Enhance Economic Selection and Dispatch of *Contingency* Reserves

Akshay Korad, *Engineer Market Evaluation & Design, MISO*
Oluwaseyi Akinbode, *Engineer Market Evaluation & Design, MISO*
Dhiman Chatterjee, *Director Market Evaluation & Design, MISO*
Jeff Bladen, *Executive Director Market Services , MISO*

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Purpose & Key Takeaways

- **Purpose**
  - Overview of MISO market design for Contingency Reserves (CR)
  - Identify and quantify need for proposed market design enhancement
  - Propose solutions to address market design needs
- **Key Takeaways**
  - Historically, significant uplift incurred for Contingency Reserves Deployment (CRD) events
  - Full production cost is not currently considered in CR selection and deployment process
  - Proposed solutions to address MISO market needs and improves Market Efficiency by reducing uplift

Overview: Operating Reserves

Reg.
- Online Resources
- Deployed in sec.
- Avg. ~400 MW requirement
- Compensation: capacity, energy, and mileage

Spin
- Online Resources
- 10 min. response time
- Avg. ~900 MW requirement
- Compensation: capacity and energy

Supp.
- Online and/or Offline Resources
- 10 min. response time
- Avg. ~1100 MW requirement
- Compensation: capacity and energy

Contingency Reserve

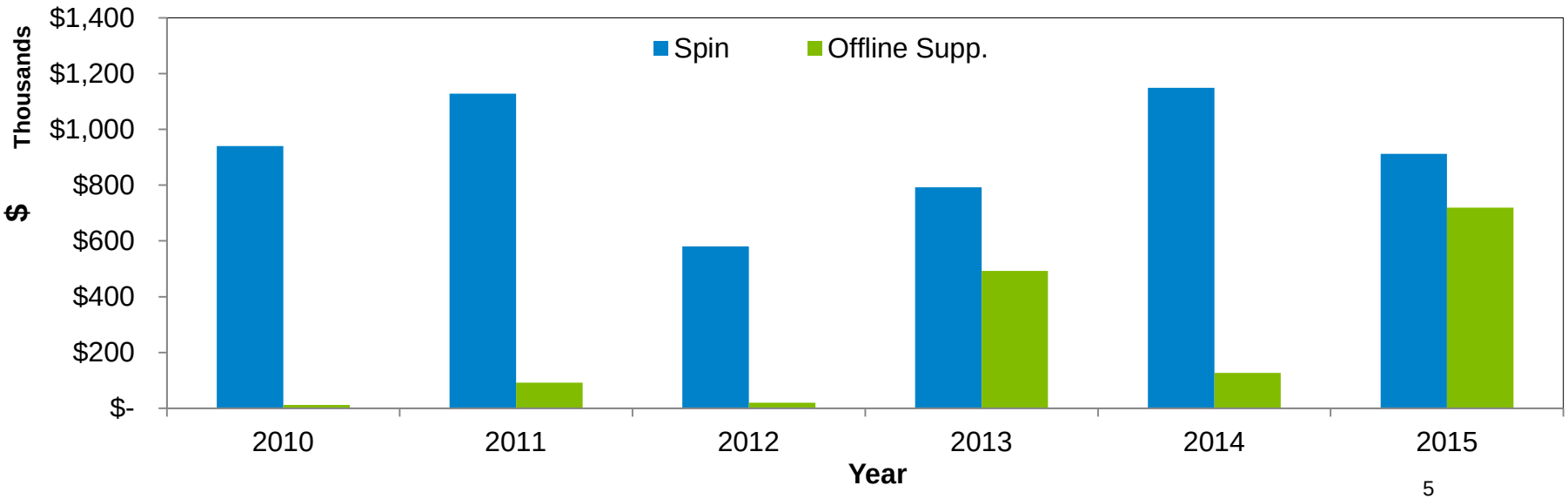
Contingency Reserve Scheduling Logic

- **Objective: Minimizes scheduling costs (not production costs)**
- **Offline resources are scheduled based on reserve capacity offer only**
  - Minimum runtime and commitment costs are not included in selection logic
- **Online resources are scheduled for spin based on spin offer and energy opportunity**
  - DRR-I curtailment time and curtailment offer not included in scheduling logic

