# Review of March 1, 2017 Implementations

*March 1 – October 31, 2017*

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# Presentation Road Map

- Fast-start pricing (FSP)
- Sub-hourly settlement (SHS)
- Net Commitment-Period Compensation (NCPC)
- Dispatchable-asset-related demand (DARD pumps)
- Summary

# March 1 implementations were intended to:

- Enable rapid response pricing assets (RRPAs) to set real-time locational marginal price (LMP) more frequently by:
  - Participating in price setting when they are part of the least-cost solution
  - Reflecting costs of dispatching the resources in market clearing prices
- Enhance price formation to increase transparency, efficiency, and maintain system reliability
- More precisely compensate resources by applying pricing that aligns more closely with the service provided
- Provide NCPC payments to enhance incentive to follow dispatch instructions
- Improve modeling and dispatch of pumps to better reflect the operating characteristics of pumped storage

# Overview

- March 1 implementations went smoothly
- Market outcomes consistent with design expectations
  - **Fast-start pricing** (FSP) has raised real-time (RT) LMPs and reserve prices
  - **Sub-hourly settlement** (SHS) has increased generator revenue compared to hourly compensation
  - New **Net Commitment-Period Compensation** (NCPC) categories implemented to incent dispatch following
  - **Dispatchable-asset-related demand** (DARD pumps) modeling changes have reduced self-scheduling of pumping load

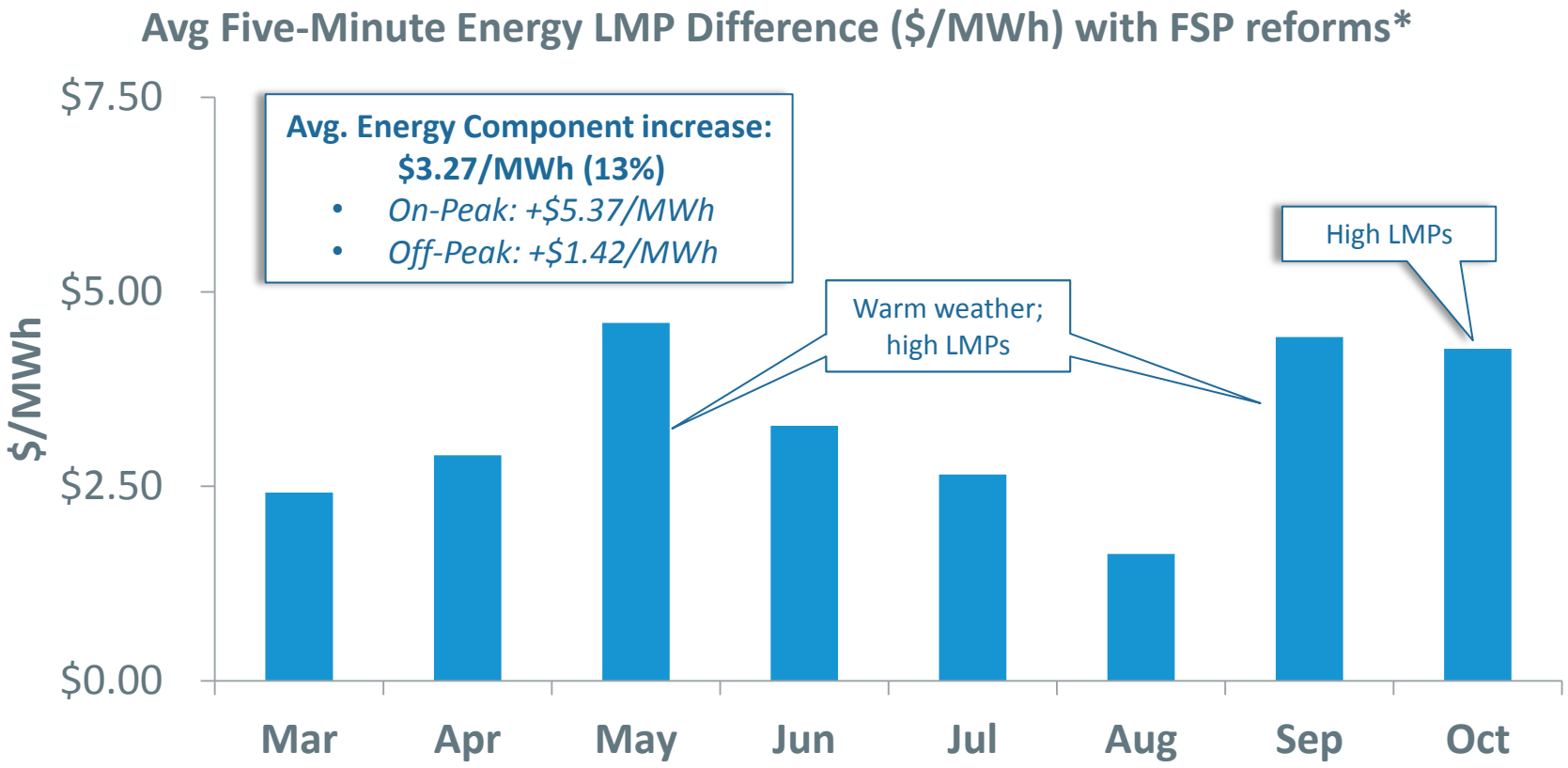
# FAST-START PRICING

# Summary - Fast-start Pricing

- Changes enable rapid response pricing assets (RRPA) to set real-time LMP more frequently by
  - Participating in price-setting when they are a part of the least-cost solution to meet RT demand
  - Reflecting costs of dispatching the resource (including start-up and no-load costs) in market clearing prices
- NCPC rules changed to compensate dispatchable resources that incur an opportunity cost when RRPAs are setting price (presented later)

