EIM Resource Sufficiency #3

Step 1: Introduction and Education
Step 2: Description of the Issue

Agenda

- Introduction and Education (Step 1)
  - Background Information
  - Balancing Test
    - Test description
    - Scenario discussion
  - Flex Ramp Sufficiency (FRS) Test
    - Test description
    - Scenario discussion
  - Relationship between Balancing Reserves (BR) and Resource Sufficiency (RS)

- What's the Issue? (Step 2)
  - ROD: BPA will consider addressing RS on the sub-balancing authority area level
  - ROD: BPA will consider developing policies to ensure it passes the RS evaluations as often as possible

Objectives

- BPA intends to explore all RS tests in future stakeholder meetings, but today is focusing on the most critical RS test questions
- Transmission feasibility is advisory and will be discussed in later stakeholder meetings
- We are focusing on the FRS Test over the Capacity Test because, based on our understanding, passing the former almost always means passing the latter

EIM Resource Sufficiency #3:

Step 1: Introduction and Education

ROD and RS

As part of Phase III, the ROD states that BPA will evaluate the following regarding RS:

- BPA will consider addressing RS on the sub-balancing authority area level
- BPA will consider developing policies to ensure it passes the RS evaluations as often as possible

Resource Sufficiency

- The RS evaluation determines whether each BA has procured, prior to each operating hour, sufficient resources and flexible capacity (both internal and external) to serve their load and load/VERs uncertainty

Resource Sufficiency Tests

The RS evaluation consists of four tests performed every hour:

- **Transmission Feasibility Test** → provides an opportunity to manage potential Transmission constraint violations prior to the operating hour
- **Balancing Test** → checks that resource base schedules balance to the BA's load forecast provided by CAISO, otherwise an over/under scheduling penalty may apply
- **Bid Range Capacity Test (Capacity Test)** → checks that there's sufficient bid range capacity to manage any imbalance from the Balancing Test and historical interchange deviations
- **Flexible Ramp Sufficiency Test (FRS Test)** → checks that there's sufficient within hour ramping capability and bid range capacity to meet intra-hour load ramping needs and historical net load uncertainty

Why RS Matters

- Balancing Test → over/under scheduling penalty
  - Failure results in over/under scheduling penalties
  - Failure does not result in limitations on EIM participation, i.e., CAISO does not limit incremental EIM imports/exports to the BA

- FRS Test → limitations on EIM participation
  - Failure does not result in over/under scheduling penalties
  - Failure does result in limitations on EIM participation, i.e., CAISO limits incremental EIM imports/exports to the BA

EIM BA's Resource Plan

- The EIM Entity (BA) submits a resource plan every hour, which is evaluated for Resource Sufficiency (RS)

- The resource plan contains the resources (Internal generation and Interchanges) that the EIM BA plans to utilize to serve the BA's load and load/VERs uncertainty:
  - Base schedules for participating resources (PRs), non-participating resources (NPRs) and interchanges
  - Energy bids (bid curves and bid range capacity, which are submitted only by PRs)
  - Ancillary service schedules (submitted by PRs and NPRs)
    - Reserves to provide contingency reserves and regulation service (sub 5-min), which are not bid into the market but are indicated to CAISO

Base Schedules

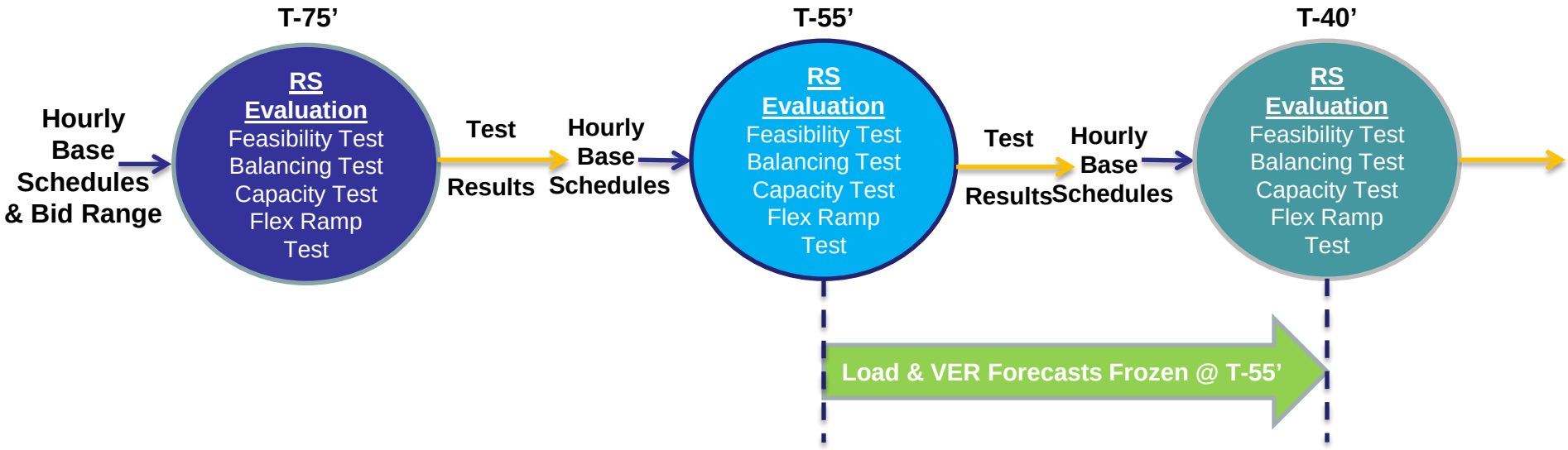
- A base schedule is an hourly schedule:
  - Includes generation and interchange schedules
  - Both participating and non-participating resources submit base schedules
  - Used as the financial reference for measuring instructed/uninstructed imbalance energy for EIM settlement
- Interim base schedules can be submitted as early as a week in advance and are finalized for each operating hour
  - Participating Resource Scheduling Coordinator can adjust up to T-55’
  - EIM Entity Scheduling Coordinator can make changes up to T-40’
- Base schedules are used by all of the RS tests

Energy Bids

- Participating resources submit energy bids
  - These include the bid price curve and the bid range capacity that's made available to the EIM
  - Finalized by T-75'
- The bid range capacity is used in the Capacity Test and Flex Ramp Sufficiency Test

RS Evaluation Timeline

- The resource plan is evaluated for resource sufficiency at T-75', T-55', and T-40', at which point it becomes final. Adjustments to the resource plan are allowed up to T-40'.



The Balancing Test

Balancing Test

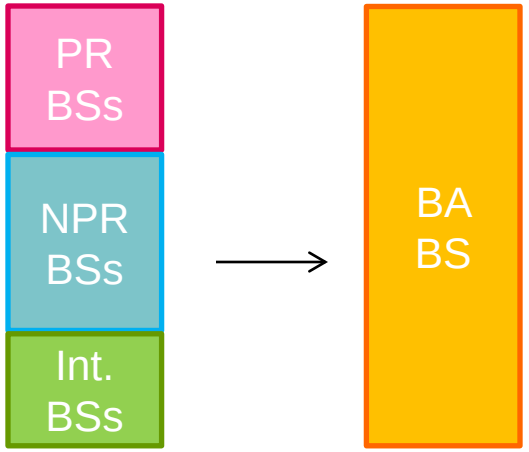
To perform the Balancing Test, the CAISO conducts 2 checks against the BA's base schedule:

BA's base schedule (BS) =

base schedules for PRs +

base schedules for NPRs +

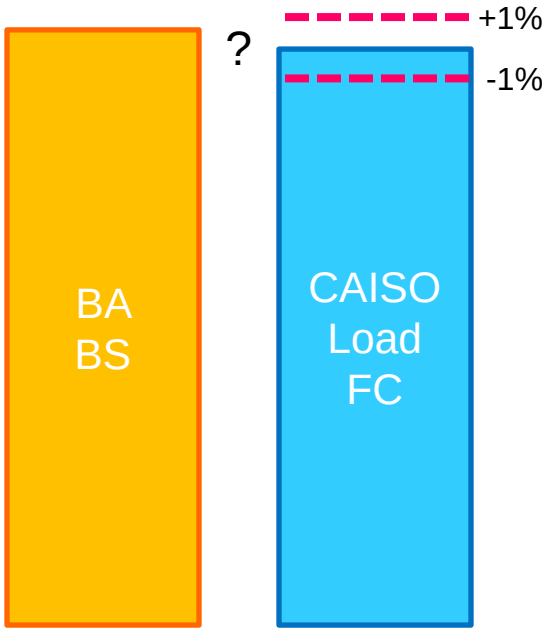
base schedules for interchange (exports/imports)



Balancing Test

First Check:

1. Is the BA's base schedule within +/-1% of the CAISO's BA load forecast?

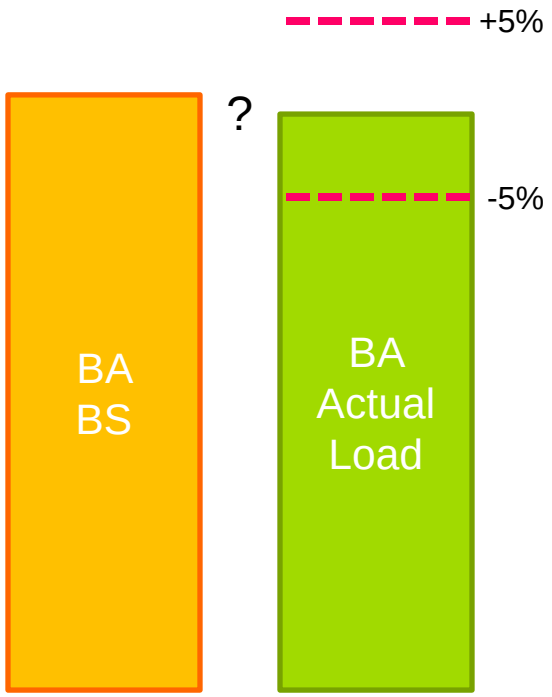


- **Yes:** the BA passes the Balancing Test
  - No over/under scheduling penalty
- **No:** CAISO conducts a second check
  - Possible over/under scheduling penalty

Balancing Test

Second Check (after-the-fact):

2. Was the BA's base schedule within +/- 5% of the BA's actual load?



- **Yes:** the BA is not charged an over/under scheduling penalty
- **No:** the BA is charged an over/under scheduling penalty
  - The penalties have a 2 tier structure

Balancing Test

Over-Scheduling Penalty:

- Tier 1 Threshold: over-scheduled by more than 5% of actual load
  - Penalty = 25% * Hourly LAP LMP * over-scheduled volume

- Tier 2 Threshold: over-scheduled by more than 10% of actual load
  - Penalty = 50% * Hourly LAP LMP * over-scheduled volume

Under-Scheduling Penalty:

- Tier 1 Threshold: under-scheduled by more than 5% of actual load
  - Penalty = 25% * Hourly LAP LMP * under-scheduled volume

- Tier 2 Threshold: under-scheduled by more than 10% of actual load
  - Penalty = 100% * Hourly LAP LMP * under-scheduled volume

Balancing Test Scenarios

Scenario	First Check	Second Check
Scenario 1	✓	N/A
Scenario 2	✗	✓
Scenario 3	✗	✗
Scenario 4	✗	✗
Scenario 5	✓	N/A

Balancing Test Scenarios

- Assume there are three LSEs within a BA, and there's no interchange
- CAISO provides a load forecast for the BA
- Each LSE develops its own independent load forecast
- Each LSE submits base schedules to serve its load forecast

Balancing Test: Scenario 1

LSEs	LSE1	LSE2	LSE3	BA Total
LSE's load forecast	3,075	2,950	1,950	7,975
Base schedules (PR + NPR)	3,075	2,950	1,950	7,975

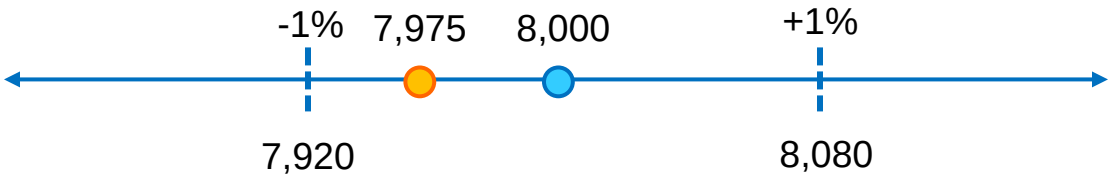
Balancing Authority	
CAISO's BA load forecast	8,000
Actual BA load	8,100
Hourly LAP LMP	$30

Balancing Test: Scenario 1

First Check:

- Is the BA's base schedule (●) within +/- 1% of the CAISO's BA load forecast (●) by T-40?

