Load Bias Analysis

MIC Special Session   IMM

July 24, 2020

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Agenda

- **Load bias history**
- **Load bias vs load forecast error**
- **Load bias vs ACE**
- **Use of bias during spinning events**
- **Impacts of load bias use**
- **Conclusions**

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IT SCED Load Bias

- **One IT SCED case executed every 5 minutes.**

- **Each case solves for 4 target times:**
  - **30 – 40 minutes ahead**
  - **45 – 55 minutes ahead**
  - **90 – 100 minutes ahead**
  - **135 – 145 minutes ahead**

  * 2020 data through June.

Year	IT SCED Bias Direction	Number of executed IT SCED cases	Percent of IT SCED cases	Average Bias (MW)	Median Bias (MW)
2018	Negative	48,150	45.7%	-746	-700
2018	Positive	35,560	33.8%	1,288	1,000
2018	Unbiased	21,634	20.5%	0	0
2019	Negative	45,902	43.3%	-762	-750
2019	Positive	32,538	30.7%	918	1,000
2019	Unbiased	27,475	25.9%	0	0
2020	Negative	20,547	39.1%	-578	-500
2020	Positive	17,250	32.8%	921	1,000
2020	Unbiased	14,748	28.1%	0	0

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RT SCED Load Bias

- **Each RT SCED case produces three solutions. The only difference is the level of load bias.**

- **The scenarios can be classified as:**
  - **Low**
  - **Mid**
  - **High**

- **The three scenarios do not necessarily reflect positive, negative, and zero bias.**
  - **For example, the low, mid, high bias in a case can be 250 MW, 500 MW, and 1,000 MW.**

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Load Bias in Approved RT SCED Solutions

Year	RT SCED Scenario	Number of approved solutions	Percent of approved solutions	Average Bias (MW)	Standard Deviation (MW)	Maximum Bias (MW)	Minimum Bias (MW)
2018	Low	39,052	29.0%	-1,108	580	1,500	-5,000
2018	Mid	65,127	48.4%	-569	529	1,500	-3,500
2018	High	30,356	22.6%	-92	568	2,000	-3,000
2018	Total	134,535		-618	663	2,000	-5,000
2019	Low	43,001	29.2%	-1,148	548	1,300	-6,500
2019	Mid	71,497	48.6%	-634	497	1,750	-7,500
2019	High	32,745	22.2%	-172	548	2,300	-5,000
2019	Total	147,243		-682	630	2,300	-7,500
2020	Low	15,778	26.6%	-842	507	1,500	-3,500
2020	Mid	30,654	51.6%	-340	465	2,500	-3,000
2020	High	12,960	21.8%	150	510	2,750	-2,500
2020	Total	59,392		-366	596	2,750	-3,500

* 2020 data through June.

* See Appendix for percentile statistics.

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Load Bias in RT SCED

- **Load bias in approved RT SCED solutions is predominantly negative.**

- **Through the first six months of 2020, the percent of approved RT SCED solutions that were negatively biased is lower than in 2018 and 2019.**

Year	Bias Direction	Number of approved solutions	Percent of approved solutions	Average Bias (MW)	Median Bias (MW)
2018	Negative	103,814	77.2%	-874	-800
2018	Positive	16,369	12.2%	466	500
2018	Unbiased	14,352	10.7%	0	0
2019	Negative	119,989	81.5%	-886	-800
2019	Positive	13,068	8.9%	454	500
2019	Unbiased	14,186	9.6%	0	0
2020	Negative	39,124	65.9%	-695	-500
2020	Positive	11,236	18.9%	485	500
2020	Unbiased	9,032	15.2%	0	0

* 2020 data through June.

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Load Bias in LPC

Year	Bias Direction	Number of LPC Cases	Percent of LPC Cases	Average Bias (MW)	Median Bias (MW)
2018	Negative	81,390	77.4%	-864	-750
2018	Positive	12,338	11.7%	463	500
2018	Unbiased	11,391	10.8%	0	0
2019	Negative	86,168	82.0%	-881	-800
2019	Positive	8,977	8.5%	446	500
2019	Unbiased	9,975	9.5%	0	0
2020	Negative	34,595	66.0%	-690	-500
2020	Positive	9,791	18.7%	484	500
2020	Unbiased	8,018	15.3%	0	0

* 2020 data through June.