FSP

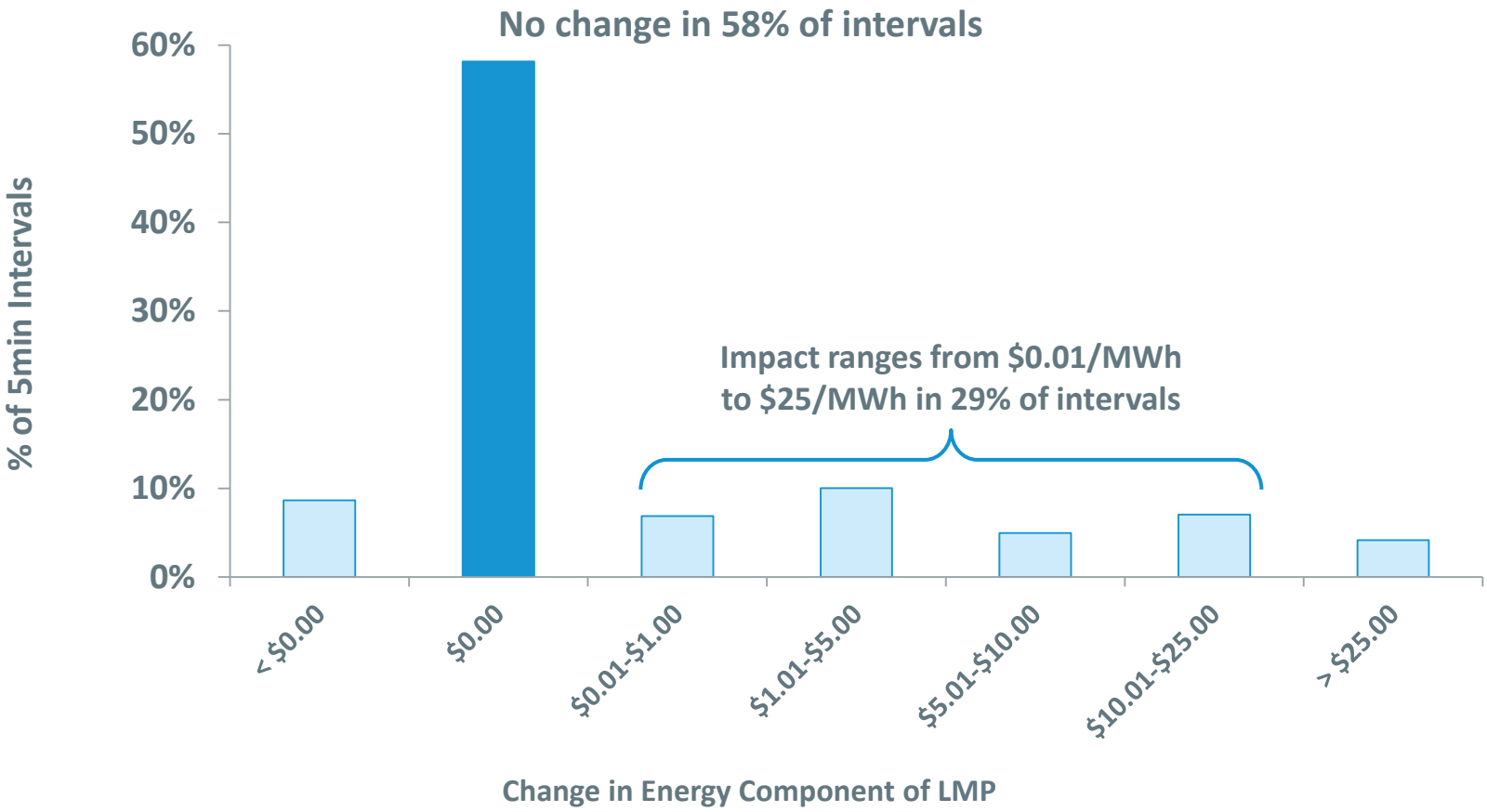
# Fast-start pricing has increased energy component of RT LMP – March 1 - October 31




FSP

*Compares prices using new vs. old method

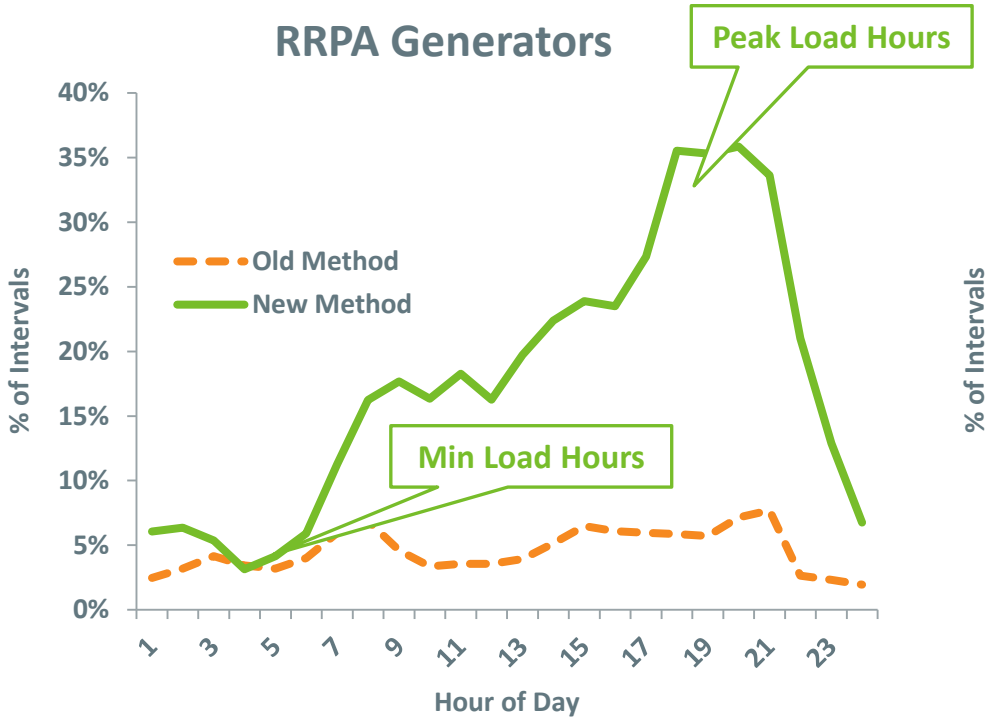
# Fast-start pricing has changed prices in about 42% of intervals – March 1 - October 31

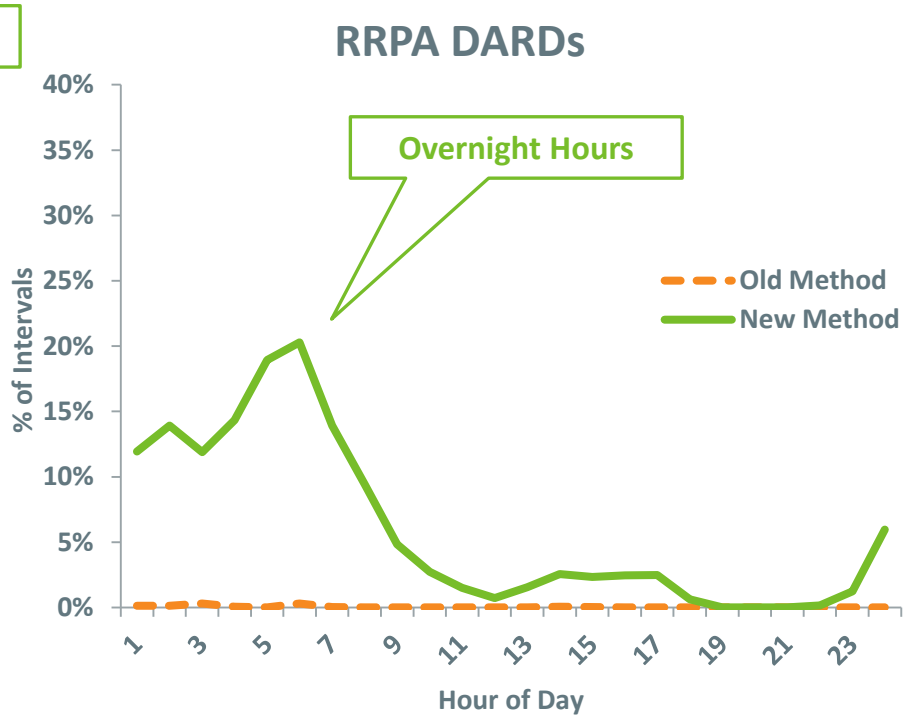



FSP

Note: Compares Energy LMP results using the new method vs. the old method. No price change means the application of fast-start pricing resulted in the marginal unit staying within the same price offer block under the new method.