- Yes:



- The BA passes the first check:
  - No second check
  - No over/under scheduling penalty

Balancing Test: Scenario 2

- LSE2's load forecast is lower than in Scenario 1

LSEs	LSE1	LSE2	LSE3	BA Total
LSE's load forecast	3,075	2,750	1,950	7,775
Base schedules (PR + NPR)	3,075	2,750	1,950	7,775

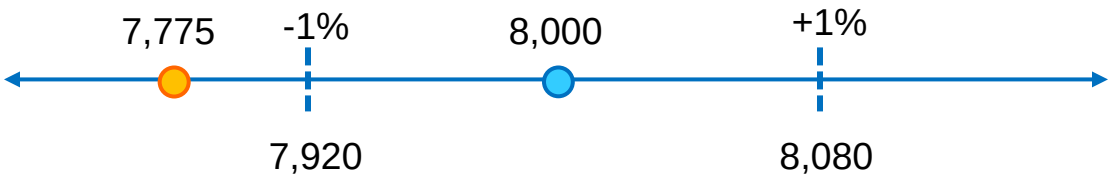
Balancing Authority	
CAISO's BA load forecast	8,000
Actual BA load	8,100
Hourly LAP LMP	$30

Balancing Test: Scenario 2

First Check:

- Is the BA's base schedule (●) within +/- 1% of the CAISO's BA load forecast (●) by T-40?

- No:

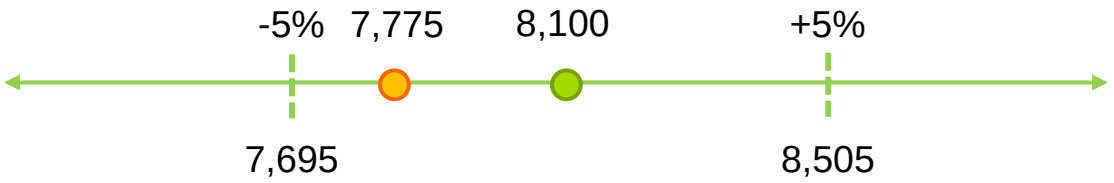


- The BA fails the first check:
  - The CAISO conducts a second check to determine whether an over/under scheduling penalty applies

Balancing Test: Scenario 2

Second Check (after-the-fact):

- Was the BA's base schedule (●) within +/- 5% of the BA's actual load (●)?
- Yes:



- The BA passes the second check:
  - No over/under scheduling penalty

Balancing Test: Scenario 3

- Actual BA load for this hour is higher than in previous scenario

LSEs	LSE1	LSE2	LSE3	BA Total
LSE's load forecast	3,075	2,750	1,950	7,775
Base schedules (PR + NPR)	3,075	2,750	1,950	7,775

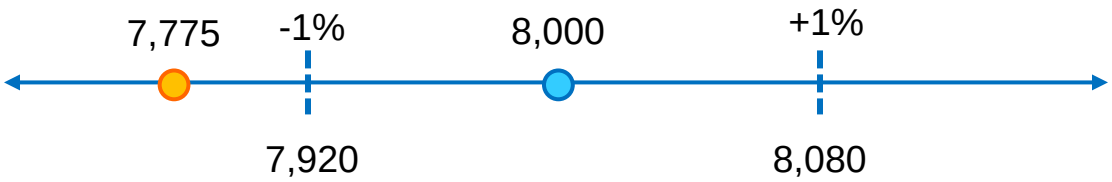
Balancing Authority	
CAISO's BA load forecast	8,000
Actual BA load	8,300
Hourly LAP LMP	$30

Balancing Test: Scenario 3

First Check:

- Is the BA's base schedule (●) within +/- 1% of the CAISO's BA load forecast (●) by T-40?

- No:

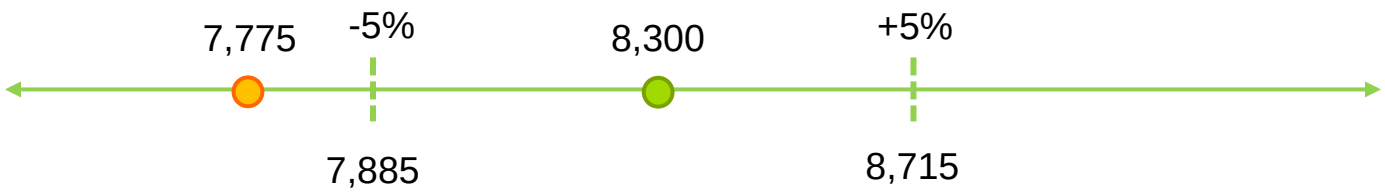


- The BA fails the first check:
  - The CAISO conducts a second check to determine whether an over/under scheduling penalty applies

Balancing Test: Scenario 3

Second Check (after-the-fact):

- Was the BA's base schedule (●) within +/- 5% of the BA's actual load (●)?
- No:

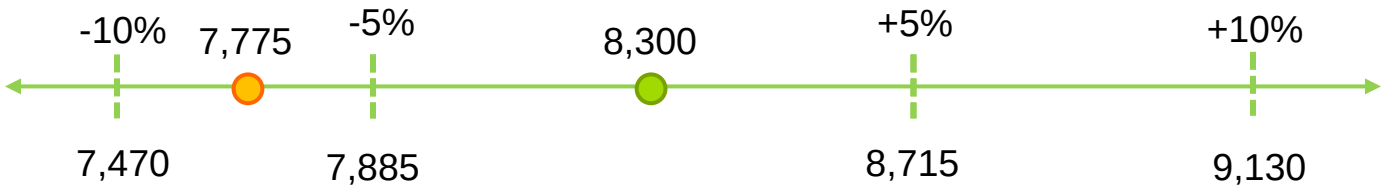


- The BA was not within +/- 5% of actual load

Balancing Test: Scenario 3

Second Check (after-the-fact):

- Was the BA's base schedule (●) within +/- 10% of the BA's actual load (●)?
- Yes:



- The BA was within +/- 10% of actual load

Balancing Test: Scenario 3

- The BA under-scheduled by more than 5%, but less than 10%
- The BA is charged an under-scheduling penalty at the 5% tier threshold
- Penalty charged at the 5% tier threshold:
  - Penalty = 25% * Hourly LAP LMP * Under-Scheduled Volume
  - Penalty = 0.25 * $30/MWh * (8,300 – 7,775) = $3,937.5

Balancing Test: Scenario 4

- LSE2 was unable to base schedule sufficient gen by T-55 to meet its load forecast from the previous scenario

LSEs	LSE1	LSE2	LSE3	BA Total
LSE's load forecast	3,075	2,750	1,950	7,775
Base schedules (PR + NPR)	3,075	2,350	1,950	7,375

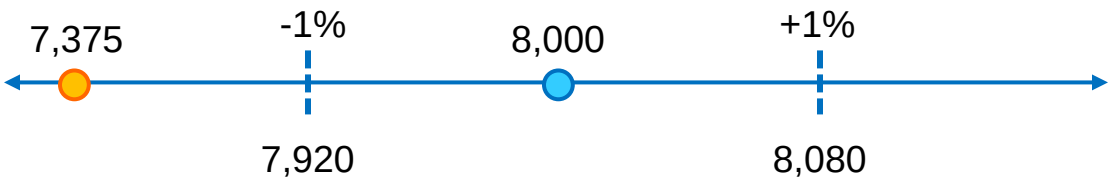
Balancing Authority	
CAISO's BA load forecast	8,000
Actual BA load	8,300
Hourly LAP LMP	$30

Balancing Test: Scenario 4

First Check:

- Is the BA's base schedule (●) within +/- 1% of the CAISO's BA load forecast (●) by T-40?

- No:

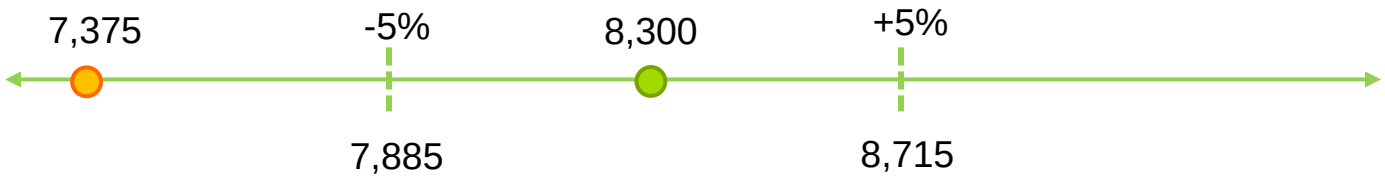


- The BA fails the first check:
  - The CAISO conducts a second check to determine whether an over/under scheduling penalty applies

Balancing Test: Scenario 4

Second Check (after-the-fact):

- Was the BA's base schedule (●) within +/- 5% of the BA's actual load (●)?
- No:

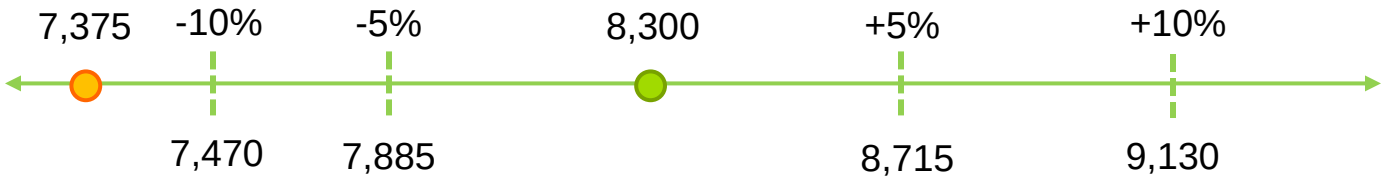


- The BA was not within +/- 5% of actual load

Balancing Test: Scenario 4

Second Check (after-the-fact):

- Was the BA's base schedule (●) within +/- 10% of the BA's actual load (●)?
- No:



- The BA was not within +/- 10% of actual load

Balancing Test: Scenario 4

- The BA under-scheduled by more than than 10%
- The BA is charged an under-scheduling penalty at the 10% tier threshold
- Penalty charged at the 10% tier threshold:
  - Penalty = 100% * Hourly LAP LMP * Under-Scheduled Volume
  - Penalty = 1.00 * $30/MWh * (8,300 – 7,375) = $27,750

Balancing Test: Scenario 5

- Conditions are the same as Scenario 4:
  - LSE2 was unable to base schedule sufficient gen by T-55 to meet its load forecast

LSEs	LSE1	LSE2	LSE3	BA Total
LSE's load forecast	3,075	2,750	1,950	7,775
Base schedules (PR + NPR)	3,075	2,350	1,950	7,375

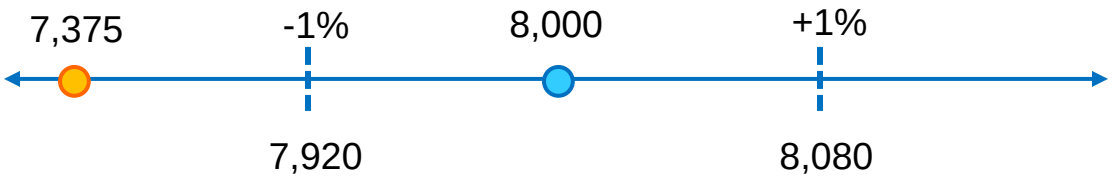
Balancing Authority	
CAISO's BA load forecast	8,000
Actual BA load	8,300
Hourly LAP LMP	$30

Balancing Test: Scenario 5

First Check:

- Is the BA's base schedule (●) within +/- 1% of the CAISO's BA load forecast (●) by T-55?

- No:



Balancing Test: Scenario 5

- LSE1 has an agreement with the BA to adjust LSE1's base schedules after T-55 to meet the Balancing Test

- The BA adjusts LSE1's base schedules to balance within +/- 1% of CAISO's BA load forecast:
  - Base schedule adjustment = 7925 MW – 7375 MW = 550 MW
  - Adjusted LSE1 base schedule = 3,075 MW + 550 MW = 3,625 MW

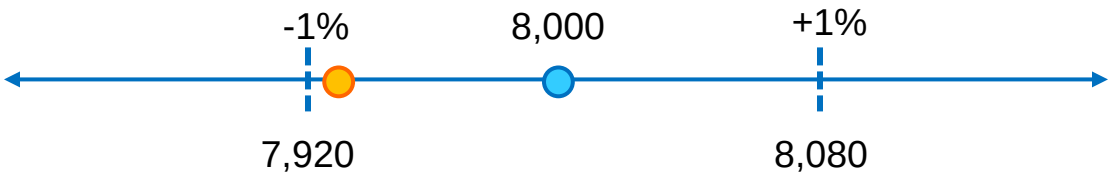
	LSE1	LSE2	LSE3	BA Total
LSE's load forecast	3,075	2,750	1,950	7,775
Base schedules (PR + NPR)	3,625	2,350	1,950	7,925

Balancing Test: Scenario 5

First Check:

- Is the BA's base schedule (●) within +/- 1% of the CAISO's BA load forecast (●) by T-40?