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Load Bias in LPC: Distribution
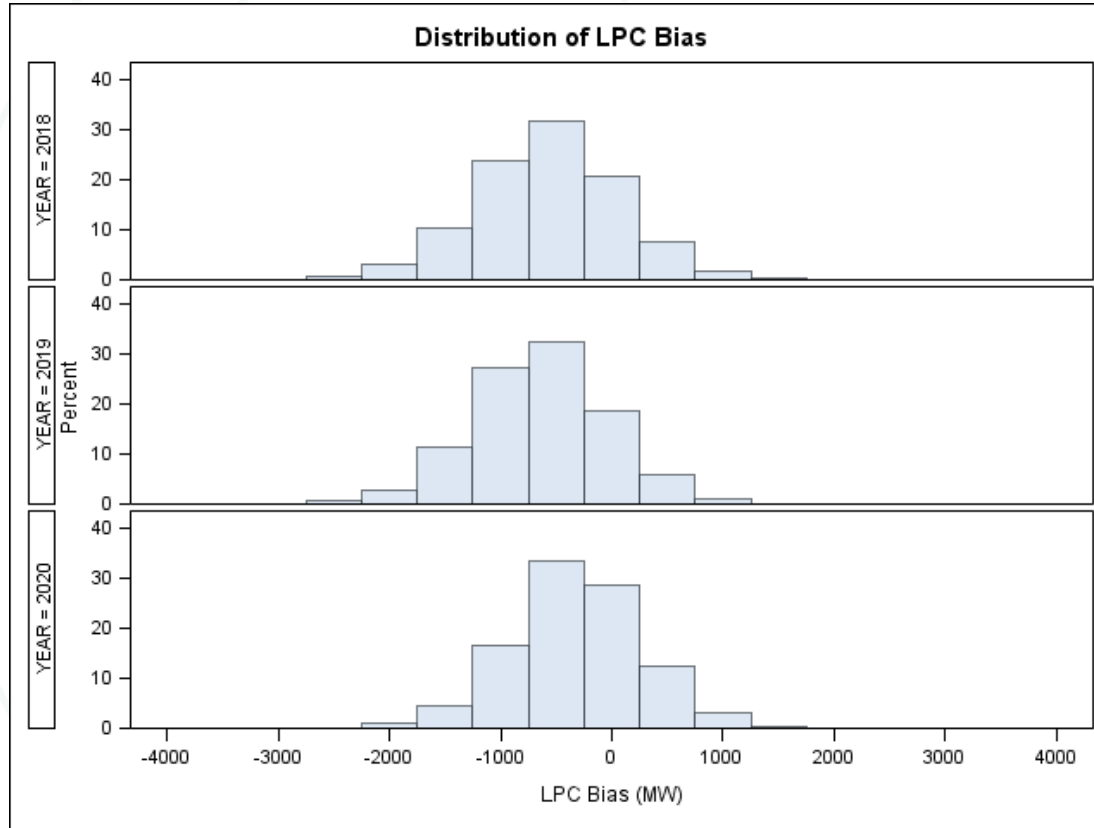
*Outliers with absolute value of bias > 4000 MW removed.

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Fifteen Minute Ahead Load Forecast Error

Distribution of 15 minute ahead load forecast error
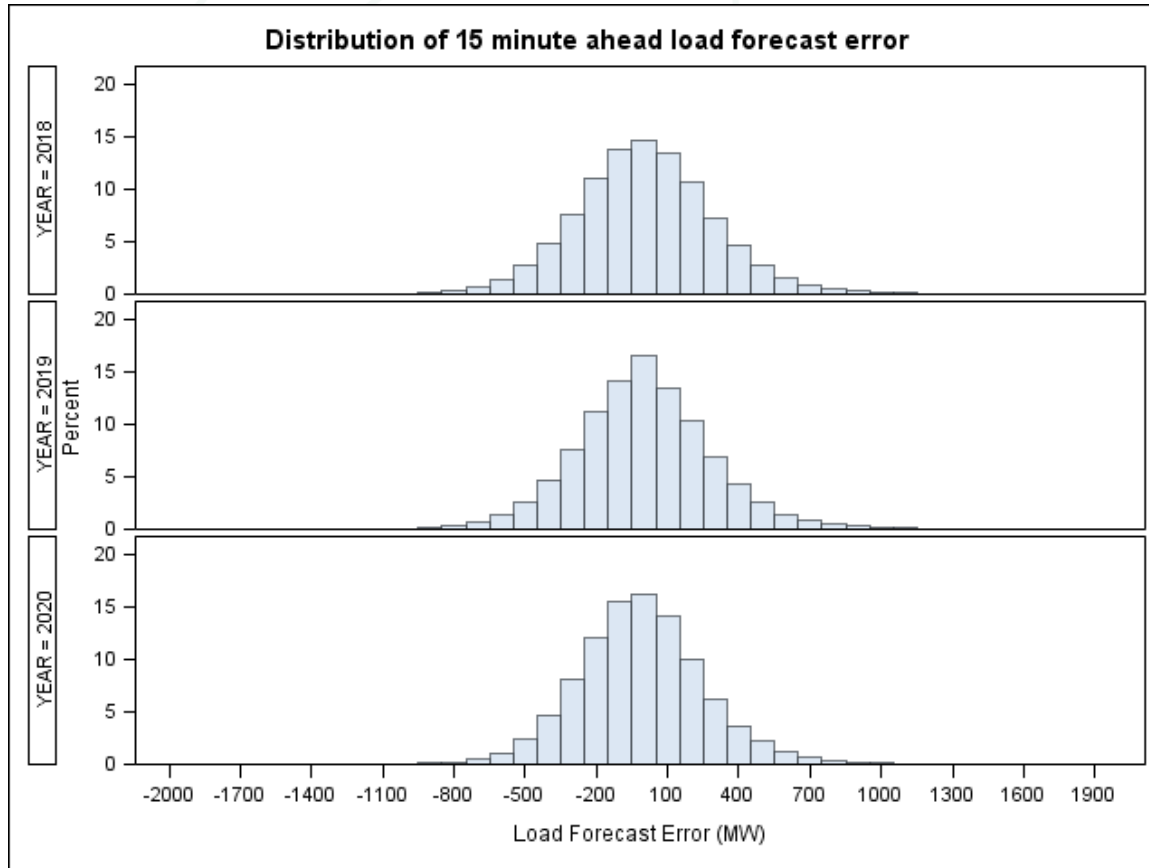
*The required generation MW is used as a proxy for load. This is the forecast that is used in RT SCED.

