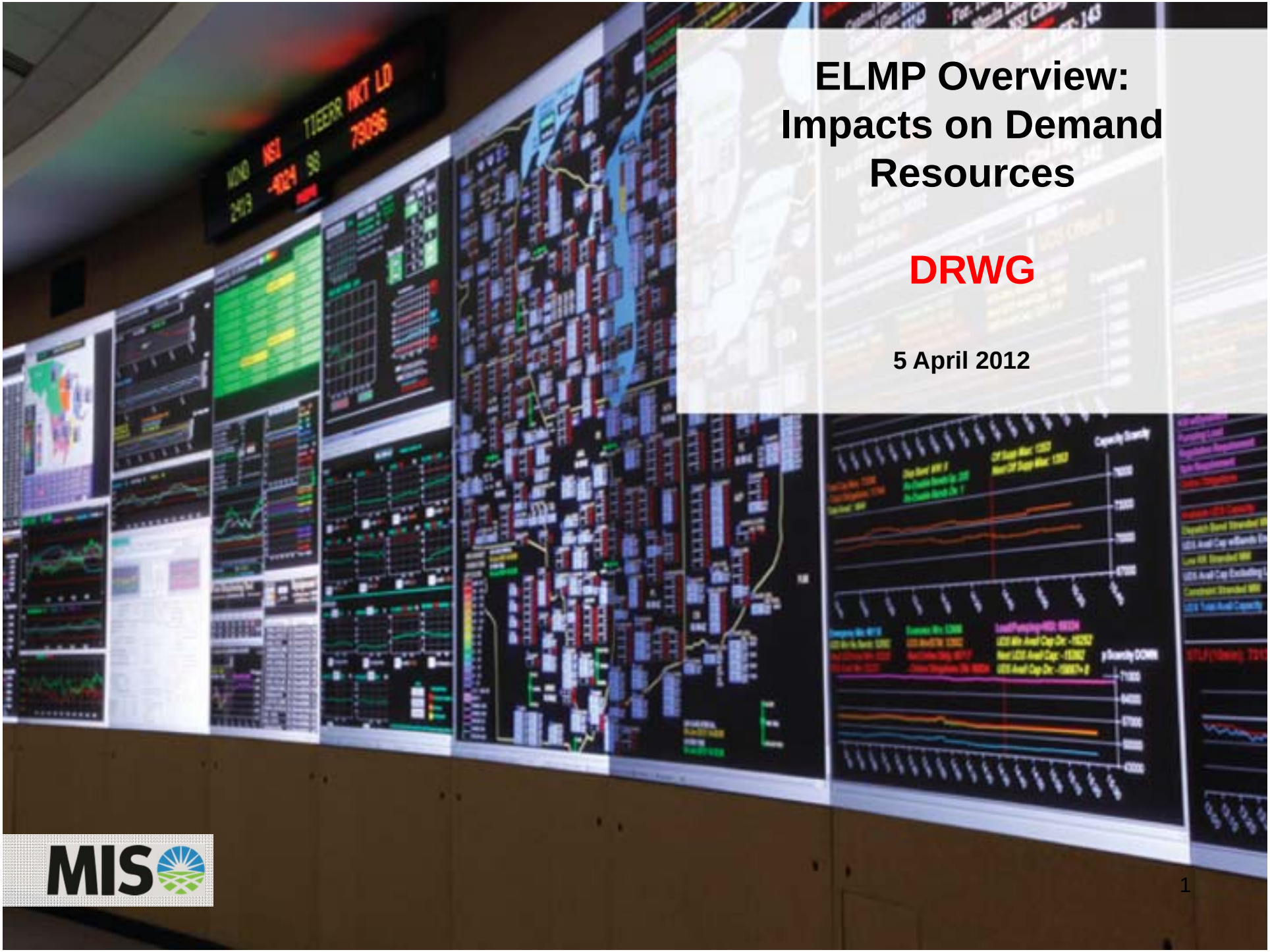

ELMP Overview: Impacts on Demand Resources

DRWG

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Background on Topic

- A high level goal of pricing in electricity markets is to capture the factors that contribute to the cost of providing energy and ancillary services (AS) at a given time and price energy and AS accordingly.

- Since market start in 2005, the Independent Market Monitor (IMM) has had the following recommendations as # 1 and #2:
  - Develop real-time software and market provisions that allow gas turbines that are block loaded or running at minimum or maximum output to set energy prices.
  - Develop provisions that allow non-dispatchable demand response (or interruptible load) to set energy prices in the real-time market when they are called upon in a shortage.
    - Per FERC requirement, MISO has been investigating ways to allow Emergency Demand Response (EDR) to set price when called upon in the Real-Time market.

Pricing to Reflect Engineering & Economics

- **Prices should reflect the physical reality of how costs are incurred in generating electricity.**
- **Electricity markets will function most efficiently, and with the least ad hoc intervention, when structured to provide prices that are consistent with the underlying cost structure.**
  - In order to address physical reality, generators in MISO are permitted to make offers for start-up costs, no-load costs, incremental energy costs, and minimum and maximum generation, among other things.
  - LMP itself originated in order to reflect the physical reality that congestion costs cause locational differences in prices.
    - LMP incorporates the costs of dispatch and transmission congestion in the prices.
    - ELMP incorporates the costs of commitment as well as dispatch in the prices.