- Yes:



- The BA passes the first check:
  - No second check
  - No over/under scheduling penalty

The Flex Ramp Sufficiency Test

Flexible Ramp Sufficiency Test

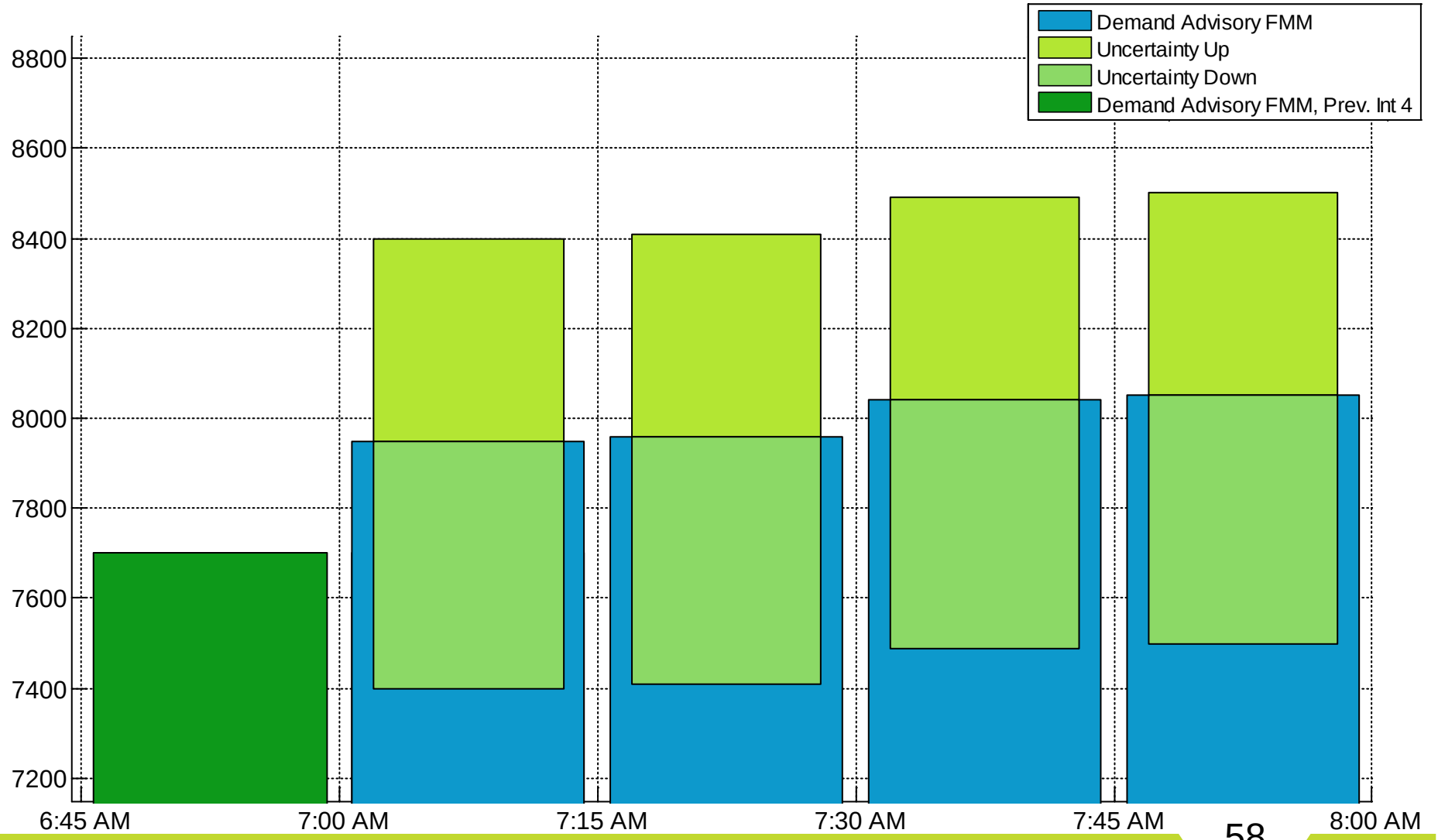
The Flexible Ramp Sufficiency Test (FRST) ensures that the EIM BA has sufficient upward/downward flexible ramp capability and capacity to meet load intra-hour ramping and *net* load uncertainty

- The EIM BA is tested against the 15-min, 30-min, 45-min, and 60-min ramps within the hour from the T-7.5 FMM reference point of the prior hour
- Each 15-minute interval is evaluated separately and failures are enforced for only that failed 15-minute interval
- The FRST ramping requirements can be reduced by the EIM diversity benefit, but only if sufficient Transmission (import/export) capability is made available to the EIM

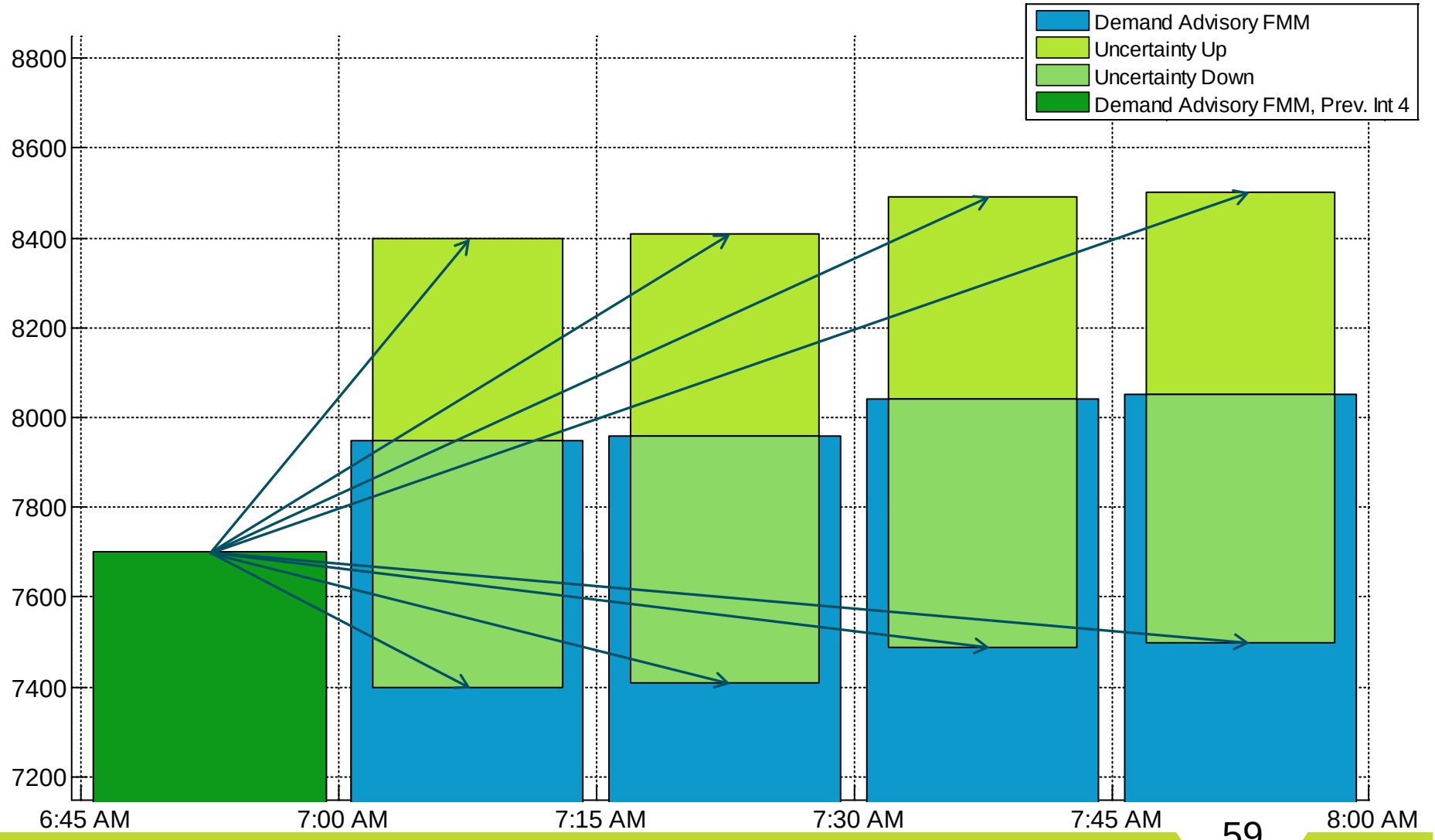
FRST

- Pass:
  - There's sufficient ramp capability and flexible ramping up/down capacity to meet the flex ramp up/down requirements
  - No restrictions are placed on EIM Transfers
- Fail:
  - There was insufficient ramp capability and/or flexible ramping up/down capacity
    - Can fail in one direction or both
  - The CAISO places limits on EIM Transfers in the corresponding direction(s) for that 15-minute interval

FRST Scenarios: Requirement



FRST Scenarios: Requirement

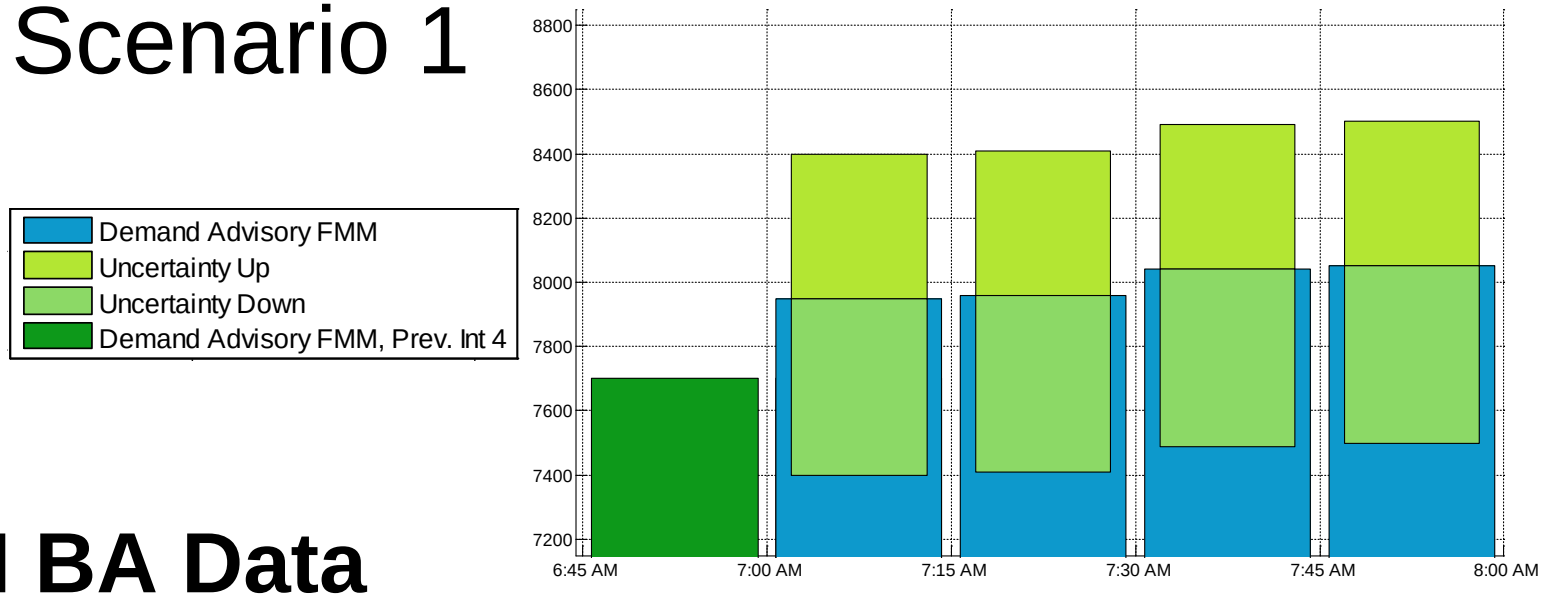


FRST Scenarios

- Scenario 1: The BA does not bring sufficient upward capacity to meet the FRST requirement in 2 intervals

- Scenario 2: The BA does not have enough ramp capability associated with its upward capacity to meet the FRST requirement in 1 interval.

