

ERSTF

Loads and Resources Balance

Clyde Loutan, Senior Advisor – Renewable Energy Integration, CAISO

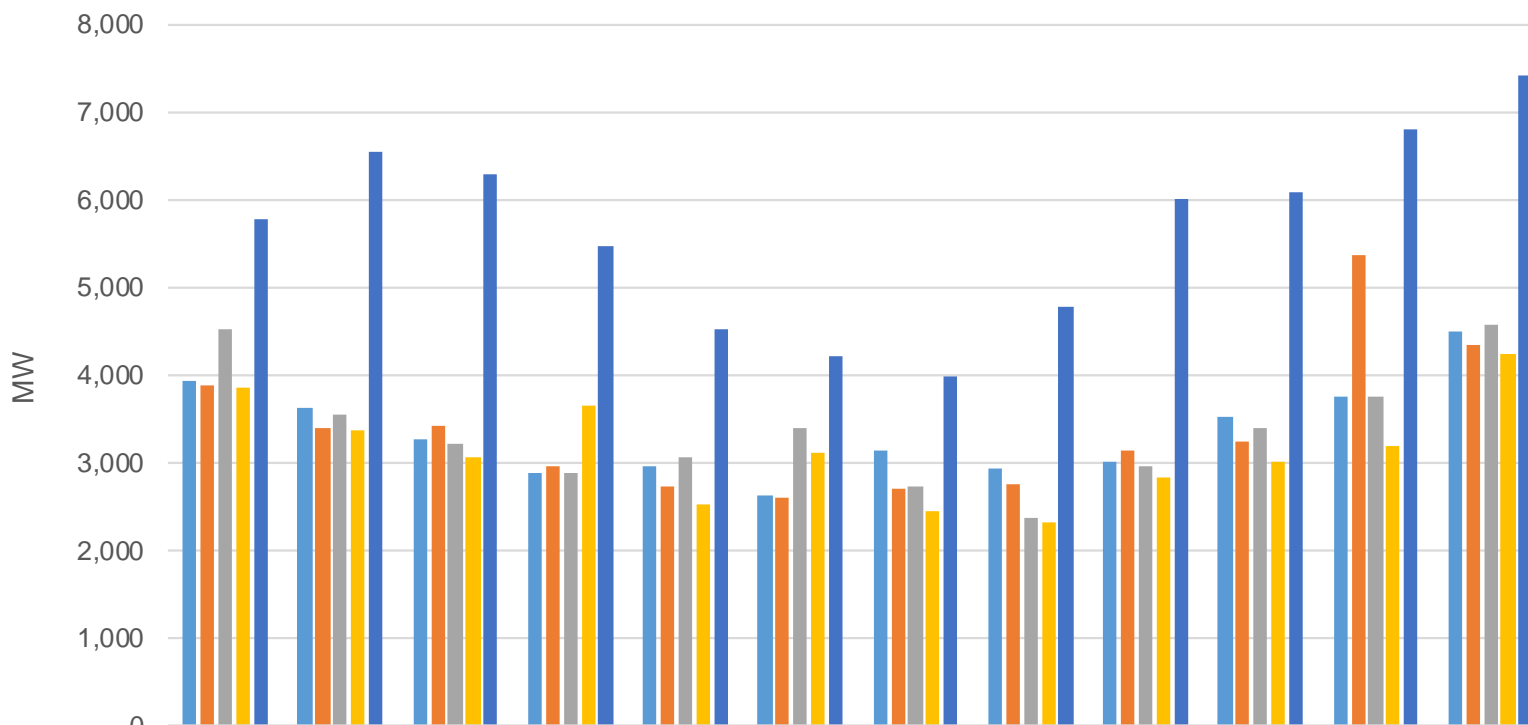
EPRI Dallas Regional Office
Las Colinas Tower II
February 3 & 4