Uplift for Deployed Contingency Reserve

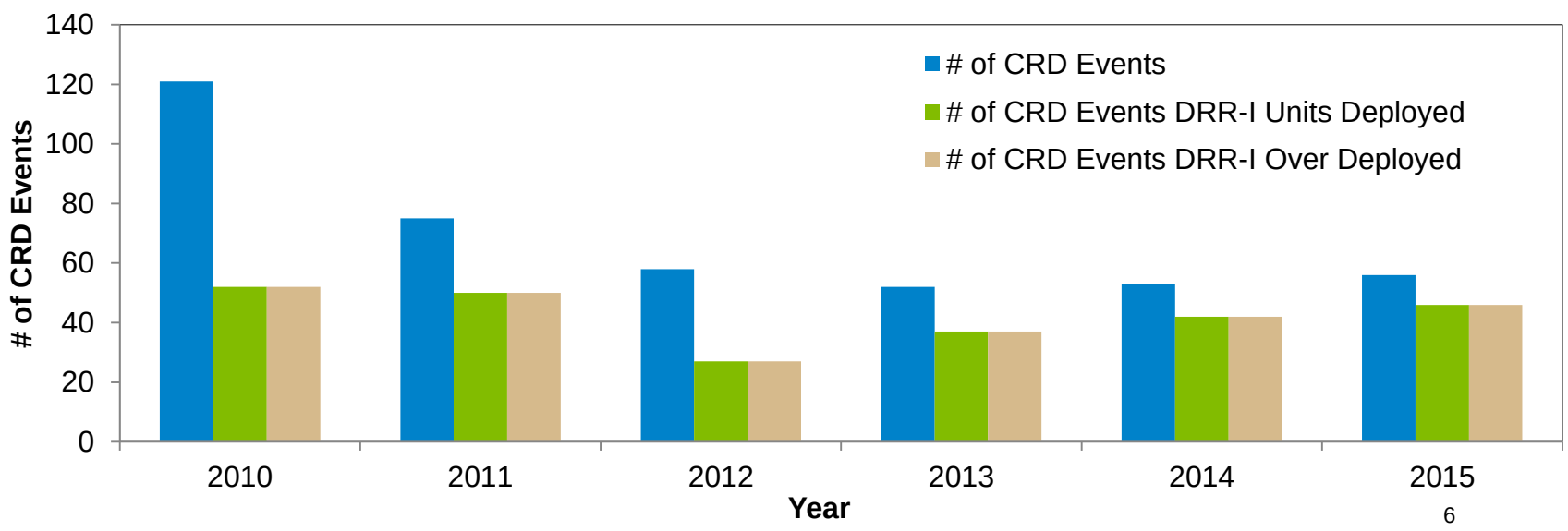
- **Spin: Mainly DRR-I resources paid ~$900k/year in uplift (2010-15) for CRD due to relatively high curtailment cost**
- **Offline Supp.:Mainly Generators paid ~$275k/year in uplift (2010-15) for CRD.**
  - Uplift increased to ~$720k in 2015.