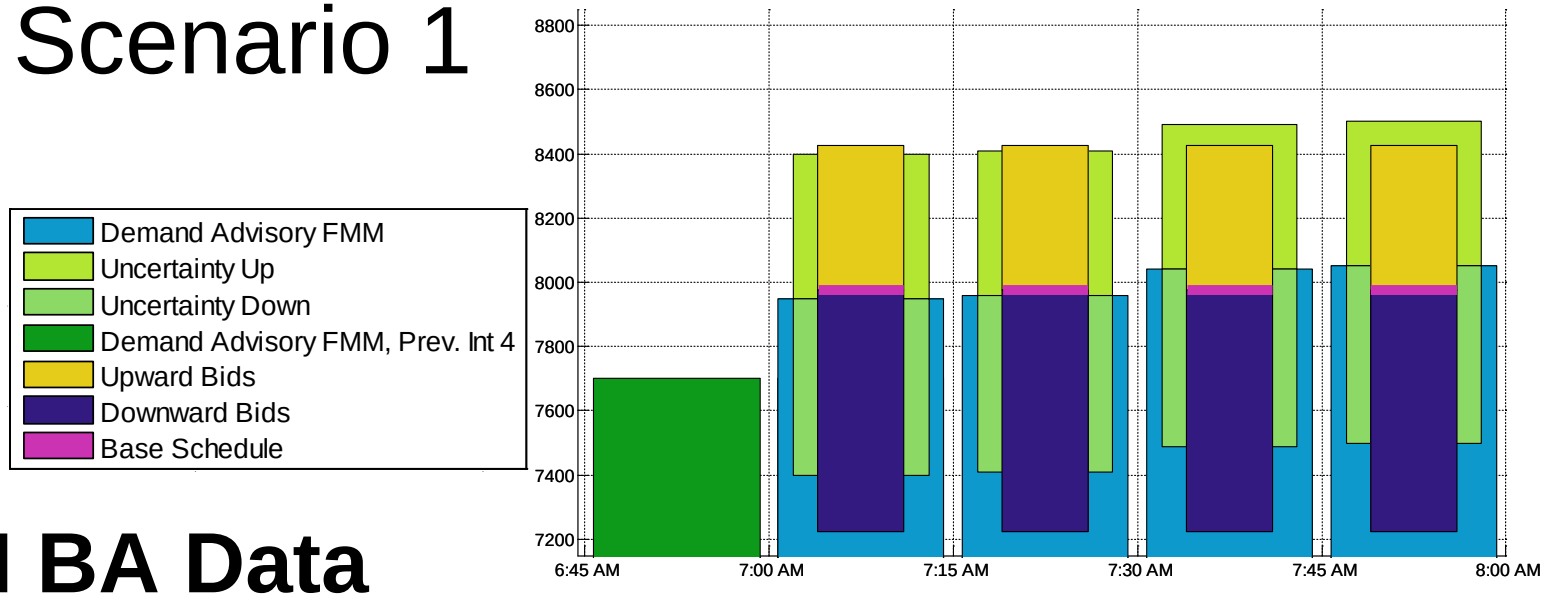
FRST: Scenario 1



- **EIM BA Data**

	LSE1	LSE2	LSE3	BA Total
Previous interval 4 award	2975	2900	1825	7700
CAISO BA Forecast				8000

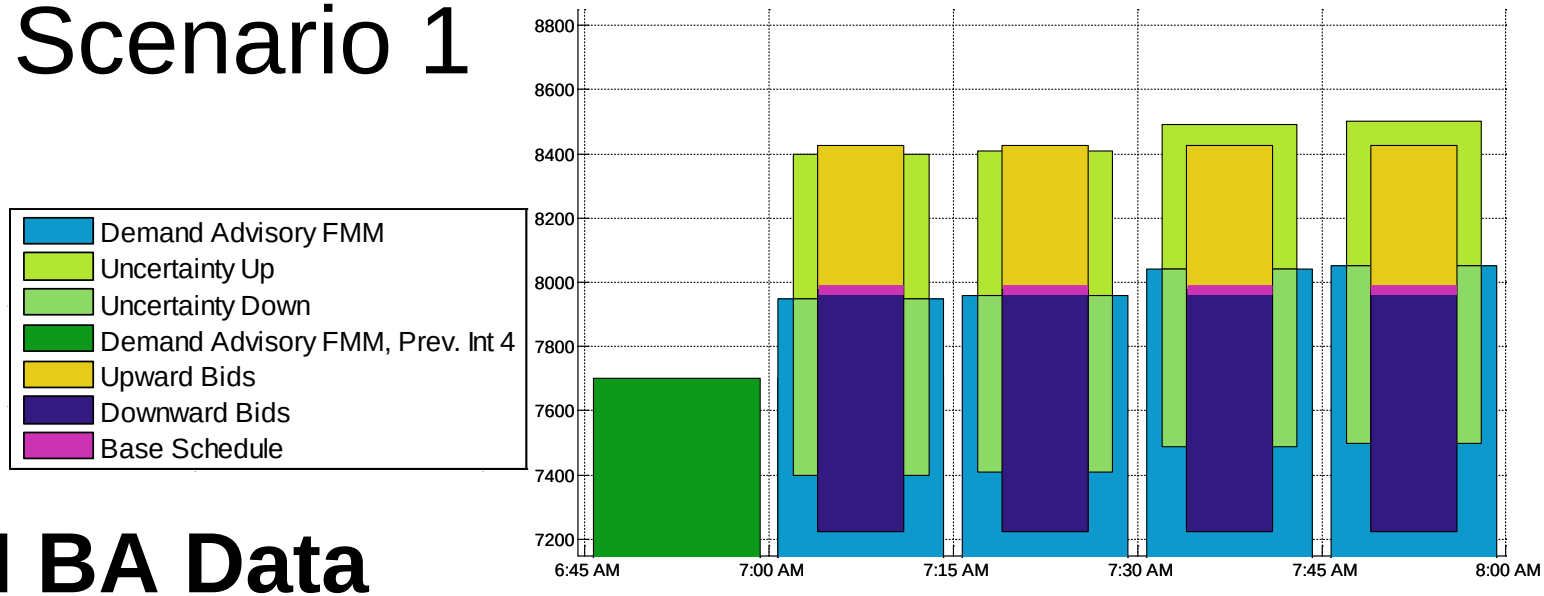
FRST: Scenario 1



- **EIM BA Data**

	LSE1	LSE2	LSE3	BA Total
Previous interval 4 award	2975	2900	1825	7700
CAISO BA Forecast				8000
Base Schedules	3075	2950	1950	7975
Upward Bids	+250	+150	+50	+450
Downward Bids	-250	-350	-150	-750

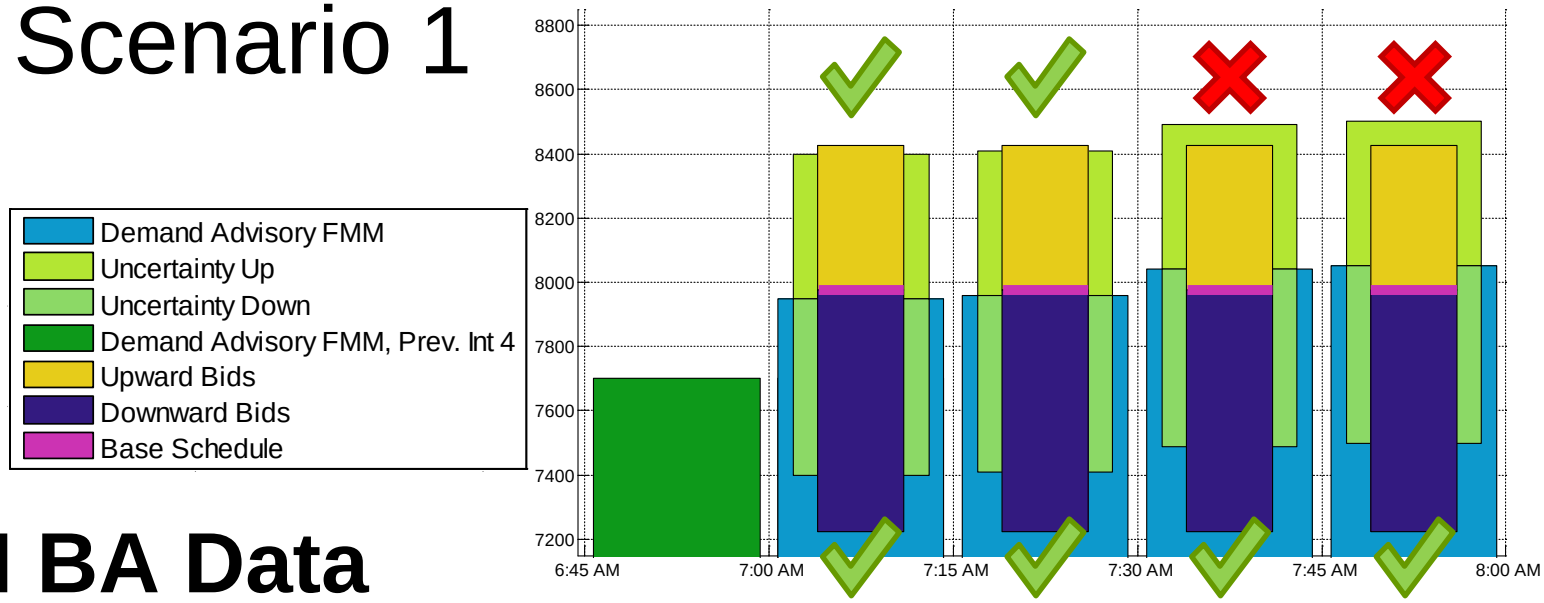
FRST: Scenario 1



- **EIM BA Data**

	LSE1	LSE2	LSE3	BA Total
Previous interval 4 award	2975	2900	1825	7700
CAISO BA Forecast				8000
Base Schedules	3075	2950	1950	7975
Upward Bids	+250	+150	+50	+450
Downward Bids	-250	-350	-150	-750
Ramp Rate (MW/15min)	1000	500	150	N/A