# RRPA Price Setting by Type of Resource and Time of Day – March 1 - October 31

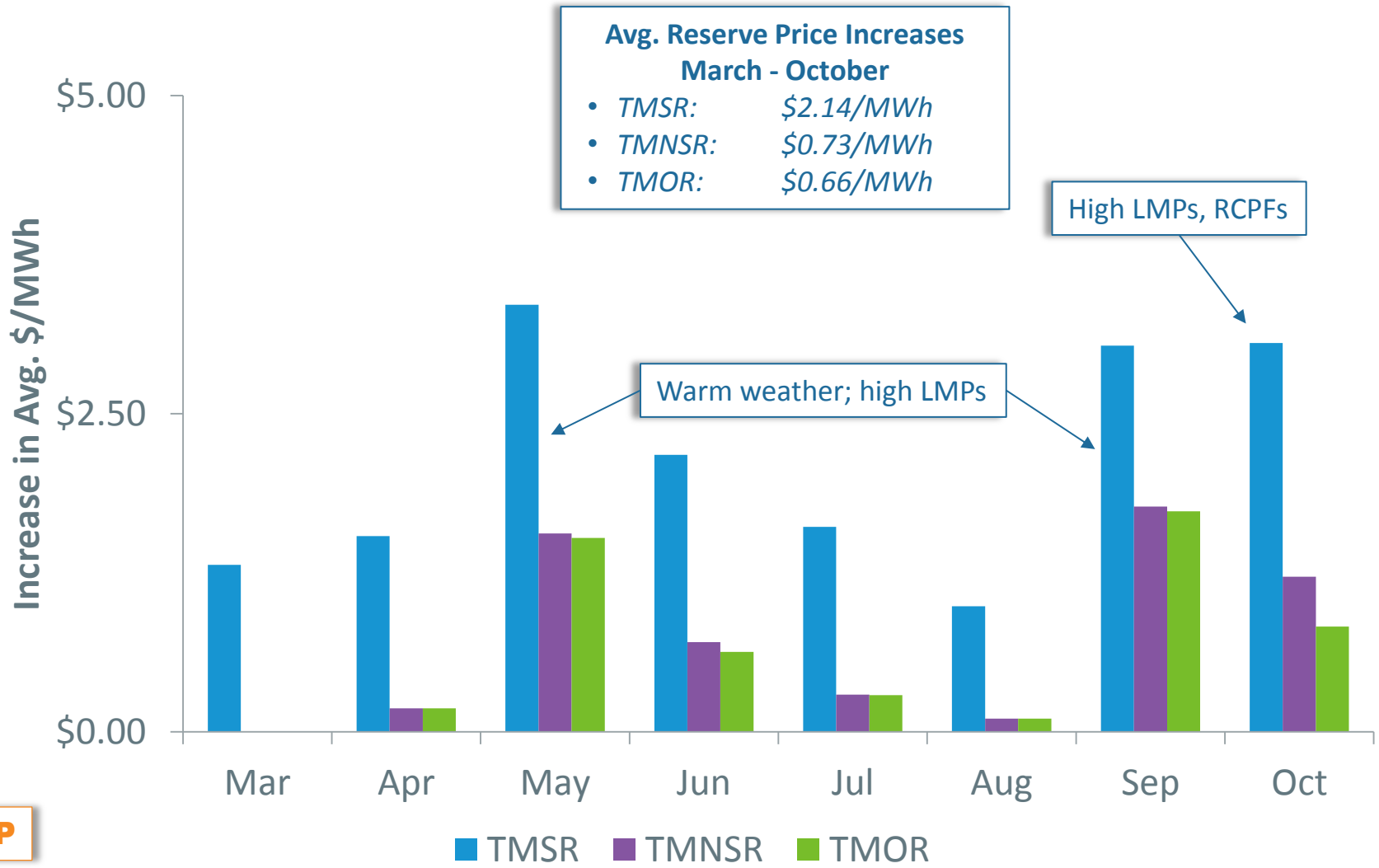



FSP

Note: More than one resource (or category of fast-start resource) may be marginal in the same interval.

# FSP has raised reserve prices; largest impact on TMSR




FSP

# Fast-start Pricing - Conclusions

- Changes have enabled RRPAs to set real-time LMP more frequently
  - Average energy price has increased by $3.27/MWh, or 13%
    - Average RT energy price, March 1 - October 31: $28.45/MWh
  - FSP has affected reserve price frequency and levels
- Enhanced price formation under FSP makes the cost of dispatching RRPAs more transparent and efficient
  - Incents RRPA performance to meet demand for load and maintain system reliability
- Dispatchable resources that incur an opportunity cost when RRPAs are setting price receive NCPC payments (presented later)
- SHS impacts (presented in the next section) are over and above this increase

FSP

# SUB-HOURLY SETTLEMENT OF REAL-TIME MARKETS

- *Energy*
- *Reserves*

# Objective: Increase Accuracy of Compensation

- The sub-hourly settlement revisions to the Real-Time Energy Market were intended to have two important benefits:
  - Enhance incentives to follow dispatch instructions
  - More accurately compensate the energy and reserve products delivered in real time