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Load Forecast Error and Load Bias

- **Load forecast error (fifteen minutes ahead) is generally symmetrically distributed in the positive and negative direction.**

- **Distribution of load bias skewed negative in both approved RT SCED solutions and LPC cases.**

- **The analysis compares the forecast error for a specific target time with the bias applied for the same target time in the RT SCED cases that were used in pricing.**

- **Load bias is disproportionately negative regardless of forecast error.**

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Load Forecast Error and Load Bias

2018				
Forecast Direction	Positive Bias	Zero Bias	Negative Bias	Total
Load Underforecast	19.1%	13.9%	67.0%	100.0%
Load Accurately Forecast	10.4%	10.6%	79.0%	100.0%
Load Overforecast	6.2%	7.4%	86.4%	100.0%

2019				
Forecast Direction	Positive Bias	Zero Bias	Negative Bias	Total
Load Underforecast	15.4%	13.1%	71.5%	100.0%
Load Accurately Forecast	6.7%	9.2%	84.0%	100.0%
Load Overforecast	4.0%	6.4%	89.6%	100.0%

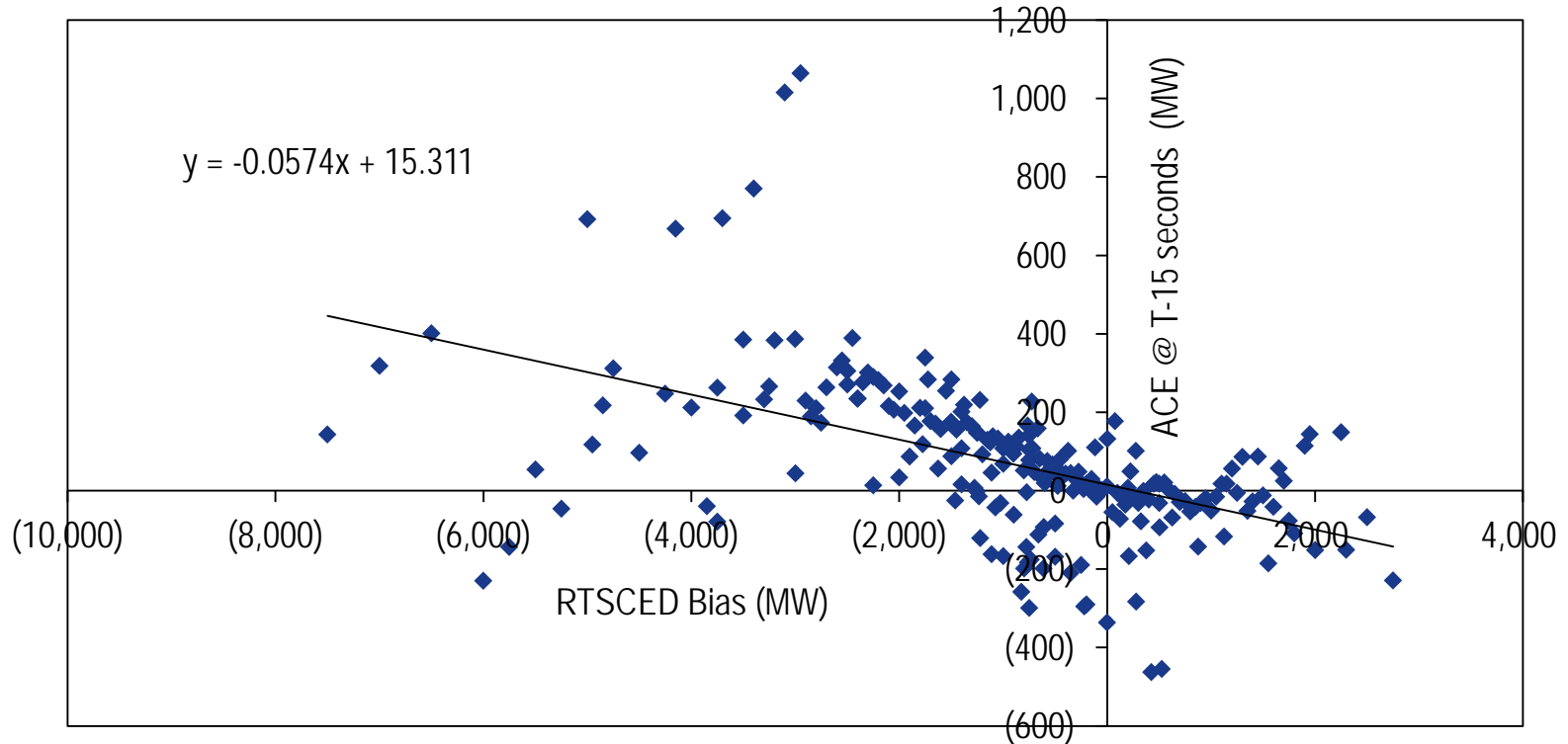| 2020				
Forecast Direction	Positive Bias	Zero Bias	Negative Bias	Total
Load Underforecast	28.8%	19.0%	52.2%	100.0%
Load Accurately Forecast	16.8%	16.0%	67.2%	100.0%
Load Overforecast	11.2%	11.4%	77.3%	100.0%