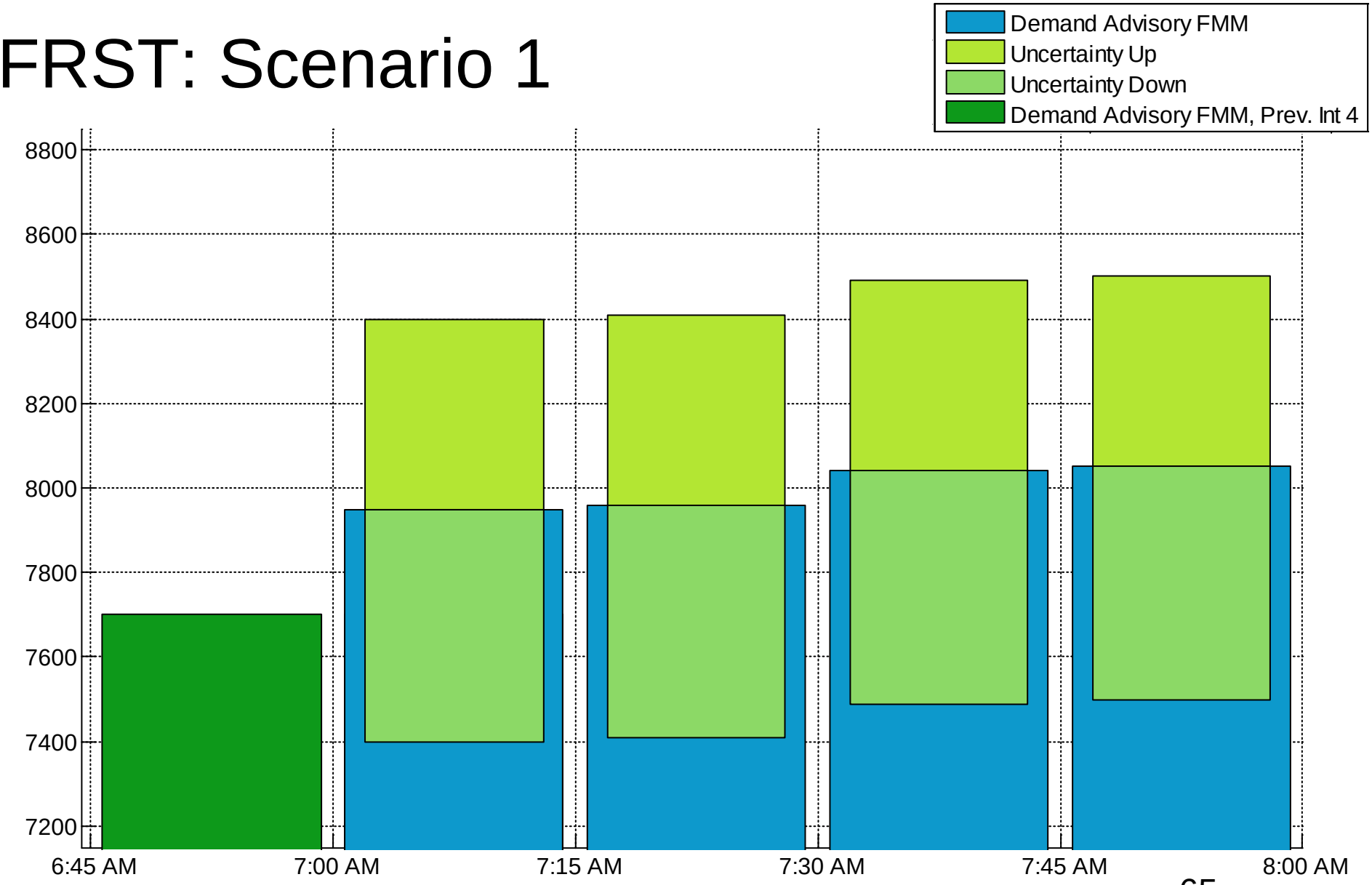
FRST: Scenario 1



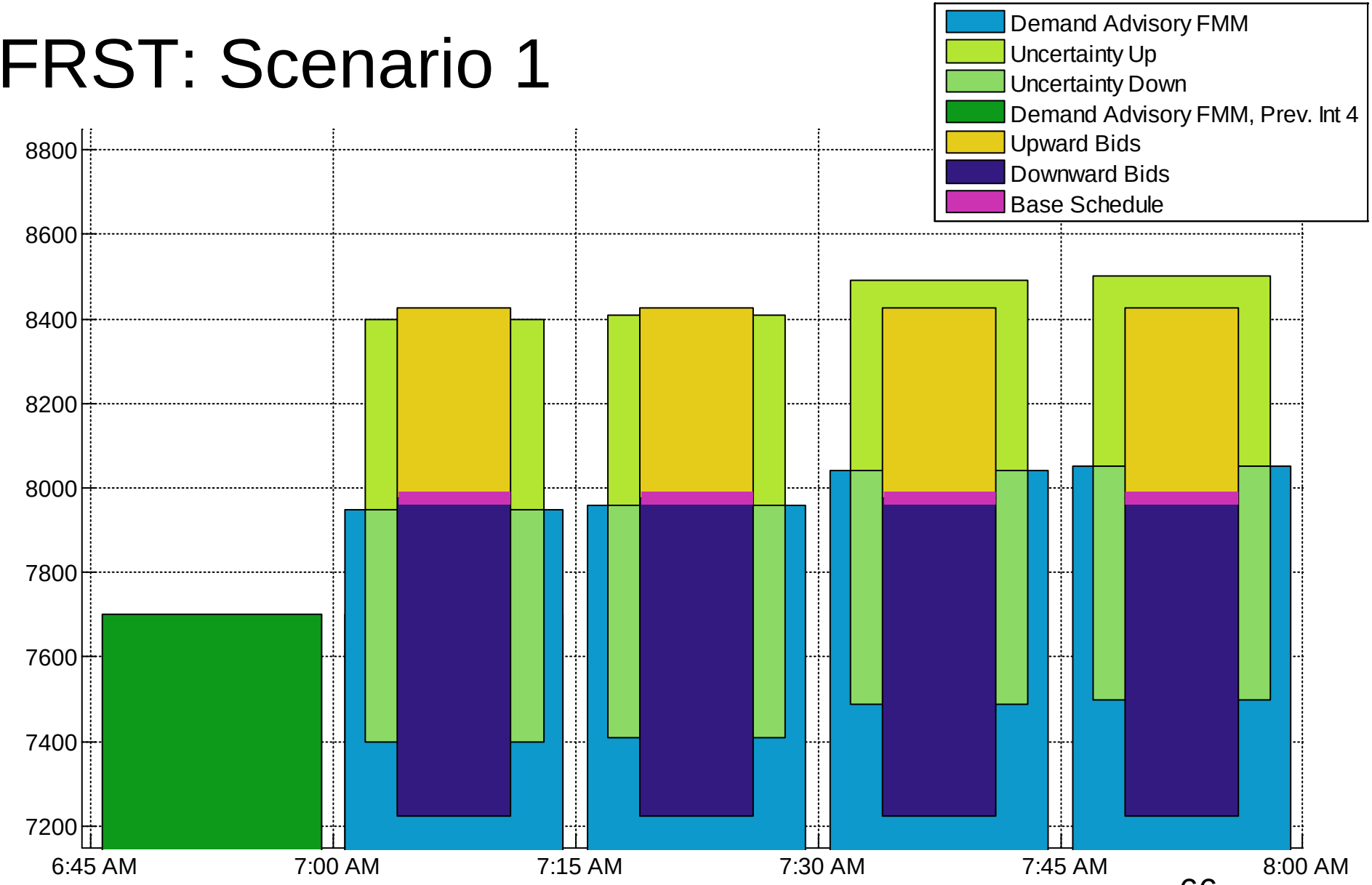
- **EIM BA Data**

	LSE1	LSE2	LSE3	BA Total
Previous interval 4 award	2975	2900	1825	7700
CAISO BA Forecast				8000
Base Schedules	3075	2950	1950	7975
Upward Bids	+250	+150	+50	+450
Downward Bids	-250	-350	-150	-750
Ramp Rate (MW/15min)	1000	500	150	N/A

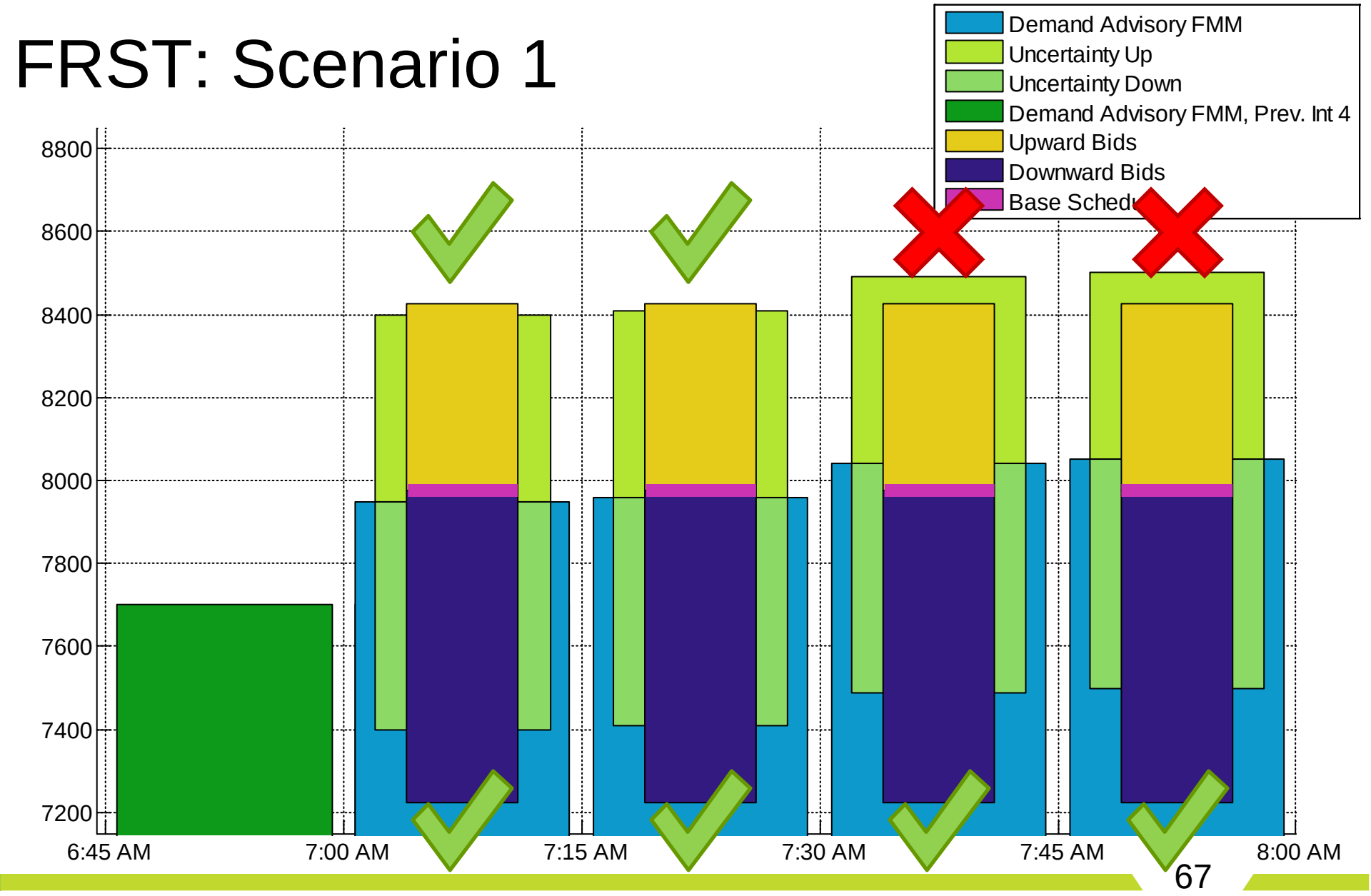
FRST: Scenario 1



FRST: Scenario 1



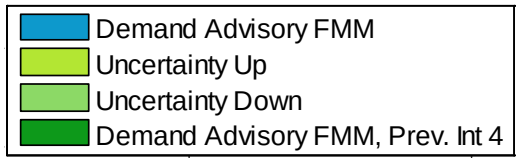
FRST: Scenario 1

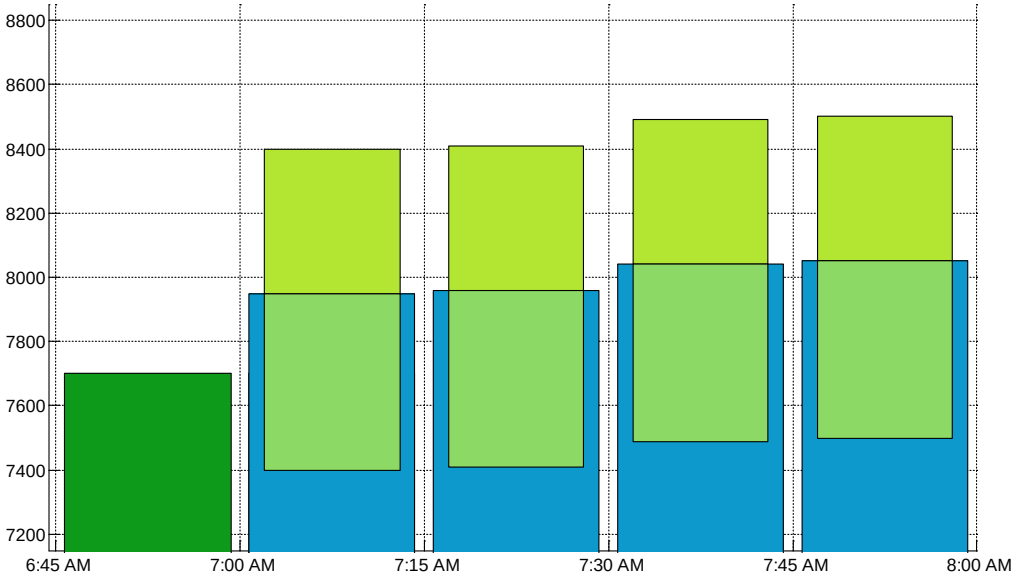


FRST Scenario 1: Summary

- The BA's bid range capacity was insufficient
- The BA failed to meet the flex ramp up requirement for the 3rd and 4th 15-min intervals of the next hour, and failed these intervals
- Due to the failure, the BA is limited in incremental imports from the EIM for the 3rd and 4th 15-minute intervals of the next hour

FRST: Scenario 2

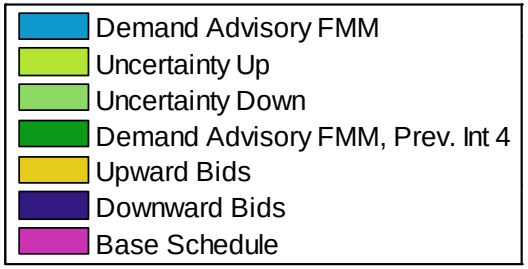


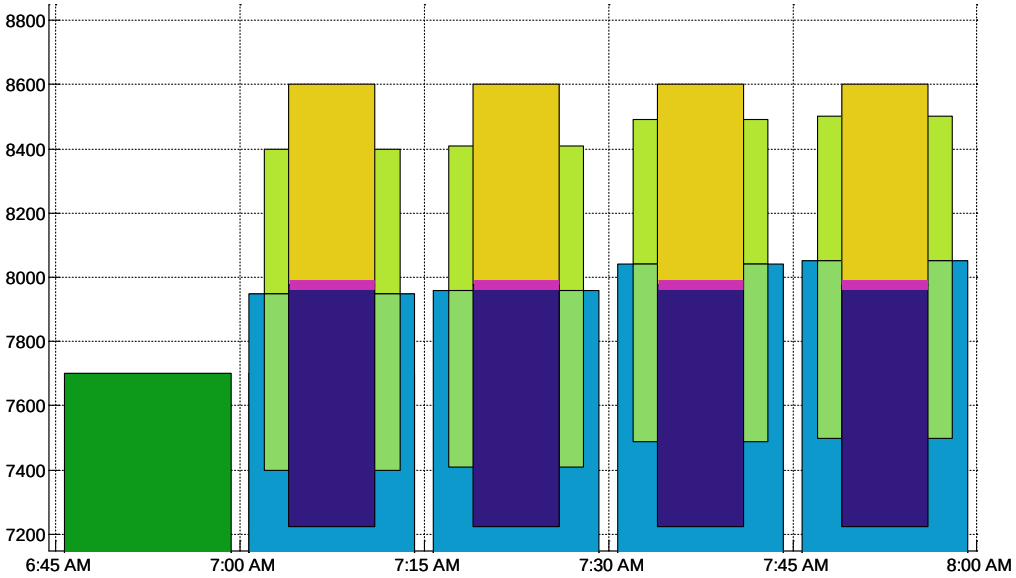


- **EIM BA Data**

	LSE1	LSE2	LSE3	BA Total
Previous interval 4 award	2975	2900	1825	7700
CAISO BA Forecast				8000