SHS

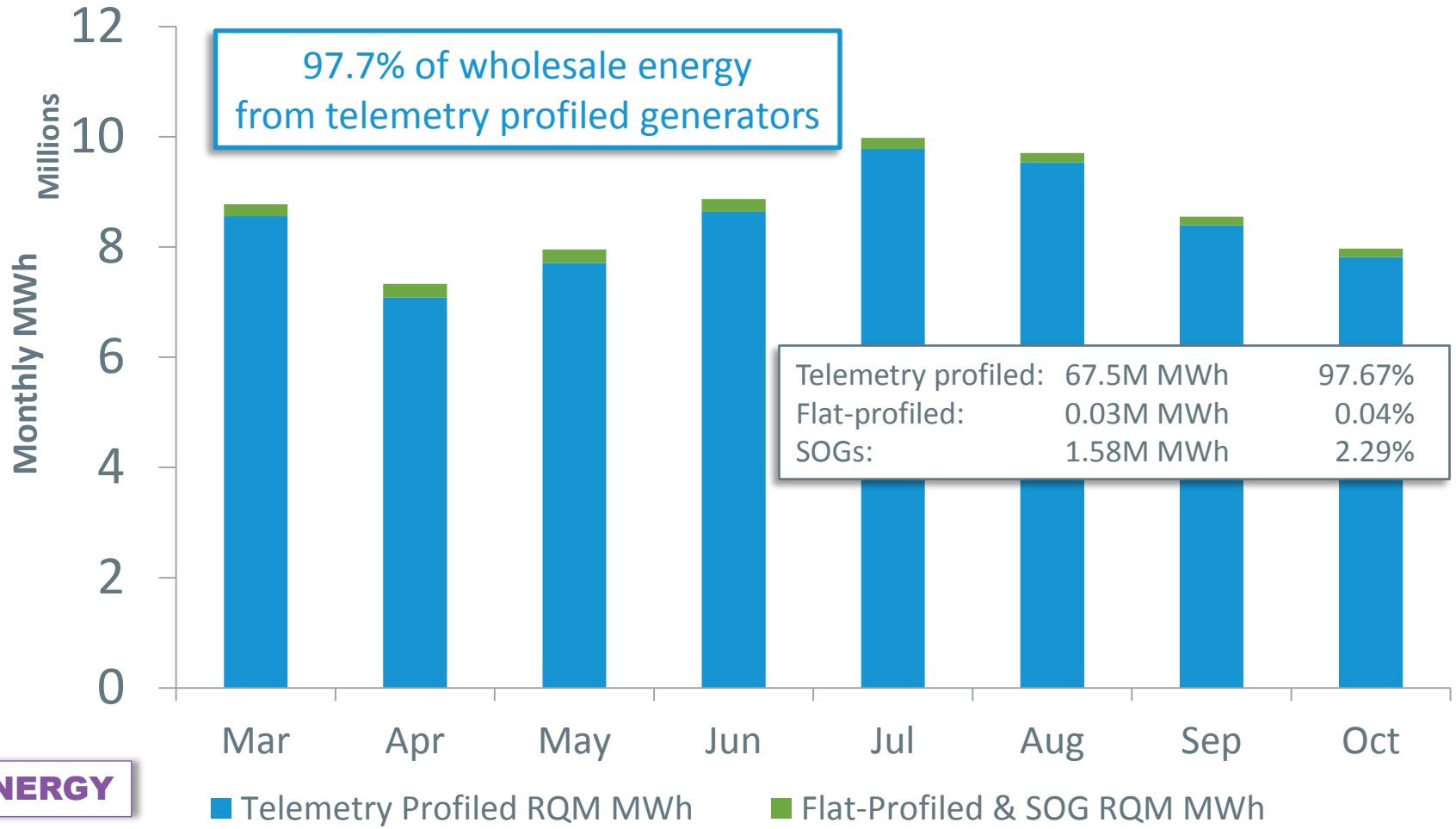
# Sub-hourly Energy and Reserve Settlement – Summary

- Real-time **energy** revenues for supply have increased
- Real-time **reserve** revenues have decreased
- Combined impact is a net increase to supply

SHS

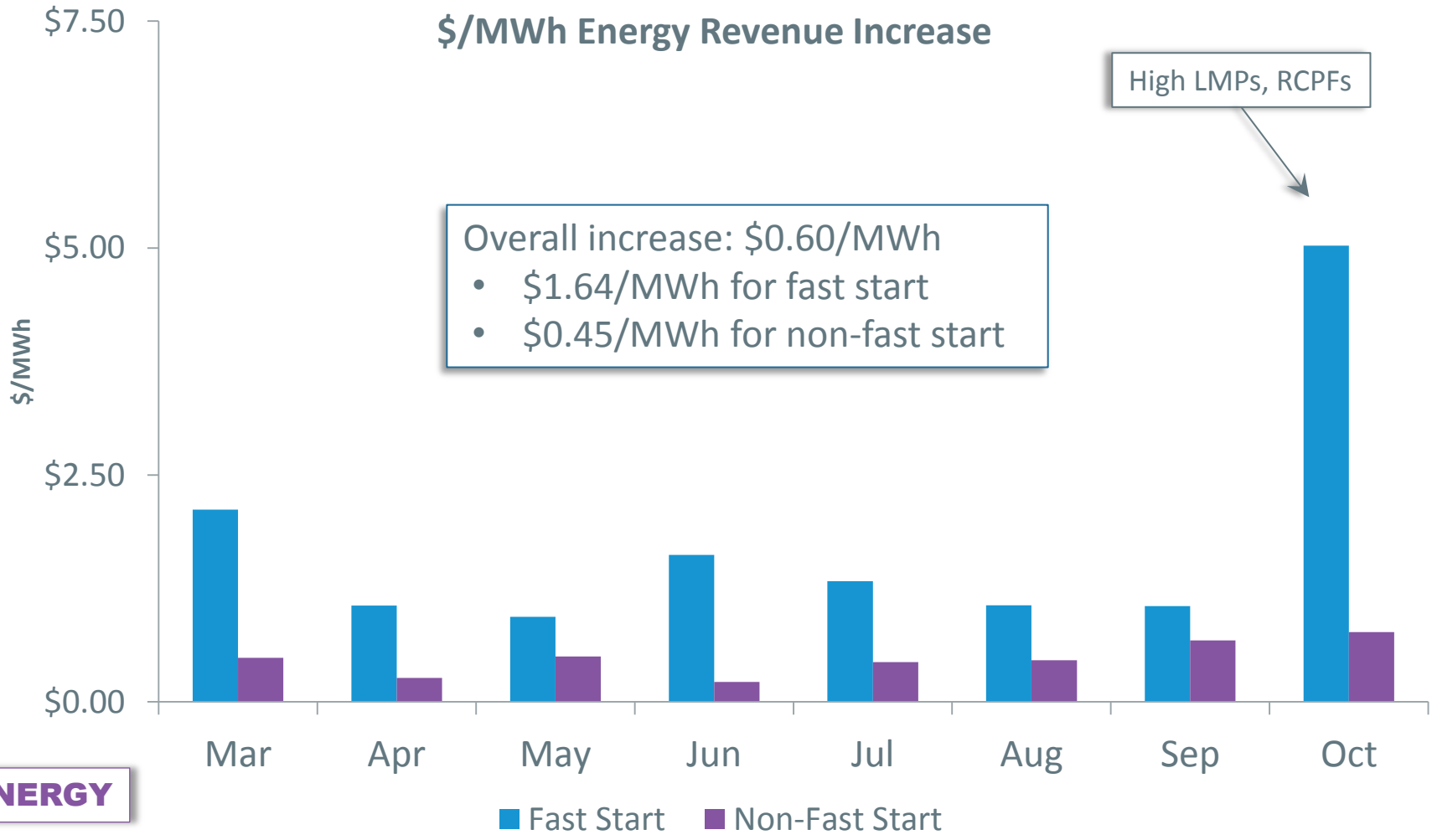
# SUB-HOURLY REAL-TIME ENERGY SETTLEMENT