Total Uplift for Deployed Contingency Reserve



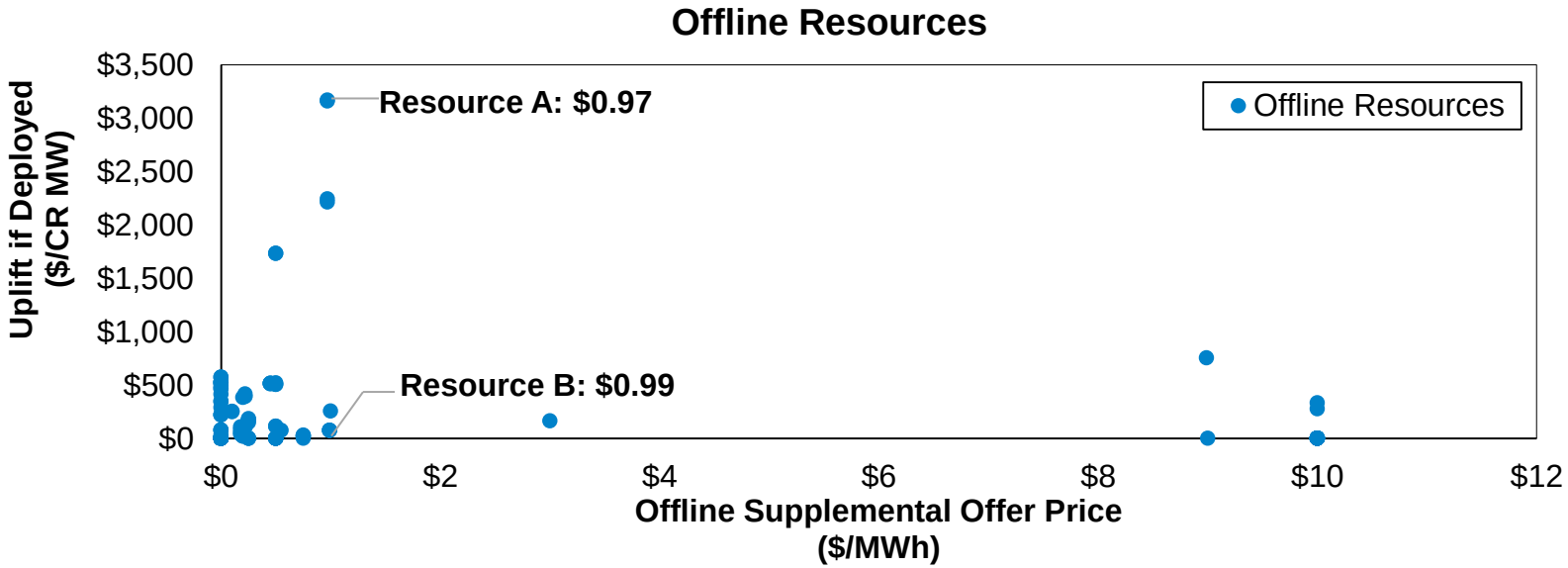
CRD Events and DRR-I Deployments

- **Steady increase of DRR-I utilization in CRD events (43% in 2010 to 82% in 2015)**
- **All DRR-I deployments resulted in over- deployment**
  - DRR-I: binary operation (no deployment or full offered capacity deployment)
  - *Automated pro-rata* CR deployment



Uplift for Offline Deployment*

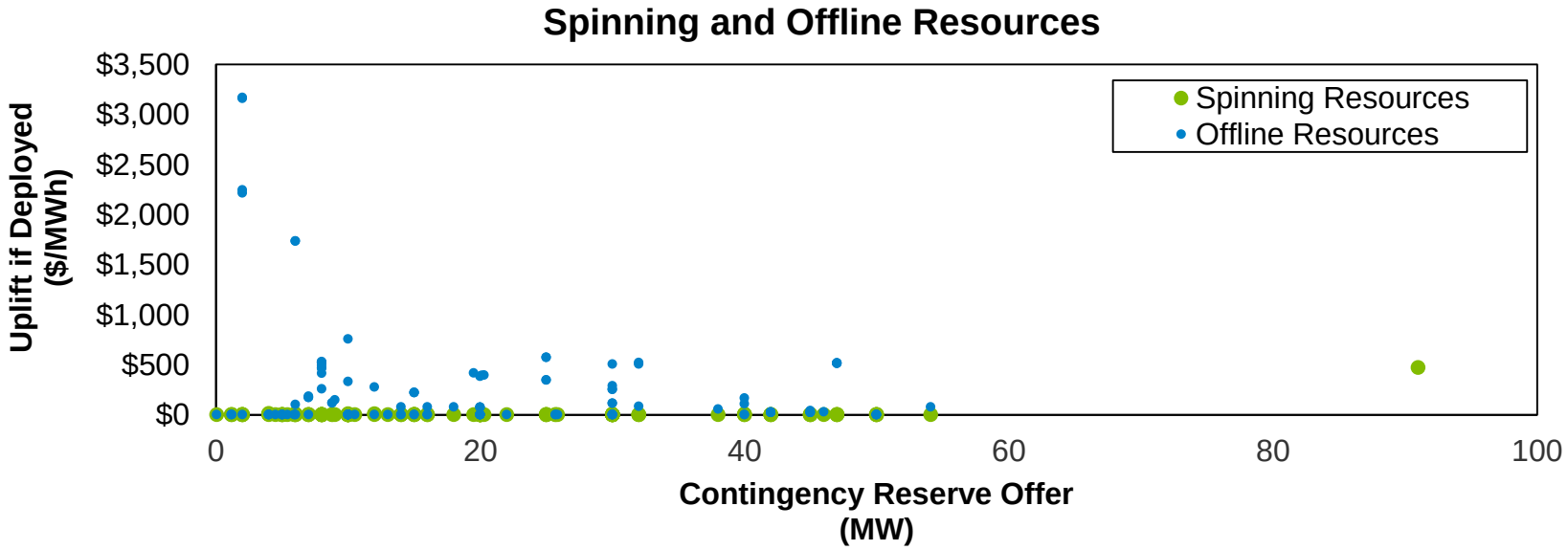
- **Offline resources are scheduled based on reserve capacity offer only**
- **Resource A will be scheduled before Resource B**
  - Resource A: lower CR offer but higher deployment cost
  - Resource B: higher CR offer but lower deployment cost