FRST: Scenario 2

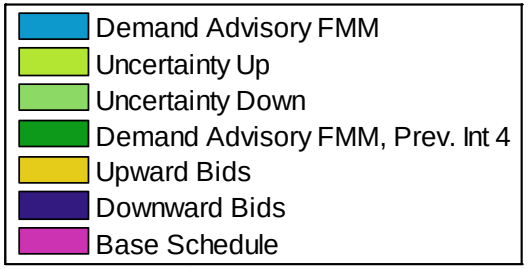


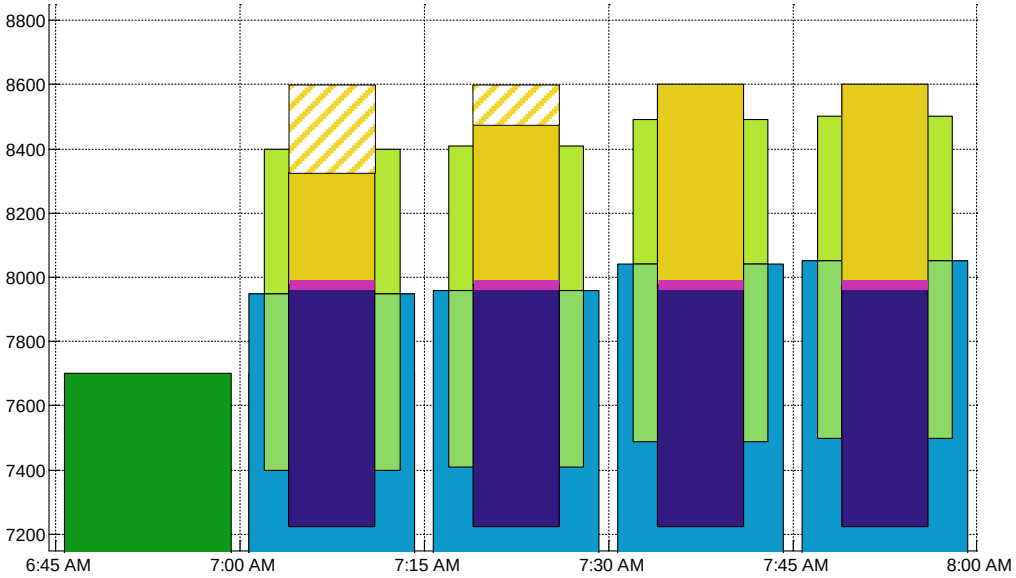


- **EIM BA Data**

	LSE1	LSE2	LSE3	BA Total
Previous interval 4 award	2975	2900	1825	7700
CAISO BA Forecast				8000
Base Schedules	3075	2950	1950	7975
Upward Bids	+150	+50	+425	+625
Downward Bids	-250	-350	-150	-750

FRST: Scenario 2





- **EIM BA Data**

	LSE1	LSE2	LSE3	BA Total
Previous interval 4 award	2975	2900	1825	7700
CAISO BA Forecast				8000
Base Schedules	3075	2950	1950	7975
Upward Bids	+150	+50	+425	+625
Downward Bids	-250	-350	-150	-750
Ramp Rate (MW/15min)	1000	500	150	N/A

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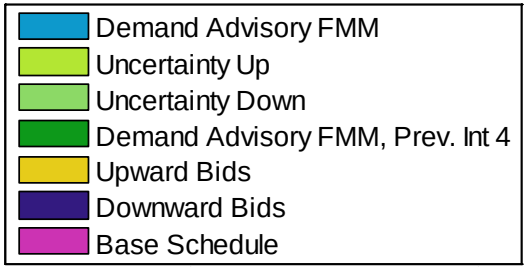

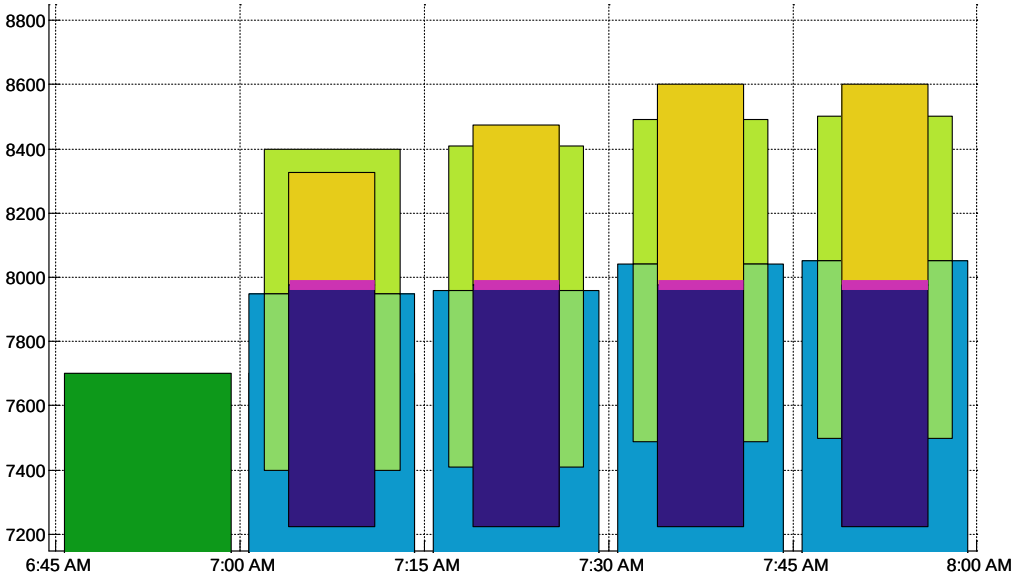

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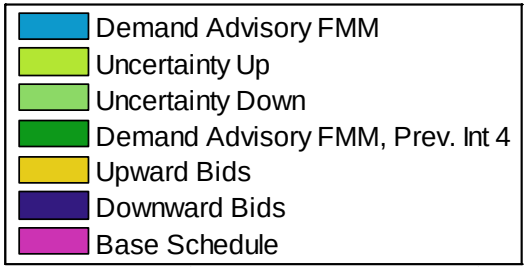