- **Excluded times when there is no approved RT SCED for a target time.**
- **Used the latest approved RT SCED case when multiple SCED cases with the same target time were used in LPC.**
- **Assumed forecast within 100 MW is accurate.**

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RT SCED Load Bias and ACE

- **Regulation is used to control ACE.**
  - **Load bias in RT SCED is also used for ACE control.**
- **RT SCED load bias and ACE are correlated:**
  - **Load bias tends to be negative when ACE is positive.**
  - **Load bias tends to be positive when ACE is negative or close to zero.**
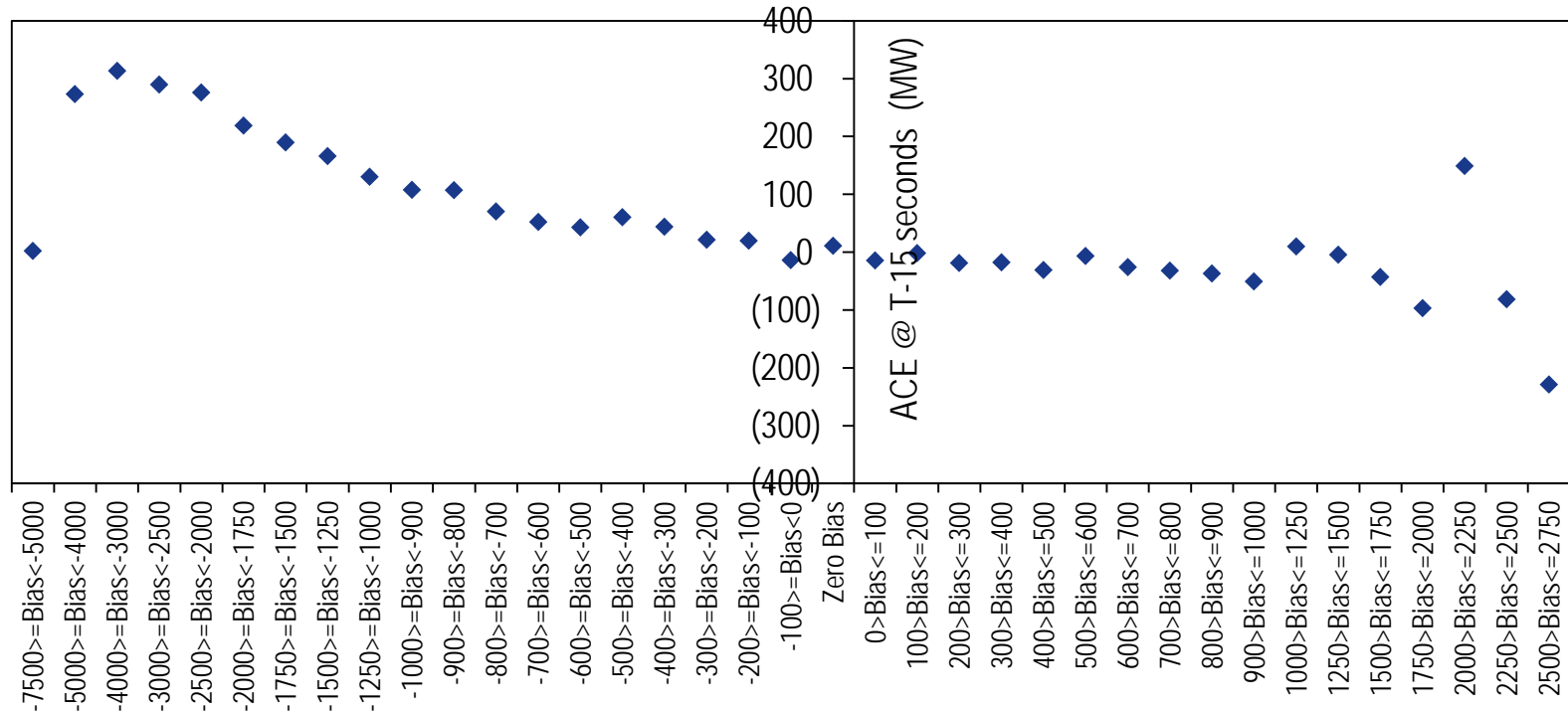 - **There are exceptional cases.**