RELIABILITY | ACCOUNTABILITY



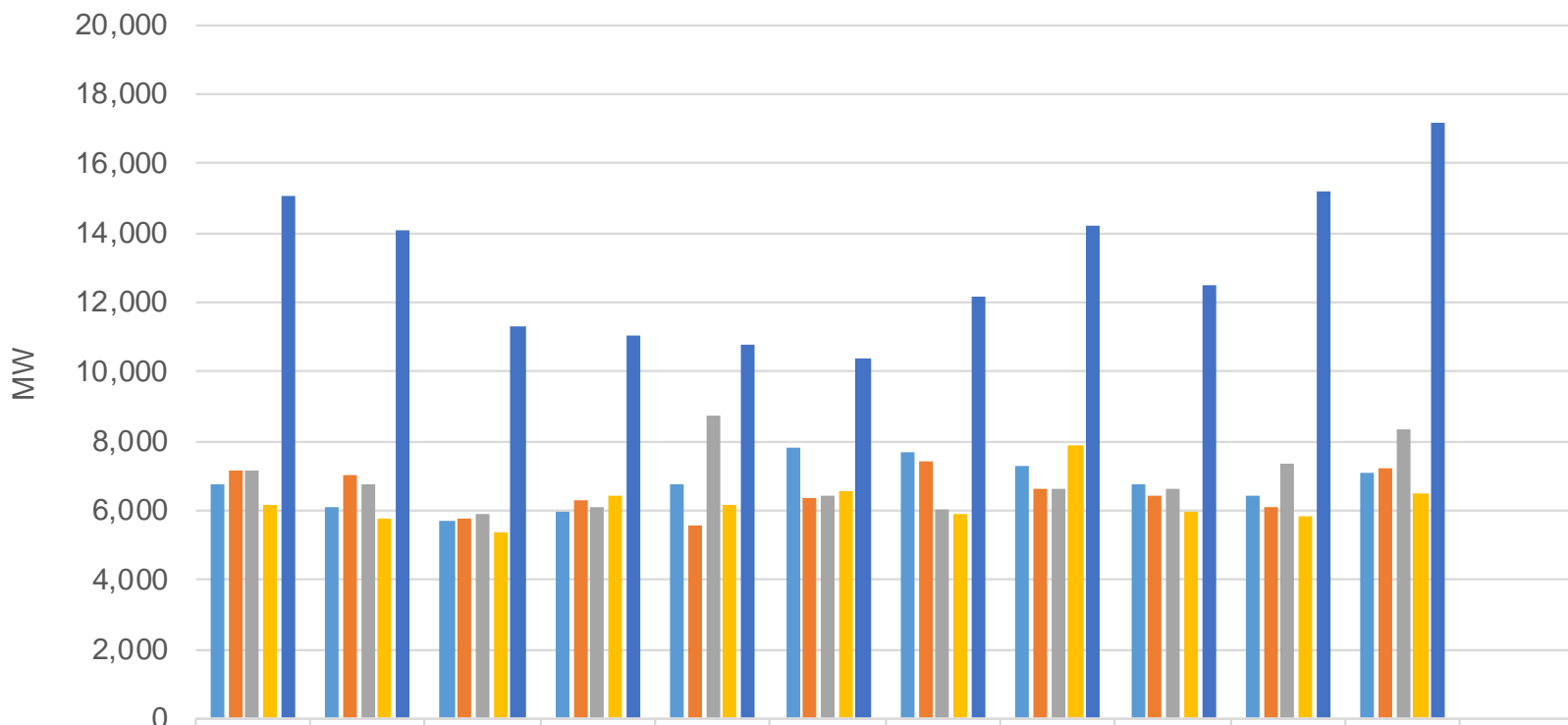
Subgroup Lead	Company	Email
Clyde Loutan	CAISO	cloutan@caiso.com
Subgroup Members		
Amir Najafzadeh	NERC	amir.najafzadeh@nerc.net
Brendan Kirby	Kirby Consulting	kirbybj@ieee.org
Dave Devereaux	IESO	david.devereaux@ieso.ca
Ed Scott	Duke Energy	edward.scott2@duke-energy.com
Jay Ruberto	First Energy	jrubert@firstenergycorp.com
Layne Brown	WECC	lbrown@wecc.biz
Michael McMullen	MISO	mmcmullen@misoenergy.org
Michael Milligan	NREL	michael.milligan@nrel.gov
Noha Abdel-Karim	NERC	noha.karim@nerc.net
Pooja Shah	NERC	pooja.shah@nerc.net
Ron Carlsen	Southern Company	rcarlse@southernco.com
Todd Lucas	Southern company	telucas@southernco.com
Tom Siegrist	Brickfield, Burchette, Ritts & Stone, P.C.	tom.siegrist@bbrslaw.com
Dariusz Shirmohammadi	California Wind Energy Association	Dariush@shirconsultants.com
Aidan Tuohy	EPRI	atuohy@epri.com