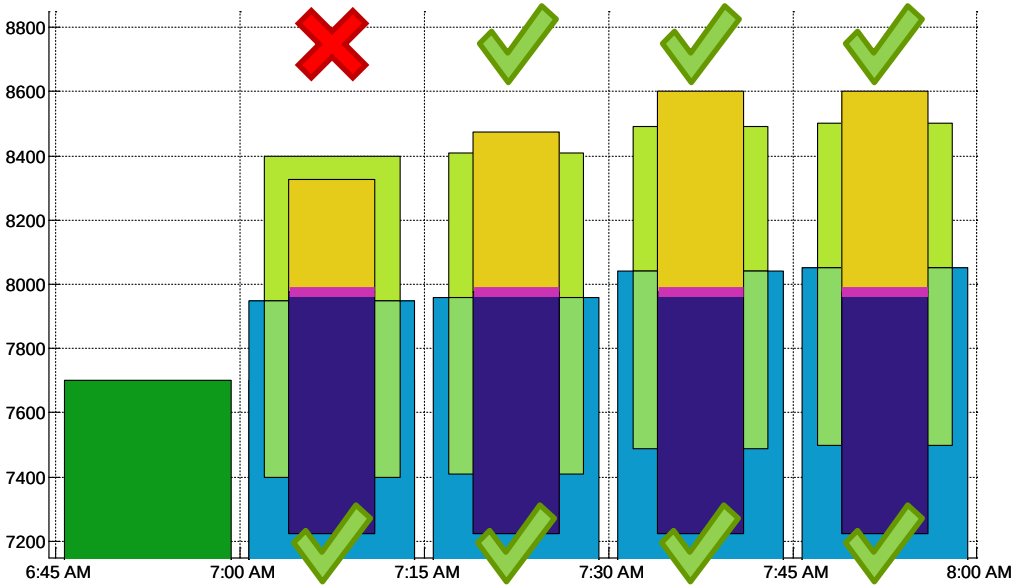

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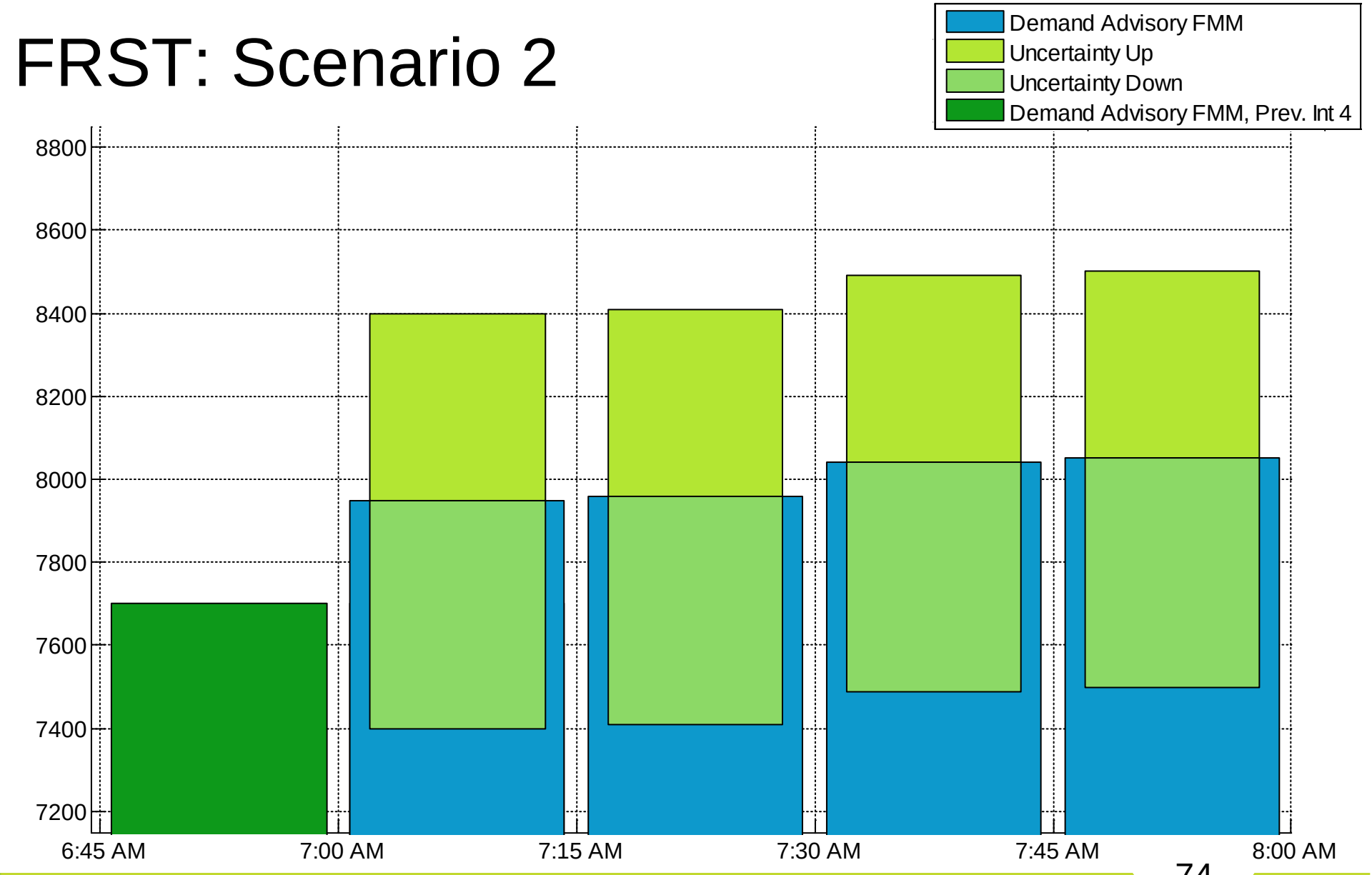
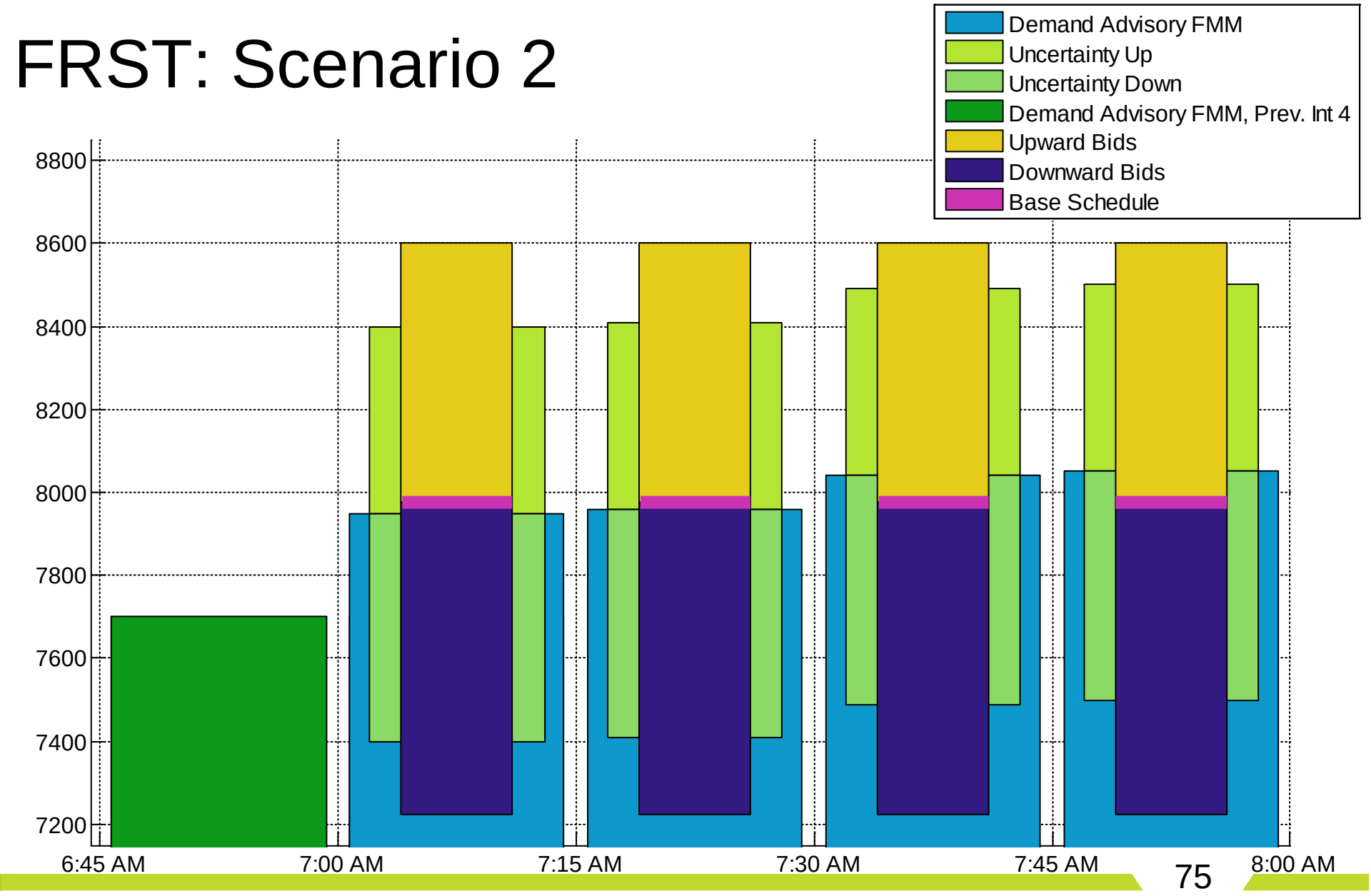
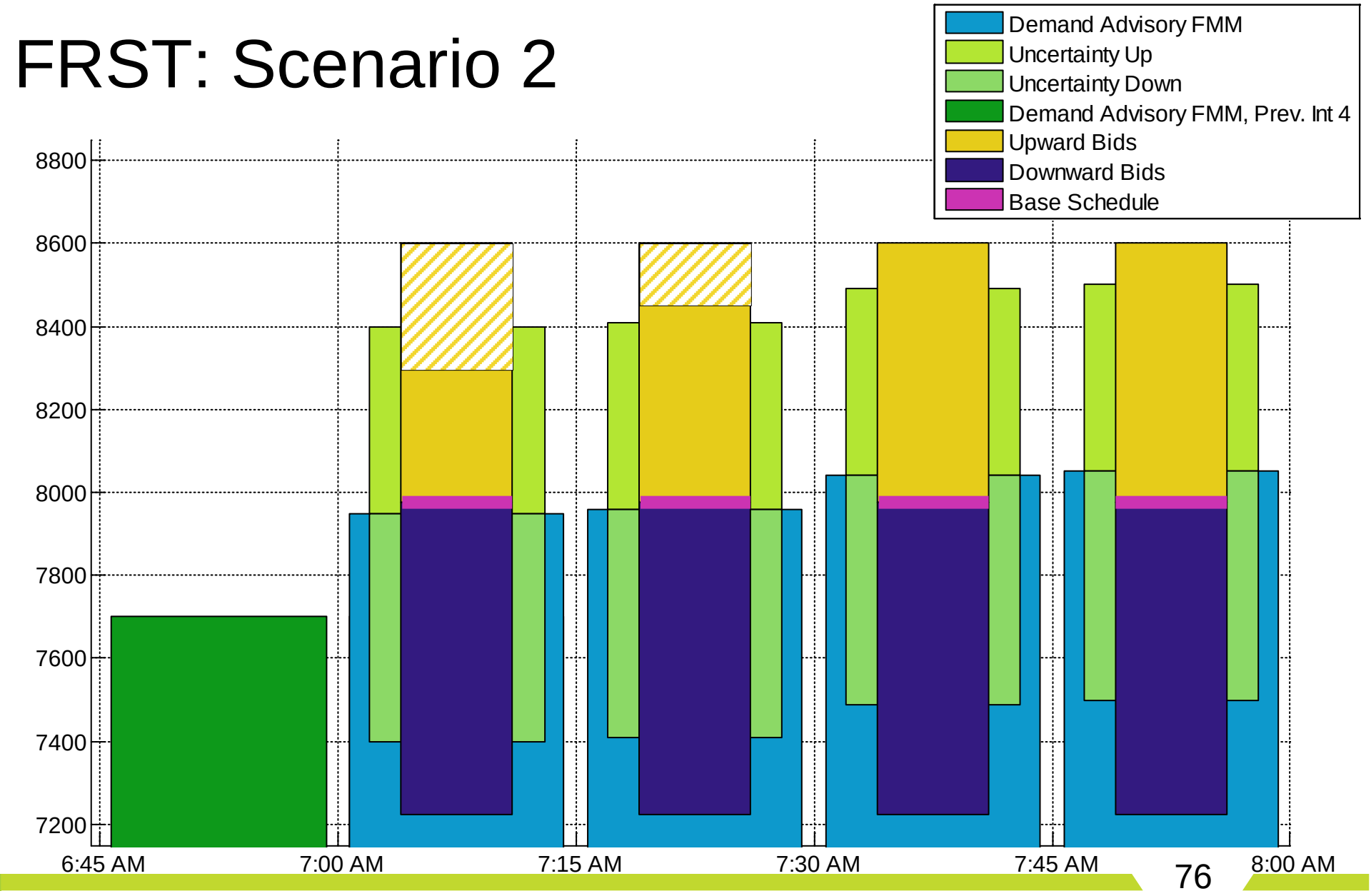


FRST: Scenario 2



FRST: Scenario 2



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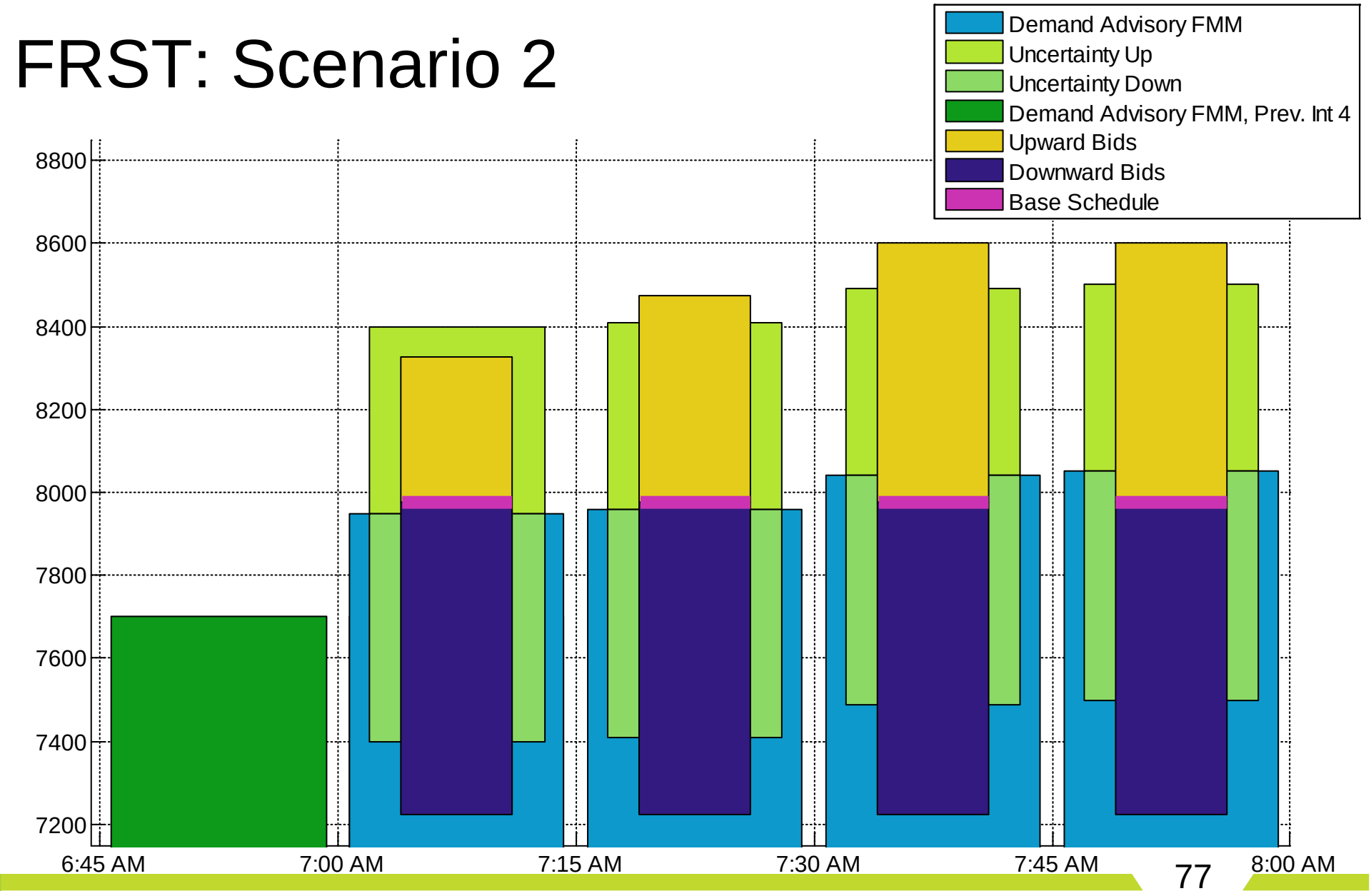

