual curtailment from this charge
- Intermittent Resources not charged EXE or DFE

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DIR Make-Whole Payments

- Eligible for cost recovery of operating costs for Economic Commitments in either Day-Ahead or Real-Time Markets
- Eligible for DAMAP (Day-Ahead Margin Assurance Payment
  - Make-whole payment that pays in circumstances when real-time dispatch is below day-ahead dispatch, and that dispatch causes a Resource to lose against its Day-Ahead result
- Eligible for RTORSGP (Real-Time Offer Revenue Sufficiency Guarantee Payment
  - Make-whole payment that pays in circumstances when real-time dispatch is above day-ahead dispatch, but the real-time LMP is below offer cost

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DIR Make-Whole Payments

- DIR DAMAP and RTORSGP eligibility is same as Generation Resource, except:
  - DIRs are not subject to the eligibility criteria that DA and RT Maximum Operating Parameters remain the same
  - DIRs are not afforded ramp rate leniency when they are within 10% of their Forecast Maximum
  - The hourly integrated Forecast Max is an input to DAMAP to determine if a De-Rate occurred

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Midwest ISO Short Term Wind Generation Forecast

Liying Wang

Topics

- Midwest ISO short term wind generation forecast Overview

- Forecast Accuracy and Enhancement Plans

- Additional Helpful Information

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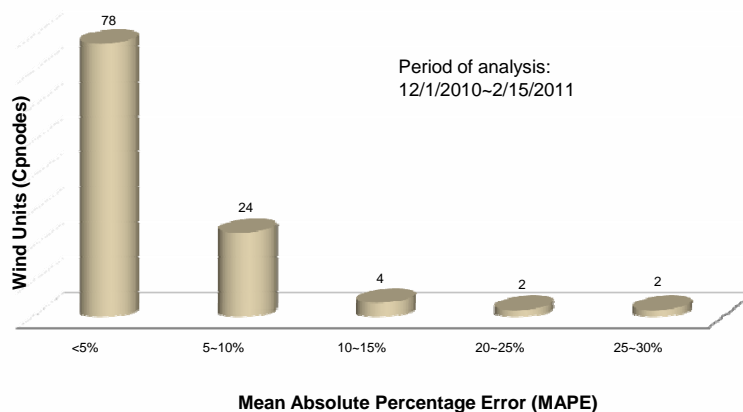
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Midwest ISO Short Term Wind Forecast

- Midwest ISO short term wind generation forecast
  - Granularity: 5-minute
  - Frequency: Every 5 minutes
  - Length: Rolling 6 hours
  - Level: Commercial Pricing Node (CPNode)

- Treatment of Midwest ISO short term wind generation forecast
  - Midwest ISO 5-minute forecast is the backup to the market participant's forecast
  - If MP's forecast is not submitted in time, the Midwest ISO forecast will be used
  - Midwest ISO CPNode level 5-minute forecast is now available to asset owners of wind CP-nodes via e-mail
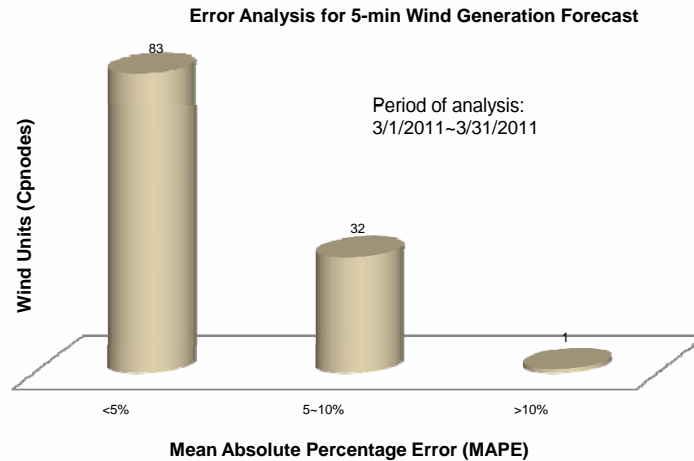 - On and after June 1st, 2011, the Midwest ISO's wind forecast data will be accessible via the portal

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Midwest ISO Wind Forecast Accuracy

Error Analysis for 5-min Wind Generation Forecast

Period of analysis:
12/1/2010~2/15/2011

Mean Absolute Percentage Error (MAPE)

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Midwest ISO Wind Forecast Accuracy

Error Analysis for 5-min Wind Generation Forecast

Period of analysis:
3/1/2011~3/31/2011

Wind Units (Cpnodes)

83

32

1

<5%   5~10%   >10%

Mean Absolute Percentage Error (MAPE)

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Latest Developments and Plans

- Significant process enhancement implemented recently
  - Cutting forecast process time from 8 minutes to less than 2 minutes
  - Improved forecast accuracy
  - Optimized timing to make the latest forecast available before the UDS case run time

- Challenges in short term wind generation forecast
  - Price chasing curtailment
    - DIRs should help
  - Icing conditions
    - Vendor's effort to learn from history
    - Midwest ISO is asking for help from stakeholders
  - New wind farms need time to fine tune
    - Availability vs. Accuracy
    - Better communication and coordination required among Midwest ISO groups and the vendor

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Additional Helpful Information

*Table 1.01: New/updated wind farm Cpnode information

Cpnode Name:	
Wind farm common name:	
Centralized geographic co-ordinate information: Latitude (in degrees with at least 4 decimal points):	
Centralized geographic co-ordinate information: Longitude (in degrees with at least 4 decimal points):	
Hub height in meters (measured from the ground level):	
Maximum nameplate capacity in MW:	
High wind speed cutoff threshold	
High temperature cutoff threshold in Fahrenheit:	
Cold temperature cutoff threshold in Fahrenheit:	
Number of turbine:	
Operational Date:	

*Please note that for updated wind farm Cpnode, only applicable/updated information is required.

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