# Nearly all wholesale energy production is produced by generators that are telemetry profiled



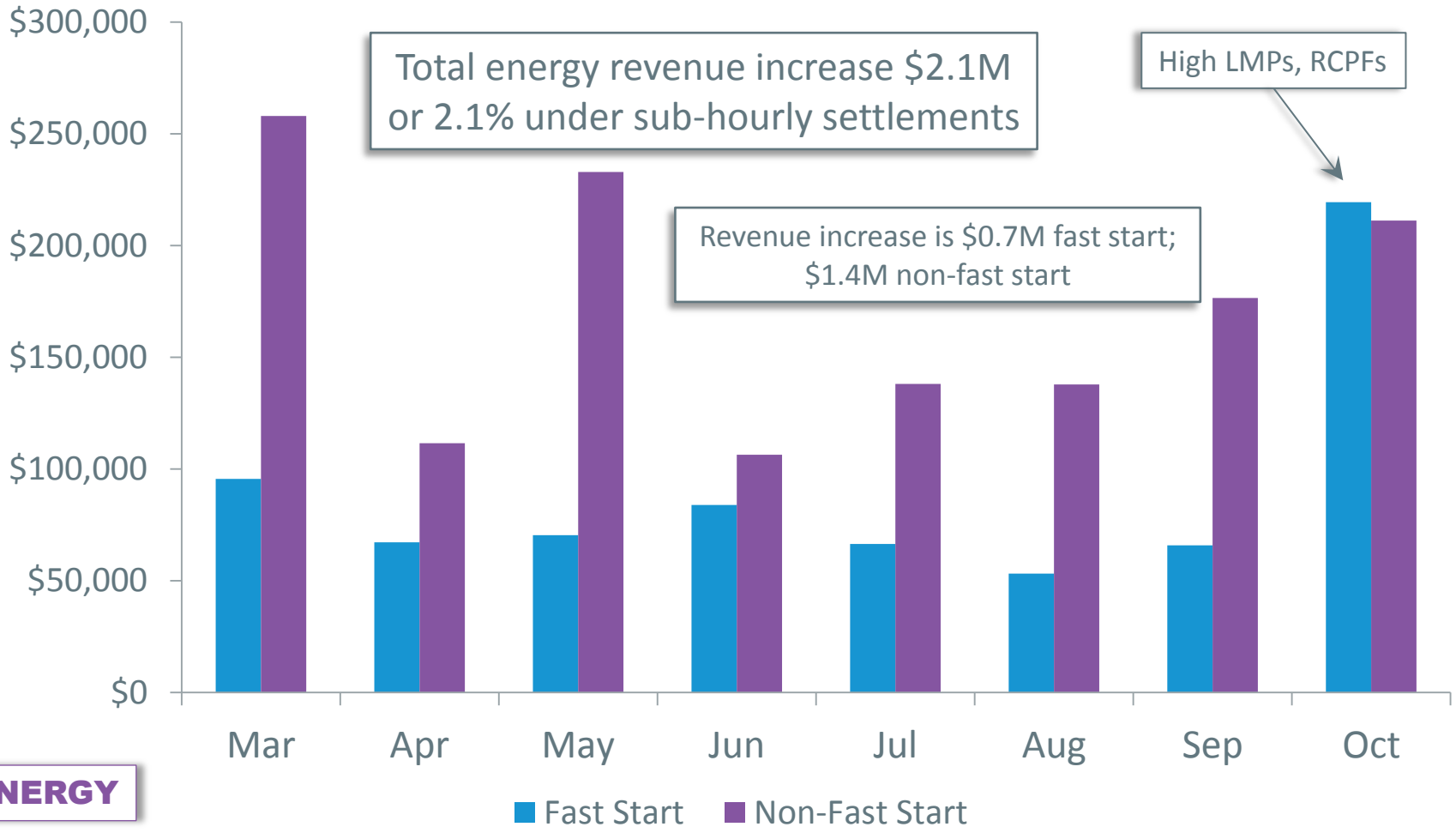

ENERGY

# RT energy revenue increases per MWh are higher for fast-start generators under SHS




ENERGY

# RT energy revenue increases are higher for non-fast-start generators under SHS




ENERGY

# Sub-hourly Settlement – Energy Summary

- Real-time **energy** settlement revenues for telemetry-profiled generators increased 2.1% ($2.1M) due to sub-hourly settlement
  - This impact is over and above FSP impacts
- Impacts are greatest for more flexible generators