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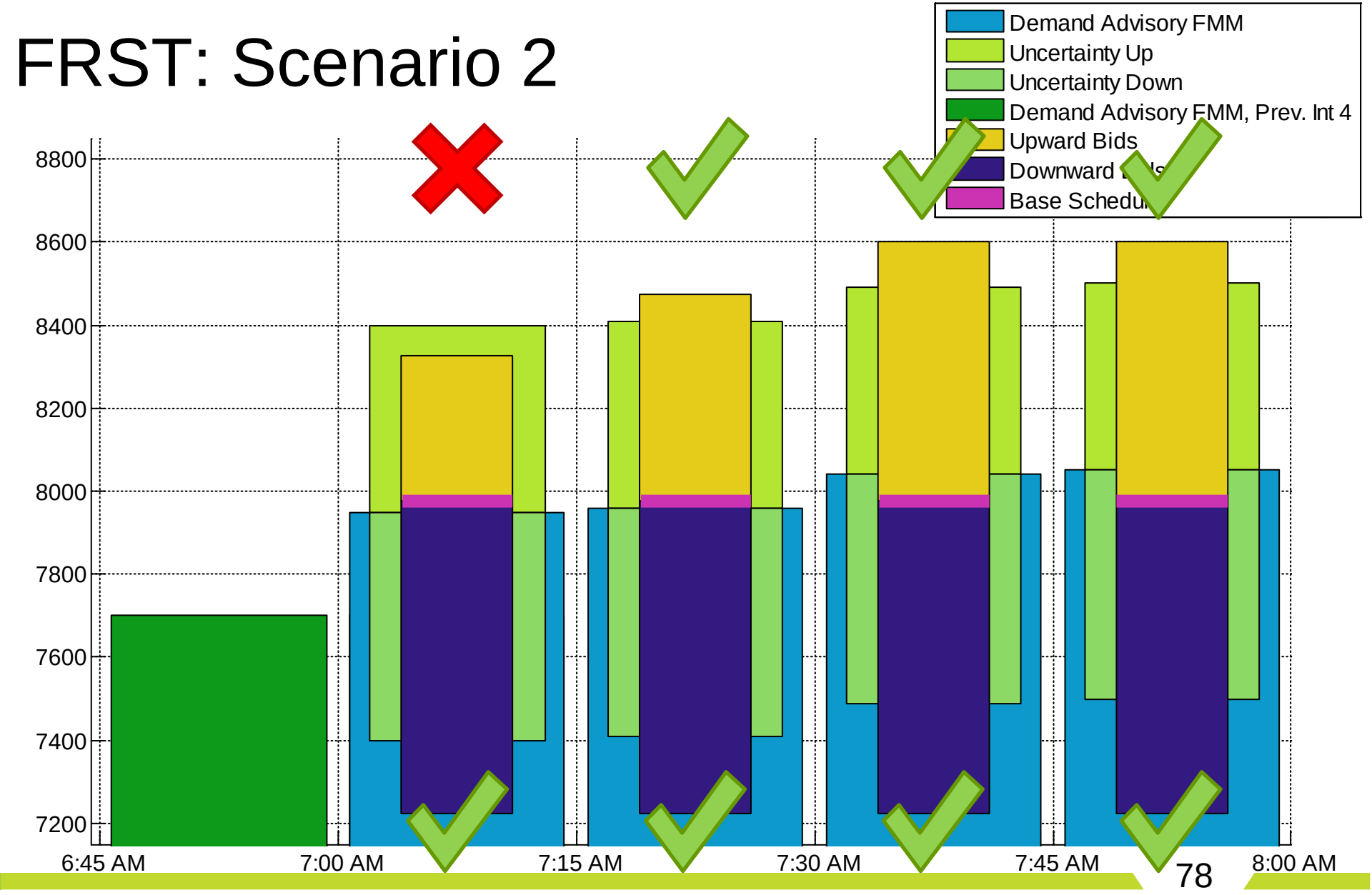


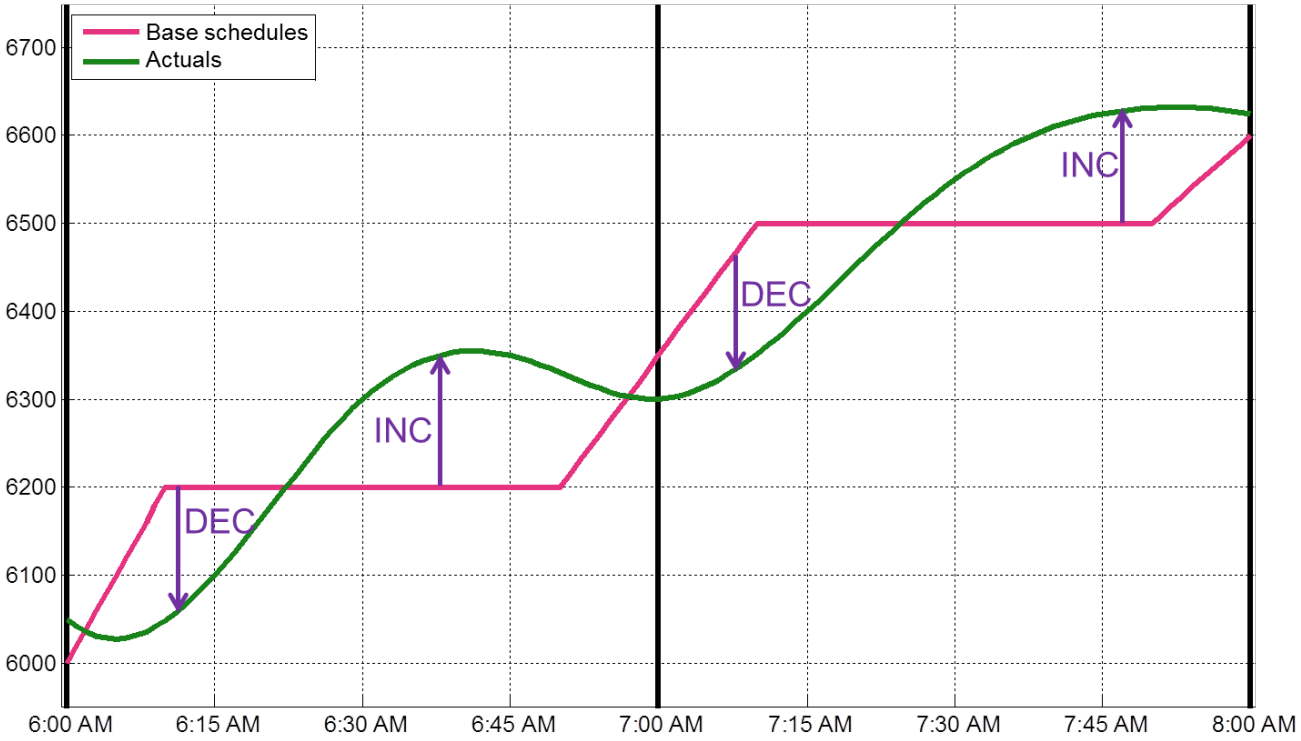
FRST Scenario 2: Summary

- The BA's overall bid range capacity was sufficient
- The BA's ramp capability was insufficient
- The BA failed to meet the flex ramp up requirement for the1st 15-min interval of the next hour, and failed this interval
- The BA is limited in incremental imports from the EIM for the 1st 15-minute interval of the next hour

Balancing Reserves and EIM

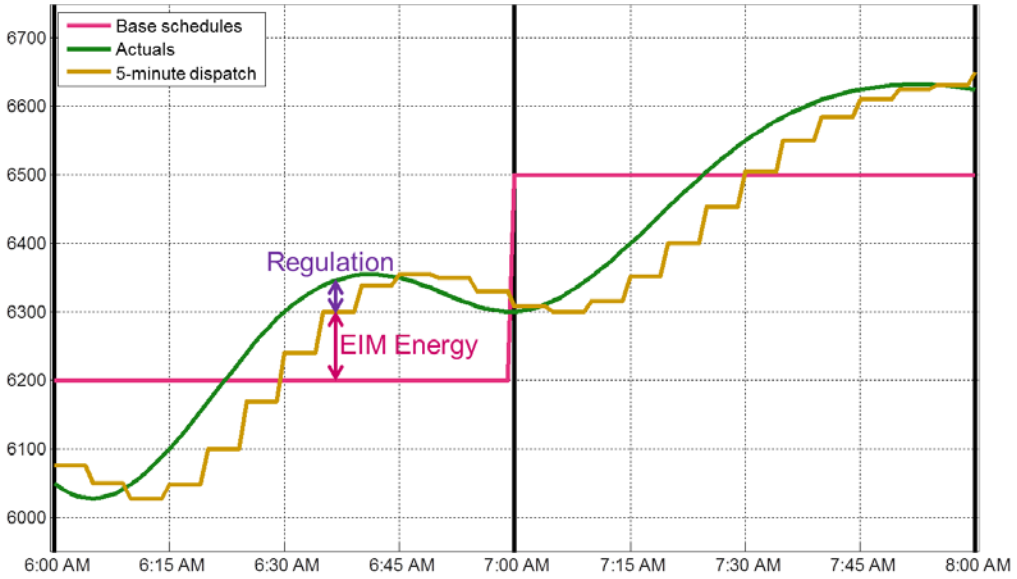
Balancing Reserves in the EIM

- BPA currently holds balancing reserves in order to balance within-hour variability

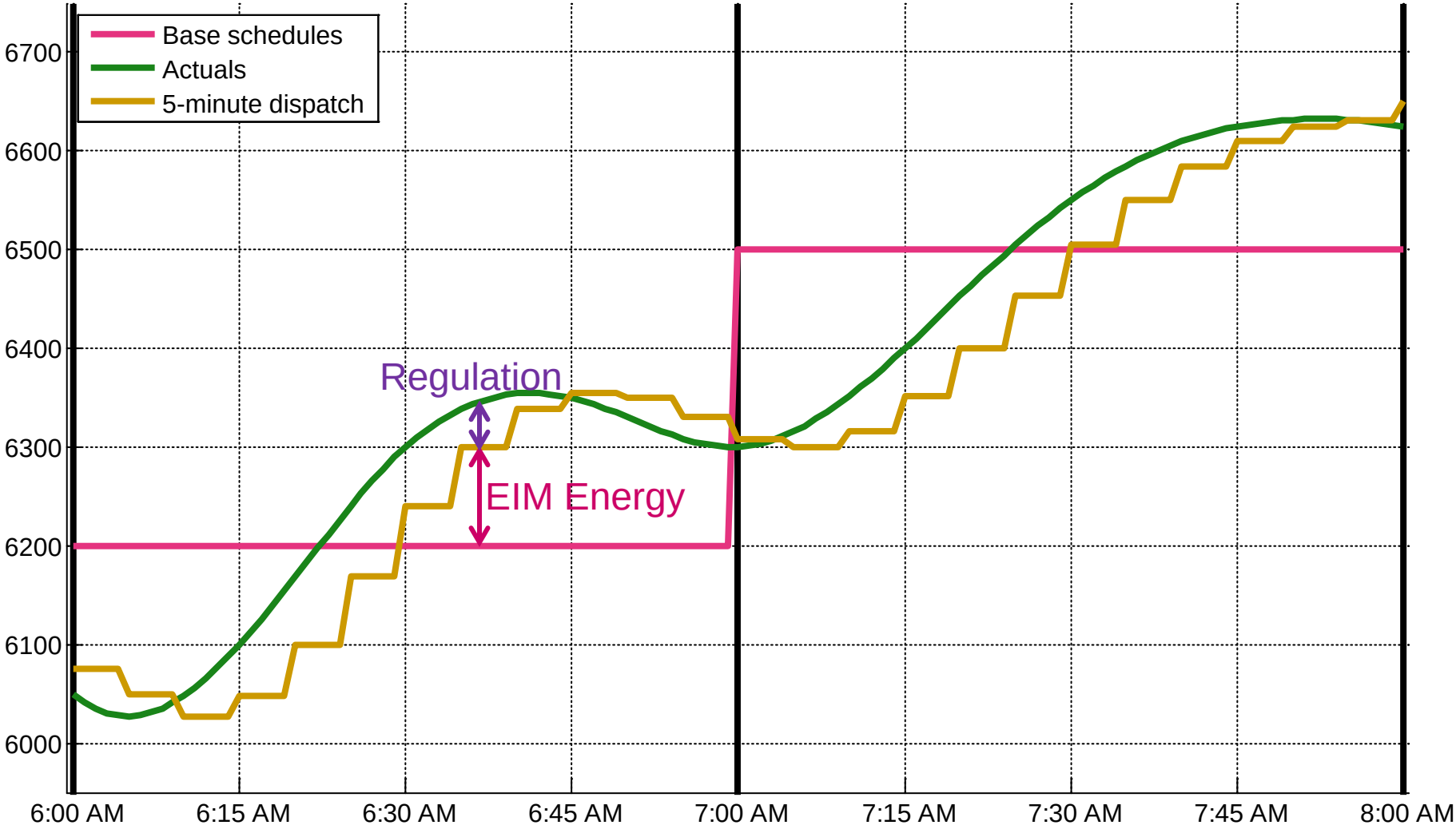


Balancing Reserves in the EIM

- Once in the EIM:
  - the EIM dispatches bid-in resources to meet imbalance
  - the BA dispatches regulation reserves (within-5 min imbalance)
- Non-regulation balancing reserves may be made available to the EIM to count towards meeting Resource Sufficiency



EIM


Base schedules
Actuals
5-minute dispatch
6700
6600
6500
6400
6300
6200
6100
6000
Regulation
EIM Energy
6:00 AM
6:15 AM
6:30 AM
6:45 AM
7:00 AM
7:15 AM
7:30 AM
7:45 AM
8:00 AM

EIM Resource Sufficiency #3:

Step 2: What's the Issue

ROD: BPA will consider developing policies to ensure it passes the RS evaluations as often as possible

- What is the expectation by BPA or its customers about how often the BA passes resource sufficiency?
  - What options are available to the BA to ensure the BA meets this target?
  - What is the expectation by BPA or its customers about what lengths BPA should go to in order to meet this target?
- What is the expectation by BPA or its customers about if or how costs/penalties associated with not passing resource sufficiency be sub-allocated?
  - Determined as part of Cost Allocation team

ROD: BPA will consider addressing RS on the sub-balancing authority area level

- What options are available to the BA in order to demonstrate resource sufficiency?
- Will the BA assign obligations tied to resource sufficiency to entities within the BA?