* MISO IMM evaluation

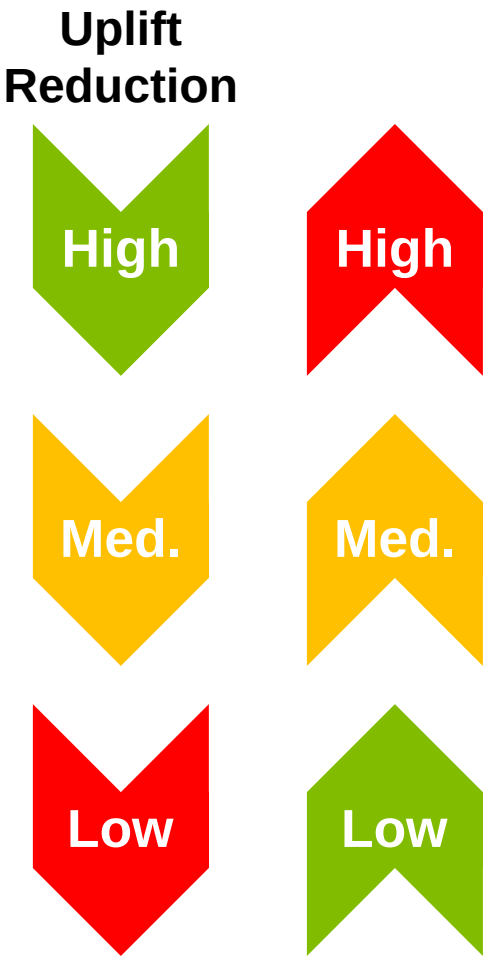
Uplift for Spinning and Offline Deployment*

- Online resources are scheduled for spin based on spin offer and energy opportunity
- Spinning reserve providers require less uplift when deployed
- Inclusion of deployment risk in selection criteria would shift more reserves to spinning resources