ENERGY

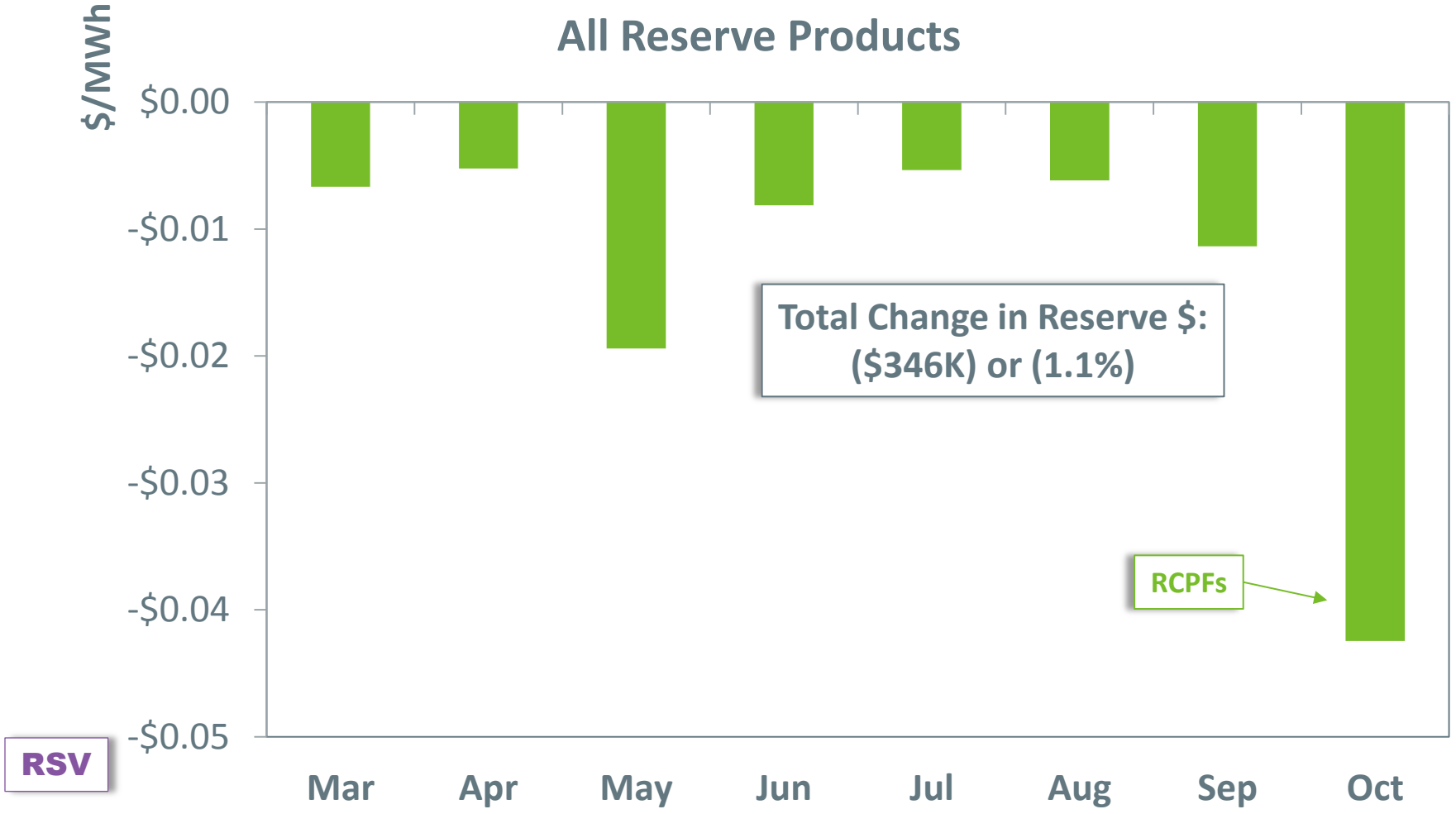
# SUB-HOURLY REAL-TIME RESERVES

# Sub-hourly Settlement – Reserve Market Overview

- Real-time reserve payments under sub-hourly settlements decreased (as expected) due to more precise compensation

RSV

# As expected, sub-hourly settlement reduced reserve revenue



# Sub-hourly Settlement – Reserves Summary

- Overall decrease to reserve providers due to five-minute settlement was 1.1% or $346K from March 1 - October 31

RSV

# Sub-hourly Energy and Reserve Settlement – Summary

- Sub-hourly changes to real-time energy and reserves (over and above FSP) have resulted in a net increase to suppliers
  - Real-time energy revenues for generators and reserve providers resulted in a net increase of $1.7M
- Overall pricing reforms more closely align compensation with services provided

SHS, RSV

# MARCH 1 NCPC IMPLEMENTATION

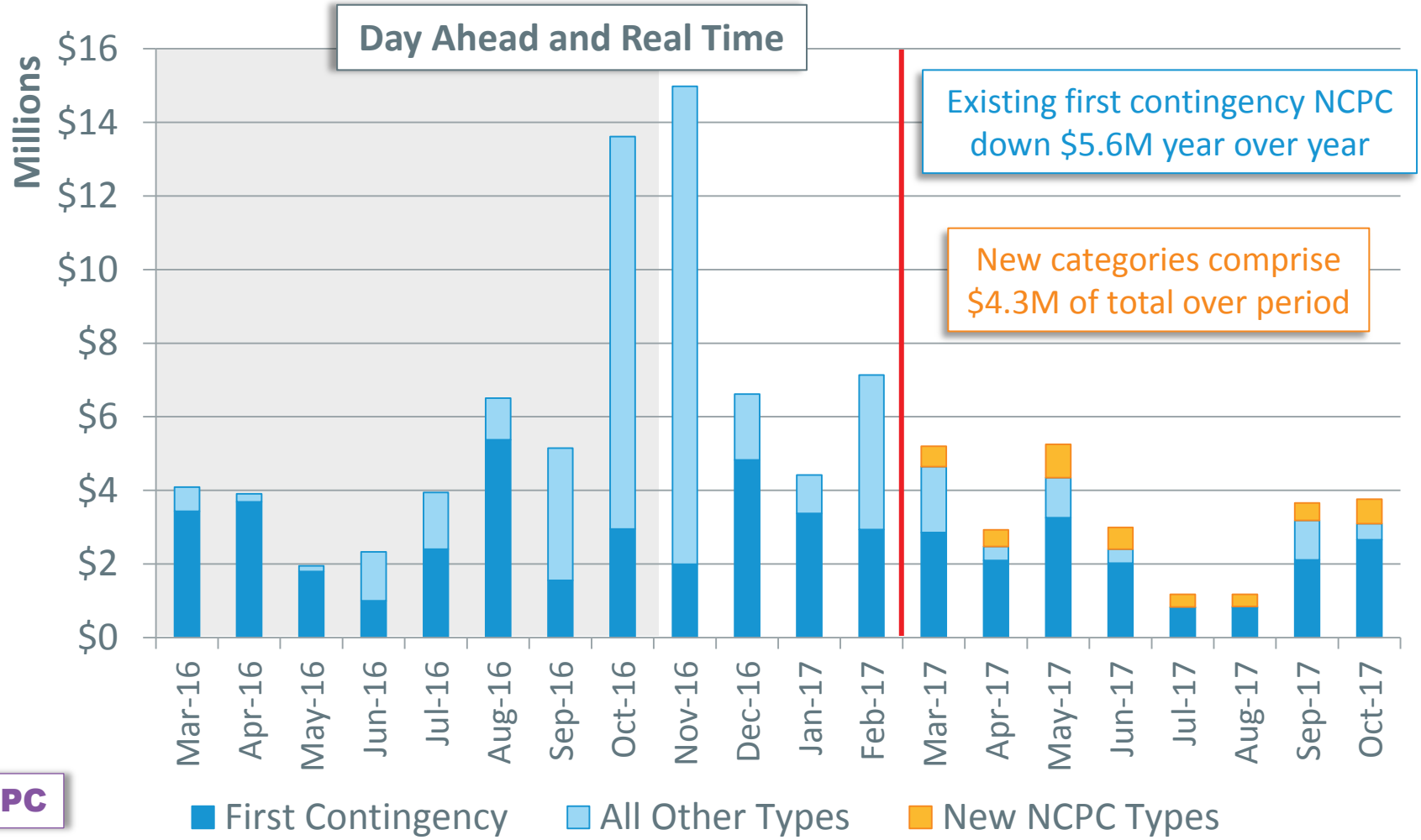
# March 1 NCPC Implementation – Overview