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RTSCED Load Bias and ACE (Jun2019-Jun2020)

- **ACE at 15 seconds before SCED case approval.**

$y = -0.0574x + 15.311$

ACE @ T-15 seconds (MW)

RTSCED Bias (MW)

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RTSCED Load Bias and ACE (Jun2019-Jun2020)

- **Load bias by MW bands:**

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Load Bias During Spin Events

January 23, 2020		RT SCED Approved Time	RT SCED Bias (MW)	RT SCED Target Time
		16:16	0	16:25
Spin Start	16:17			
		16:18	1,000	16:30
		16:19	1,000	16:30
		16:22	1,500	16:35
		16:24	1,000	16:35
		16:24	500	16:35
		16:26	500	16:35
		16:26	-500	16:35
Spin End	16:26			
		16:28	-1,000	16:40

February 18, 2020		RT SCED Approved Time	RT SCED Bias (MW)	RT SCED Target Time
		11:14	0	11:25
Spin Start	11:16			
		11:18	1,000	11:30
		11:22	-500	11:35
		11:25	-1,000	11:35
		11:25	-1,000	11:35
Spin End	11:26			
		11:29	-1,000	11:40

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Load Bias During Spin Events

- **Spinning event dispatches all reserves at RTO or MAD level; does not dispatch a subset of reserves.**

- **Use of bias indicates spin response greater than needed quantity.**

- **Load bias applied during Feb 10, 2020, spin event was negative throughout.**

February 10, 2020		RT SCED Approved Time	RT SCED Bias (MW)	RT SCED Target Time
		20:10	-500	20:20
		20:13	-500	20:25
Spin Start	20:15			
		20:16	-500	20:25
Spin End	20:24			
		20:25	-1,000	20:35
		20:28	-1,500	20:40
		20:29	-1,500	20:40
		20:32	-1,500	20:40

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Load Bias During Spin Events

- **Negative load bias decreases the system generation dispatched 10 to 14 minutes ahead.**

  - **Bias MW currently a multiple of ACE MW when bias is negative.**

- **Negative load bias in spinning events used to compensate for lack of ability to calibrate needed response in spinning events.**

  - **Spin events call on all synchronized reserves, regardless of actual need.**

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Load Bias Use

- **Analysis shows that load bias is predominantly negative.**

  - **There is a consistent need to reduce the dispatched generation in RT SCED.**

  - **Load forecast error does not appear to be the cause.**

  - **Implies that more supply is regularly dispatched in RT SCED than needed to meet demand.**

- **Load bias issue needs to be investigated and addressed.**

  - **Is use of load bias a symptom of an underlying issue?**

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Load Bias Use

- **MIC evaluated real-time dispatch and pricing issues:**
  - **Dispatch timing**
  - **Dispatch and pricing alignment**
  - **Dispatch and settlement alignment**
  - **Modeling of resource initial MW (SE vs SCED)**
- **Load bias is a tool to deal with these system and process inaccuracies.**
- **Load bias also used to control ACE, which is a metric for the entire PJM system.**
- **Load bias is a blunt tool.**

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Load Bias and Dispatch Process

- **The identified issues with the five minute dispatch and pricing process likely contribute to the inaccurate SCED output.**

- **Solution includes more than short term proposal:**
  - **Reduce the ramp time to five minutes from 10 minutes.**
  - **Model the initial resource MW to reflect the direction that resources are moving while cases are solving.**
  - **Address the issue of overlapping dispatch signals.**
  - **Address the issue of conflicting price and dispatch signals.**

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Conclusions

- **Load bias is a blunt tool to deal with identified system and process inaccuracies.**

- **Load bias changes prices and market outcomes.**
  - **Does not enhance market efficiency unless used to accurately correct load forecast.**

- **The underlying issues in the real time dispatch process and software should be addressed to minimize the need for frequent use of load bias.**

- **Fast start pricing and ORDC should not be implemented until the underlying issues are resolved.**

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Appendix

Load Bias in Approved RT SCED Cases

Year	RT SCED Scenario	Number of approved solutions	Percent of approved solutions	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
2018	Low	39,052	29.0%	-2,000	-1,950	-1,500	-1,000	-750	-500	-250
2018	Mid	65,127	48.4%	-1,500	-1,250	-1,000	-500	-250	0	250
2018	High	30,356	22.6%	-1,000	-800	-500	0	250	500	800
2018	**Total**	**134,535**		**-1,750**	**-1,500**	**-1,000**	**-500**	**-200**	**200**	**500**
2019	Low	43,001	29.2%	-2,000	-1,800	-1,500	-1,100	-800	-500	-300
2019	Mid	71,497	48.6%	-1,500	-1,250	-1,000	-600	-350	0	0
2019	High	32,745	22.2%	-1,000	-850	-500	-200	150	500	700
2019	**Total**	**147,243**		**-1,700**	**-1,500**	**-1,000**	**-700**	**-250**	**0**	**400**
2020	Low	15,778	26.6%	-1,700	-1,500	-1,100	-850	-500	-250	0
2020	Mid	30,654	51.6%	-1,000	-1,000	-500	-350	0	250	500
2020	High	12,960	21.8%	-700	-500	-150	150	500	750	1,000
2020	**Total**	**59,392**		**-1,350**	**-1,000**	**-750**	**-400**	**0**	**500**	**500**