MISO Market Operations

- **Two programs are central to MISO's least cost operations.**
- **MISO uses Security Constrained Unit Commitment (SCUC) to commit resources.**
  - SCUC commits resources to minimize cost considering:
    - The operating constraints for resources, e.g. dispatching a committed resource between its minimum and maximum operating points,
    - Offered no-load, start-up and incremental energy costs,
    - Demand for Energy and Ancillary Services,
    - Transmission constraints.
- **Once resources are committed, MISO uses Security Constrained Economic Dispatch (SCED) to dispatch them.**
  - SCED dispatches committed resources to minimize costs while:
    - Enforcing resource operating constraints for committed resources (e.g. minimum and maximum operating points, ramp limits, etc.),
    - Meeting demand for Energy and Ancillary Service,
    - Enforcing transmission constraints.

Today Prices Are Produced by SCED

- **SCED is also used to calculate prices for Energy and Ancillary Services.**
  - The LMP at a location is the cost to serve an infinitesimal increase (or decrease) in energy requirement at the location.
  - The unit commitment is not changed.
    - The cost of committing a resource when needed to meet demand is not reflected in the price.
  - Only the offered incremental energy costs of committed resources that are not dispatched at a limit can set LMPs.
    - Block loaded resources cannot set LMPs.
    - Resources at limits cannot set LMPs.
    - Costs incurred to start-up and no-load costs are not considered in setting prices.

Extended LMP (ELMP)

- **We can enhance SCUC so that it combines the abilities of SCUC and SCED for pricing purposes.**
- **MISO investigated using SCUC to set prices (Extended LMPs).**
  - The total cost as a function of demand has jumps in it caused by changes in commitment as demand changes.
    - Changes in cost in the jumps are lost when SCED is used to calculate prices.
  - ELMP smoothes out the jumps.
    - ELMP is the price based on the change in costs when demand changes enough to step through the jumps.
    - Price captures the changes in operating costs that result from adjusting dispatch and possibly commitment for this change in demand.
  - ELMP considers more offer characteristics and costs in setting prices.
- **MISO will still use SCUC and SCED to commit and dispatch resources so schedules for resources will not change.**
  - Only prices may potentially change.

ELMP Characteristics

- **ELMP minimizes uplift and the prices come closer to clearing the market.**
  - Uplift is the difference between:
    - (1) the maximum profit a resource could earn if it were to commit and dispatch itself in response to the prices, and
    - (2) the profit it earns in the Market by following the schedule produced by MISO.
  - Uplift includes (1) costs for following schedules that would incur losses at the market prices, Revenue Sufficiency Guarantee or RSG, and (2) foregone increased profits by following MISO schedules, opportunity costs uplifts which are not compensated.
  - More RSG is moved into prices.
- **ELMP allows off line resources to participate in setting prices.**
  - Tends to reduce price spikes from transient shortages or transmission violations that could be managed by committing additional resources.
    - Can reduce price volatility resulting from minor deviations from optimal operations.

Approximations & ELMP

- **Solving for prices based on SCUC requires us to develop optimization software rather than relying on a commercially available optimization package.**
  - Increases implementation risk and cost.
  - We investigated ways to approximate ELMP.
- **We have developed approximation methods that can be built by extending existing software.**
- **Based on tests, the resources that are most likely to cause ELMPs to differ materially from LMPs are Fast Start Resources such as gas turbines.**
  - The method will only consider commitment related costs for Fast Start Resources and Emergency Demand Response when calculating ELMP.

ELMP Approximation Method

- **MISO proposes to approximate ELMP by extending SCED software to include commitment of Fast Start Resources and EDR.**
  - Approach allows Fast Start Resources and EDR to participate in pricing even if they are block loaded or dispatched at a limit.
    - Approach involves allowing fractional commitment of Fast Start Resources for purposes of pricing.
      - This allows SCED to see the resources for pricing even if they are at limits.
    - Fractional commitment of these resources allows start-up costs and no-load costs as well as incremental energy costs to participate in pricing since they are included in making the decision to commit and dispatch these resources.
  - Using an approximation method based on SCED allows us to develop a robust pricing engine at less cost.

Approximation Method

- **We will calculate ELMPs for a single interval at a time as LMPs are calculated today.**
  - For a Fast Start Resource, allocate its start-up cost over its Minimum Run Time.
  - Its no-load cost stays in the hour it occurs.
- **Allow the commitment of any fraction (from 0 to 1) of a Fast Start Resource.**
  - When calculating prices, we commit just the amount of the resource that is needed to meet requirements at least cost.
  - In SCUC, commitment is all or nothing.
- **Treat EDR in a similar fashion.**

Off Line Fast Start Resources

- **MISO may encounter transient inability to meet all AS requirements while meeting Energy demand.**
  - Energy and AS prices under LMP would reflect shortage costs even when MISO is not short Fast Start Resources that could be committed to meet requirements.
  - Off line Fast Start Resources will participate in setting prices when shortages exist and committing the resource would alleviate the shortage.
    - Price reflects the cost of the action that MISO would take to meet requirements if the problem were to persist.
- **Similar problem can occur if transmission limits are violated.**
  - Rather than price transmission violations at administratively set penalty price, offline Fast Start Resources can participate in setting prices when committing the resource would alleviate the violation.
    - Price reflects the cost of the action that MISO would take to address the violation if it were to persist.

Schedule

- **Schedule**
  - ELMP Task Team and Market Subcommittee reviewed the draft tariff language and voted to approve filing Tariff language substantially similar it.
  - Tariff language filed at last year's end
  - Anticipated implementation in late 2013 or early 2014.

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