- Overall NCPC trend is down
  - First contingency NCPC reductions[1] due to:
    - FSP (higher RT LMPs)
    - SHS (higher net RT revenues)
    - Increased precision of five-minute revenues and costs reflected in RT NCPC calculations
  - Three new NCPC categories created to enhance incent dispatch following
    - DARD pumping (DA and RT)
    - Dispatch Lost Opportunity Cost (DLOC)
    - Rapid Response Pricing Opportunity Cost (RRP OC)

NCPC

[1] Results shown do not control for weather (milder) and gas prices (slightly higher)

# New NCPC categories are 17% of total NCPC between March 1 and October 31




NCPC

# March 1 NCPC Summary

- New NCPC categories total $4.3M from March 1 through October 31
  - DARD pumping NCPC
    - $421K over the eight months
  - Rapid Response Pricing Opportunity Cost (RRP OC) (paid almost entirely to non-RRPAs)
    - $1.9 million over the eight months
  - Dispatch Lost Opportunity Cost (DLOC)
    - $2.0 million over the eight months
- As expected, reductions in first contingency NCPC due to higher market prices and more precise compensation*

NCPC

*Results shown do not control for weather (milder) and gas prices (slightly higher)

# March 1 NCPC – Summary

- New NCPC payments are $4.3M
- Estimated decreases in first contingency NCPC resulting from increased prices and more precise compensation are $5.6M
- Overall reforms more closely align compensation with services provided

NCPC

Note: Results shown do not control for weather (milder) and gas prices (slightly higher)

# DARD INTERTEMPORAL PARAMETERS

# Summary – DARD Pumps

- Improved modeling and dispatch of pumps better reflects the operating characteristics of pumped storage
- Enhanced financial incentives through addition of NCPC payments

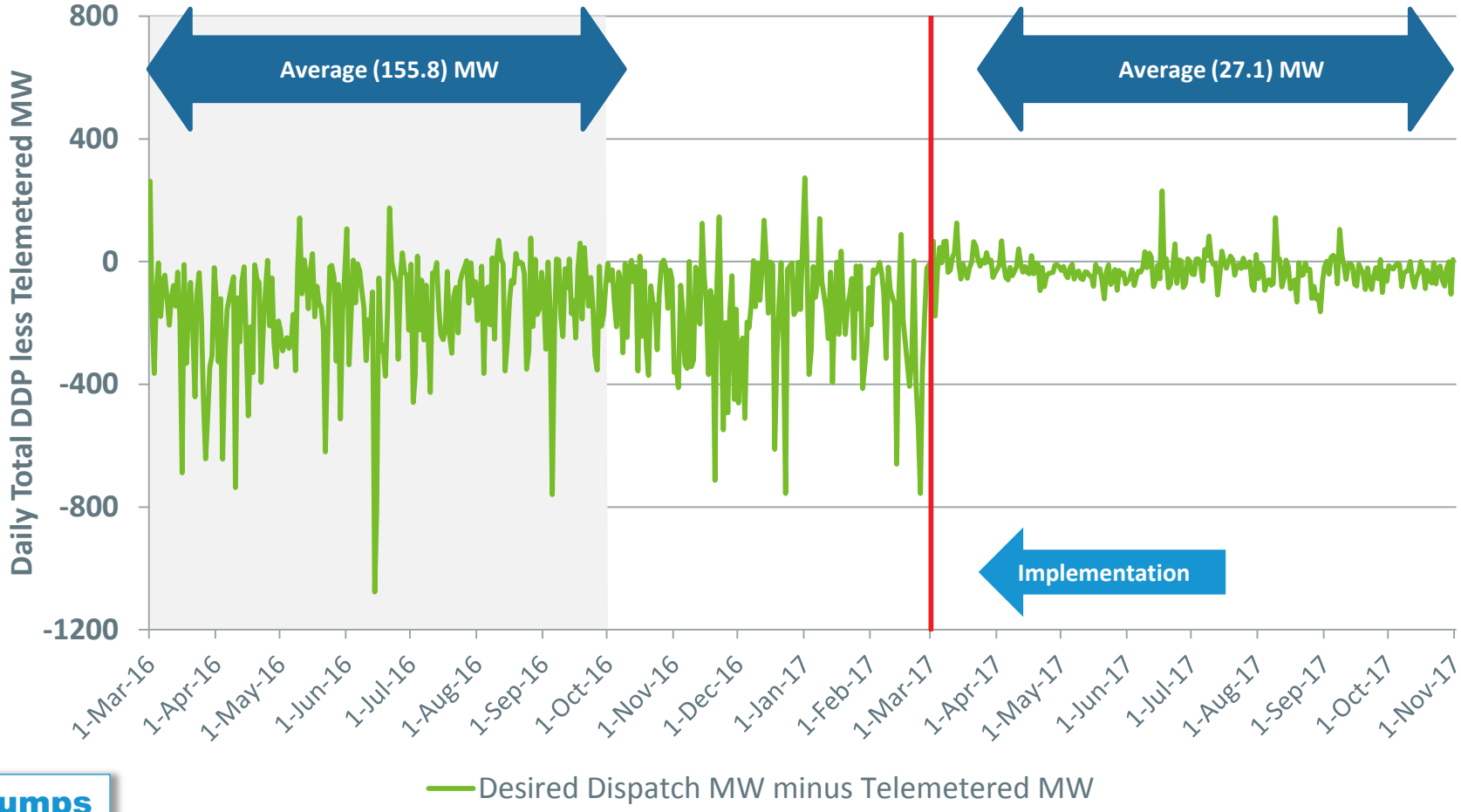
Pumps

# DARD Pump Parameters – Key Features

- New modeling practices and bidding parameters
  - **Min consumption limit** ensures dispatch matches physical ability of pump
  - **Min run time and min down time** increase certainty around expected operation
  - **Max daily consumption and max daily starts** aid DA clearing
- DA and RT NCPC settlements modified to include payments to pumps