Maximum 1-Hour Upward Ramps



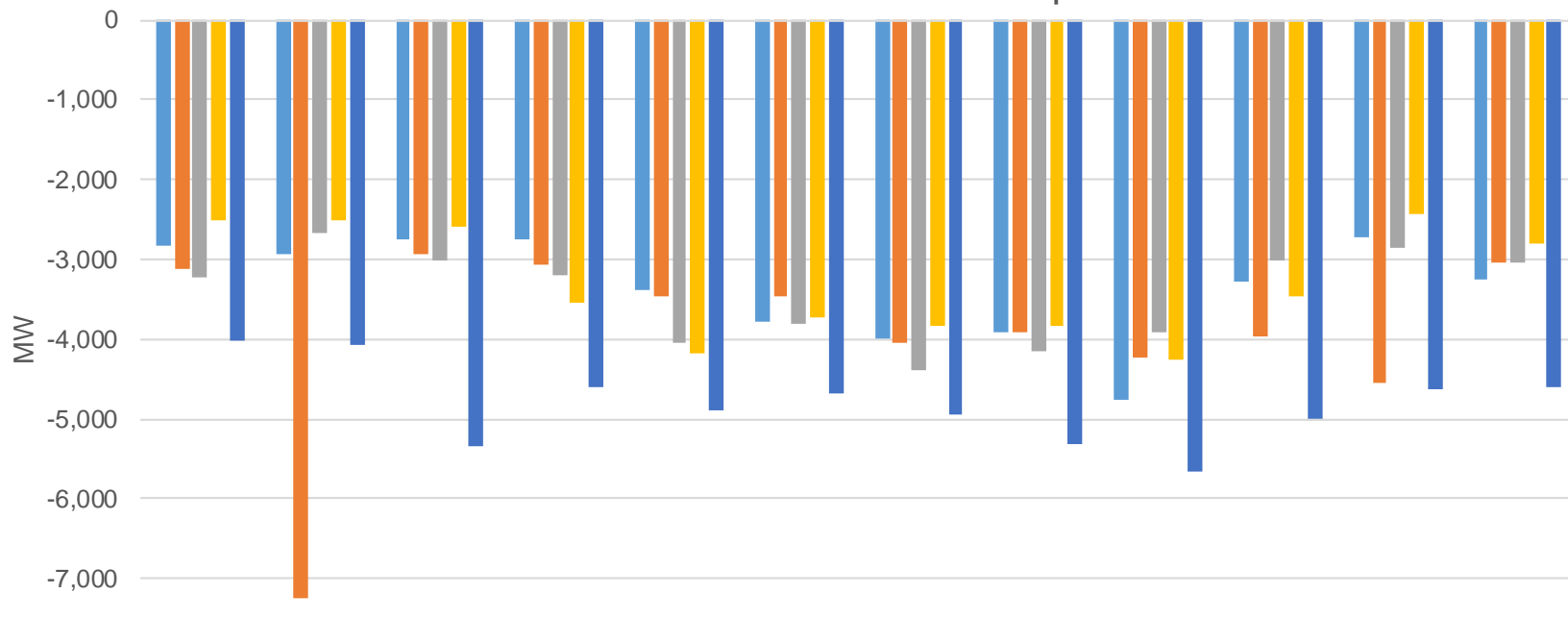
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011_1h	3,935	3,630	3,271	2,897	2,951	2,637	3,137	2,933	3,004	3,514	3,746	4,506
2012_1hr	3,875	3,394	3,428	2,959	2,736	2,606	2,695	2,766	3,143	3,240	5,358	4,352
2013_1hr	4,524	3,557	3,224	2,893	3,072	3,401	2,723	2,380	2,964	3,406	3,759	4,567
2014_1hr	3,862	3,374	3,064	3,653	2,527	3,128	2,446	2,320	2,848	3,012	3,192	4,235
2018_1hr	5,790	6,545	6,298	5,459	4,515	4,220	3,976	4,774	5,999	6,084	6,794	7,420