* MISO IMM evaluation

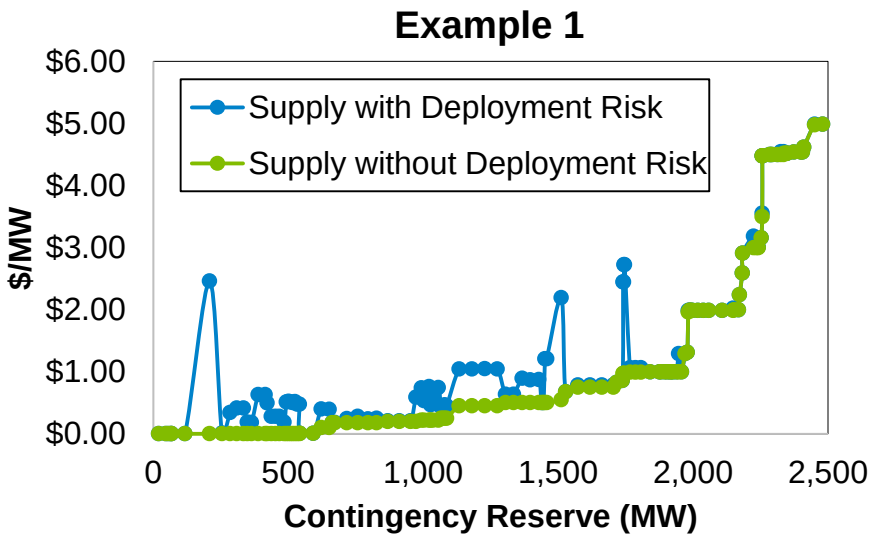
Possible Solutions

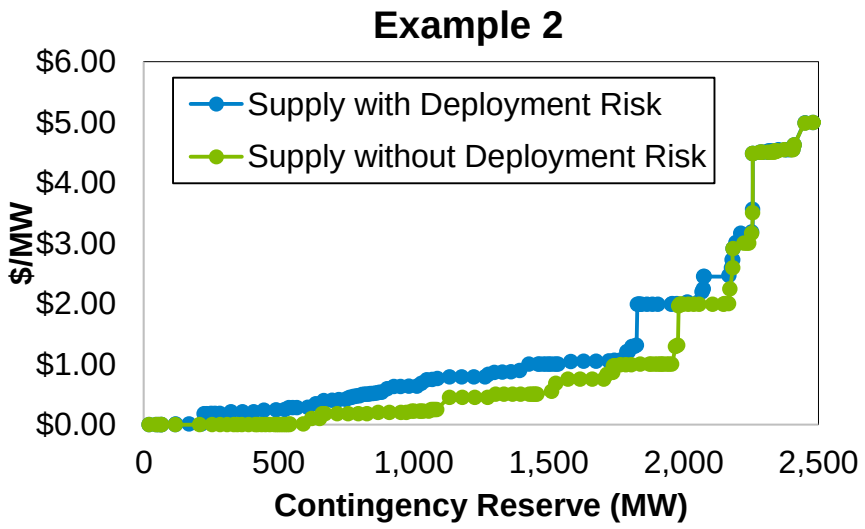


Stochastic Approach	• Two-stage Unit Commitment problem • Consider deployment-cost in CR selection
CR Supply Curve with Deployment Risk	• Determine deployment risk for each resource • Consider deployment risk adder in CR selection
CR Deployment Logic	• Enhance CR deployment logic • Consider deployment cost in CRD event

CR Supply Curve with Deployment Risk*

- **Deployment Risk = Outage Chance x Uplift Cost if Deployed**
- **Inclusion of risk would reshape/reorder CR supply curve**
  - Likely result in higher MCP but would reduce uplift expectation
  - Historical example: MCP unchanged but four offline resources not scheduled when evaluating deployment risk
- **Will not eliminate CR deployment-related uplift**





CR Deployment Logic

- **Update CR deployment logic**
  - Status quo: CR deployment does not consider resource deployment cost
    - *Spin: Pro rata deployment*
    - *Offline Supp.: Rank list approach*
  - Enhancement: Update CR deployment logic to capture deployment costs
    - Spin: Pro rata + deployment cost consideration
    - Offline Supp.: Deployment cost based rank list approach
  - Can be implemented with or without the other possible alternatives

Summary

- **MISO Stakeholders, through the MISO Market Roadmap process, have previously identified the need for this Market Enhancement**
- **Appropriate price signal is critical for Operating Reserve Market**
  - Uplift in CRD events distorts price signal and degrades market efficiency
- **Proposed solutions should reduce the uplift**
  - In MISO Market, CRD events causes avg. uplift of >$1.1 million/year
  - CRD uplift cannot be completely eliminated