Pumps

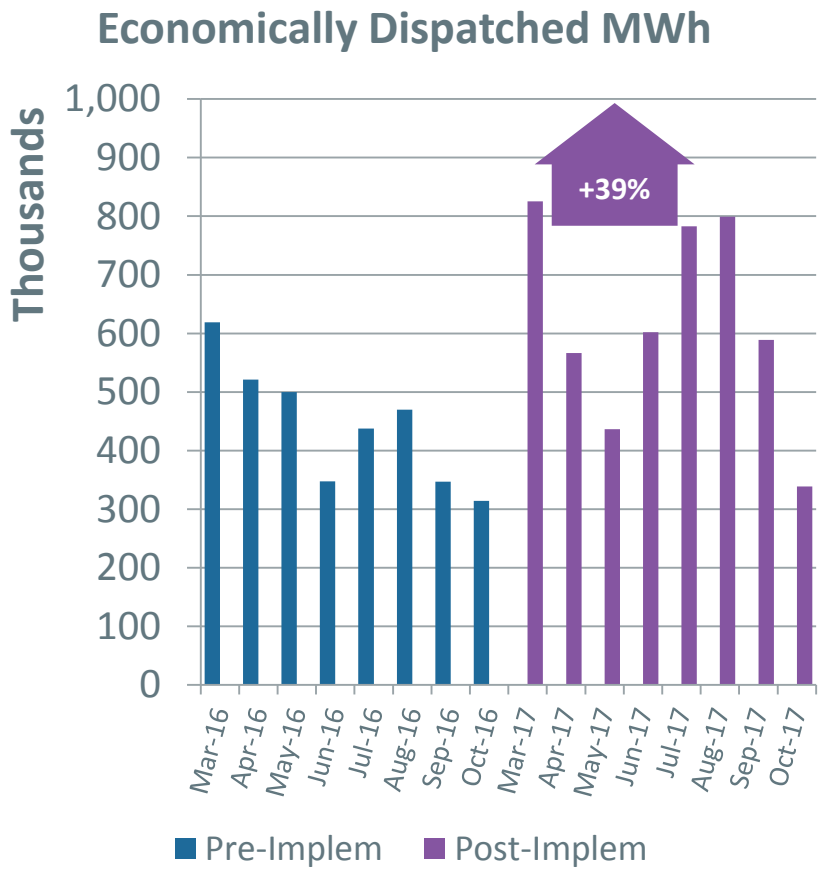
# Improved daily dispatch has resulted from improved modeling

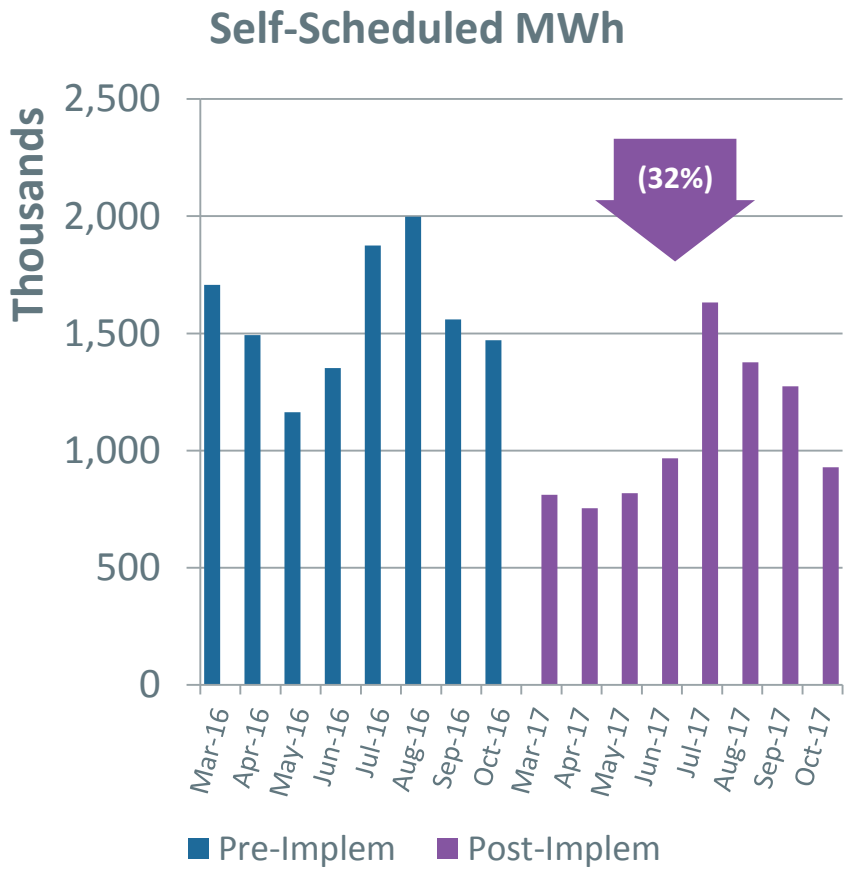



**Pumps**

Note: Economically dispatched units only

# Improved dispatch has increased economically scheduled pumping; decreased self-scheduling




**Pumps**

# Conclusions – DARD Pumps

- Improved modeling and dispatch of pumps better reflects their operating characteristics
- Economically scheduled pumping is now a larger share of total DARD pumping operations

Pumps

# March 1 implementations were intended to:

- Enable RRPAs to set real-time LMP more frequently by: ✓
  - Participating in price-setting when they are part of the least-cost solution
  - Reflecting costs of dispatching the resources in market clearing prices
- Enhance price formation to increase transparency, efficiency, and maintain system reliability ✓
- More precisely compensate resources by applying pricing that aligns more closely with the service provided ✓
- Provide NCPC payments to enhance incentive to follow dispatch instructions ✓
- Improve modeling and dispatch of pumps to better reflect the operating characteristics of pumped storage ✓

# Summary of Energy Market Enhancement Impacts on Generator Compensation

| Market | Item | Incr/(Decr) | Direction |
|---|---|---|---|
| **RT Energy Market** | *FSP effect on generator deviations*[1] | $13.3M | ▲ |
| | *SHS methodology* | $2.1M | ▲ |
| **RT Reserve Market** | *FSP effect on reserve prices* | $19.8M | ▲ |
| | *SHS methodology* | ($0.3M) | ▼ |
| **NCPC** | *New NCPC Categories* | $4.3M | ▲ |
| | *SHS methodology*[2] | ($5.6M) | ▼ |
| **All Markets** | **Net impact (8 months)** | **$33.6M** | ▲ |

| | | | |
|---|---|---|---|
| **RT Energy Settlement** | Total Value of RT Generator Deviations | **$100M** | |
| | *Impact as % Deviations* | **34%** | |
| **Value of Generation** | Day-Ahead and Real-Time | **$2,000M** | |
| | *Impact as % of Total Generation Value* | **1.7%** | |

[1] Estimates resulting from application of price deltas to 5-minute deviations, plus SOGs.

[2] Results are estimated, and do not control for weather (milder) and gas prices (slightly higher)

# Summary

- March 1 implementations went smoothly
  - FSP has increased the frequency of RRPAs setting price
    - The new treatment of RRPAs has resulted in RT LMPs increasing by $3.27/MWh or 13%
    - FSP enhances transparent and efficient pricing signals; contributes to system reliability
  - SHS has increased generator energy revenue and decreased reserve revenue by $1.7M net
  - DARD pumps modeling changes have reduced self-scheduling of pumping load
  - NCPC additions have been $4.3M
    - Higher RT prices and more precise compensation is affecting first contingency NCPC

# Questions