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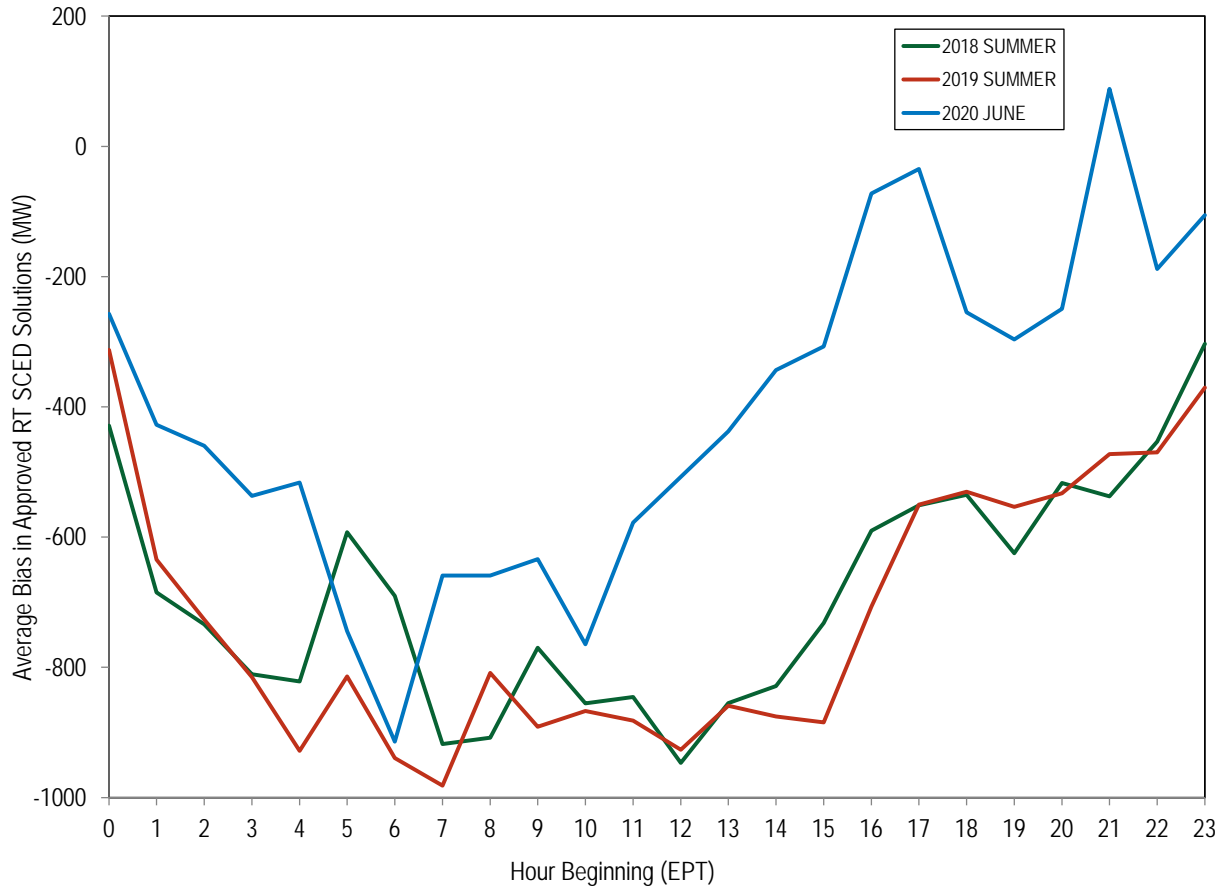# Load Bias by Time of Day and Season

- **Seasons:**
  - **Spring: March through May**
  - **Summer: June through August**
  - **Fall: September through November**
  - **Winter: December, January, February**
- **Graphs show the average load bias in approved RT SCED solutions during the hour when the solution was approved.**
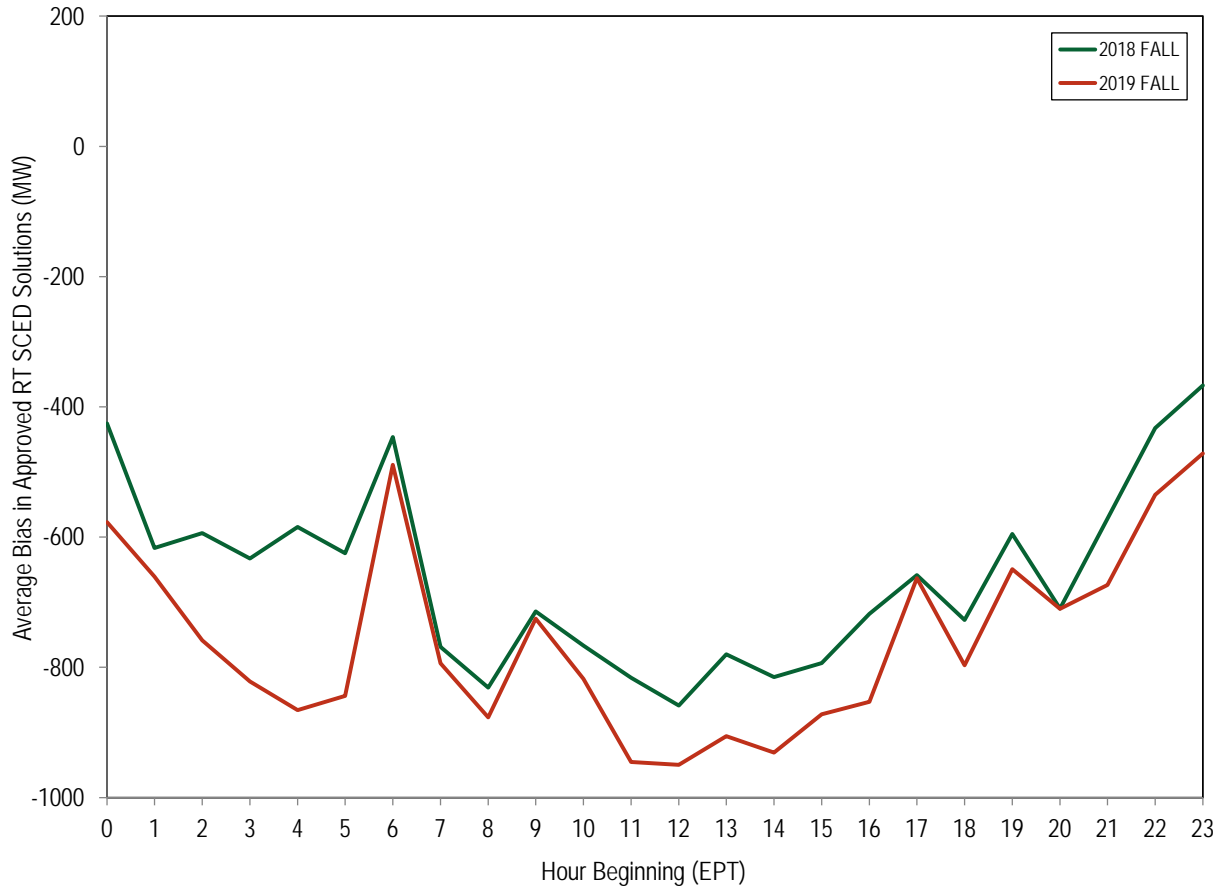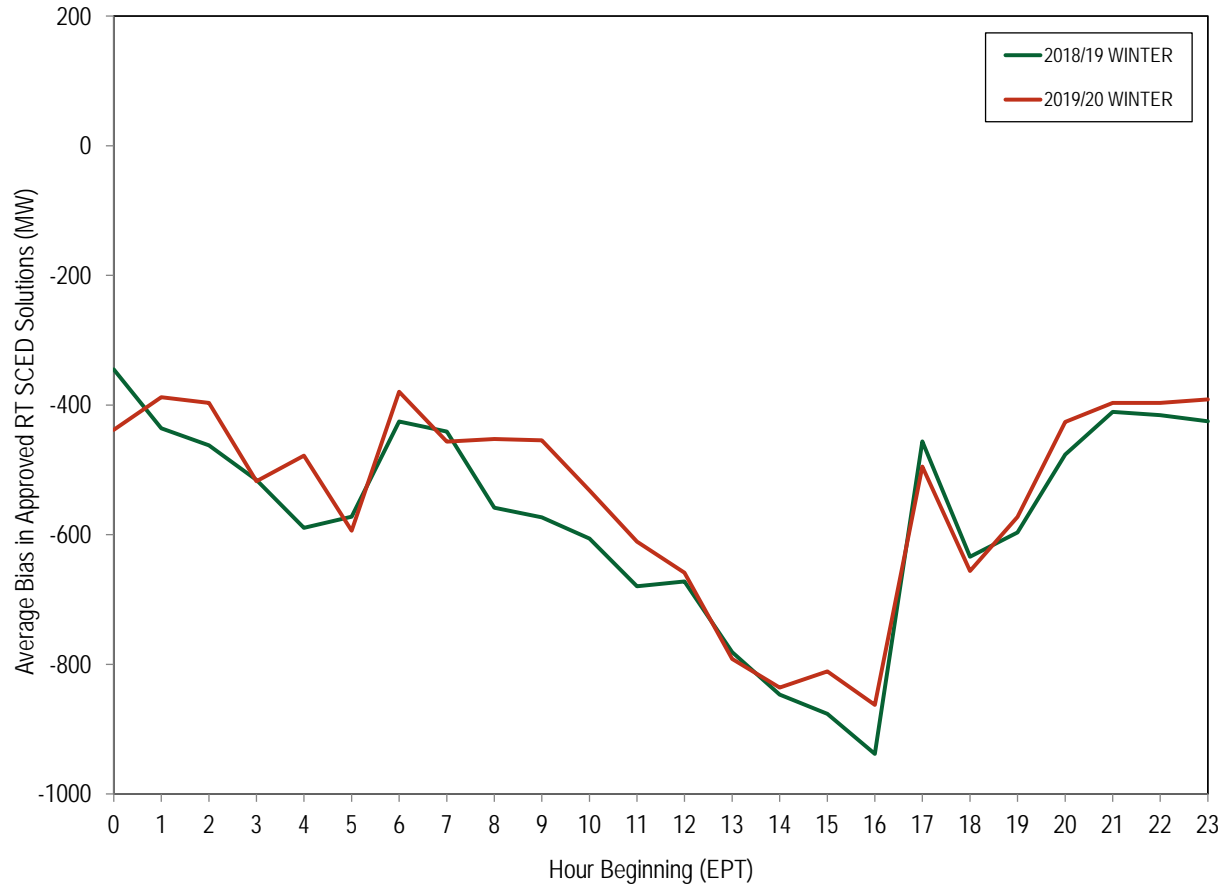
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Load Bias by Time of Day: Spring
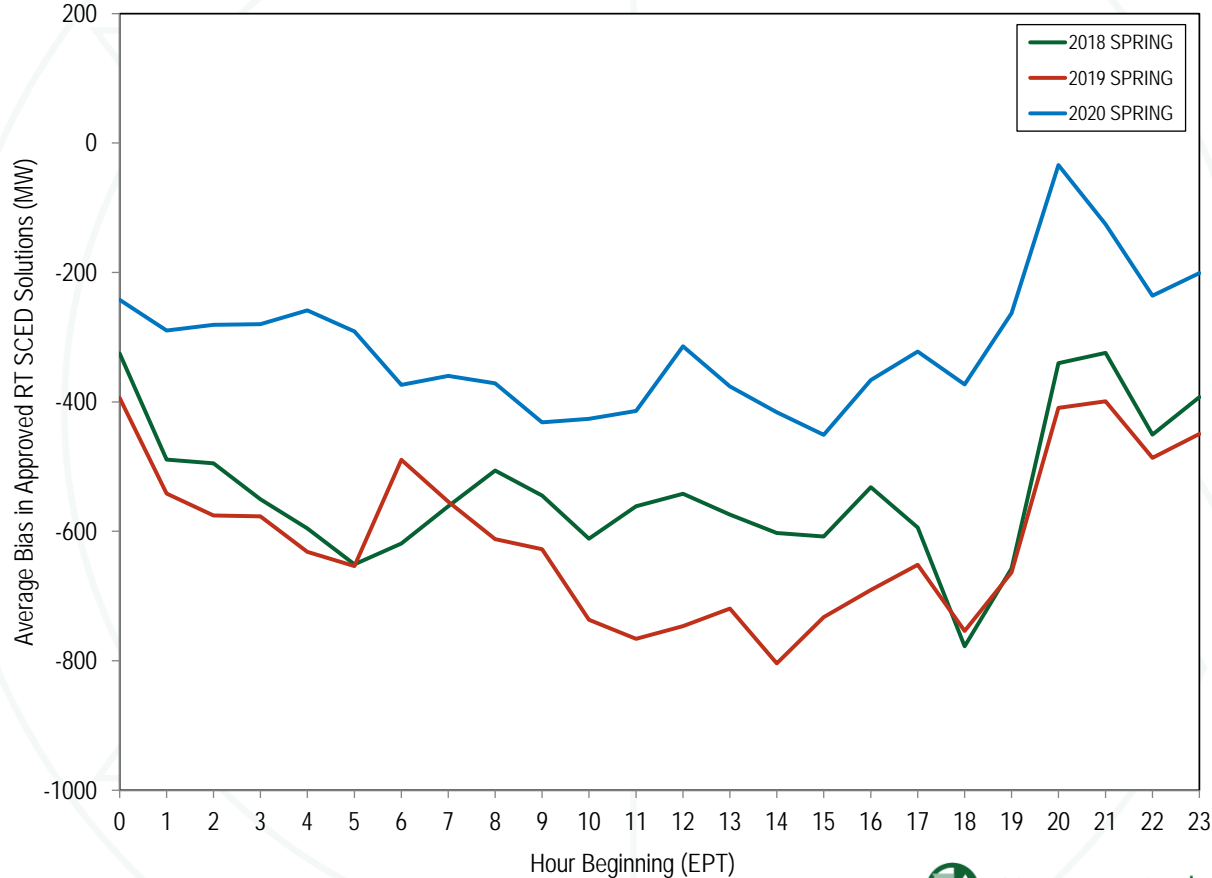
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Load Bias by Time of Day: Summer

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Load Bias by Time of Day: Fall

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Load Bias by Time of Day: Fall

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