Maximum 3-Hour Upward Ramps



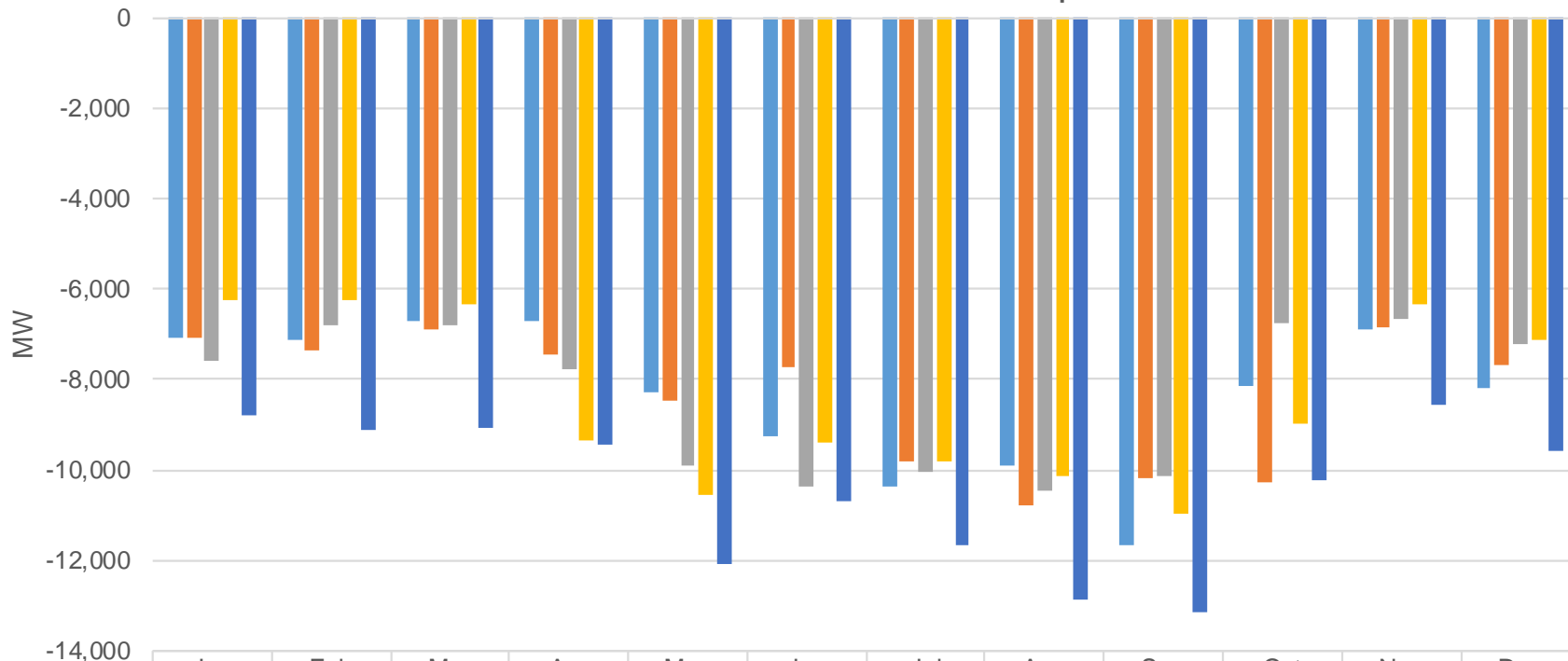
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011_3hr	6,766	6,067	5,688	5,942	6,732	7,822	7,702	7,251	6,767	6,433	7,098
2012_3hr	7,173	7,028	5,774	6,278	5,543	6,367	7,410	6,591	6,422	6,062	7,211
2013_3hr	7,171	6,736	5,881	6,096	8,745	6,426	6,024	6,591	6,609	7,355	8,343
2014_3hr	6,170	5,755	5,363	6,394	6,177	6,559	5,879	7,862	5,952	5,844	6,494
2018_3hr	15,048	14,100	11,332	11,022	10,769	10,390	12,143	14,174	12,509	15,190	17,179

Maximum 1-Hour Downward Ramps

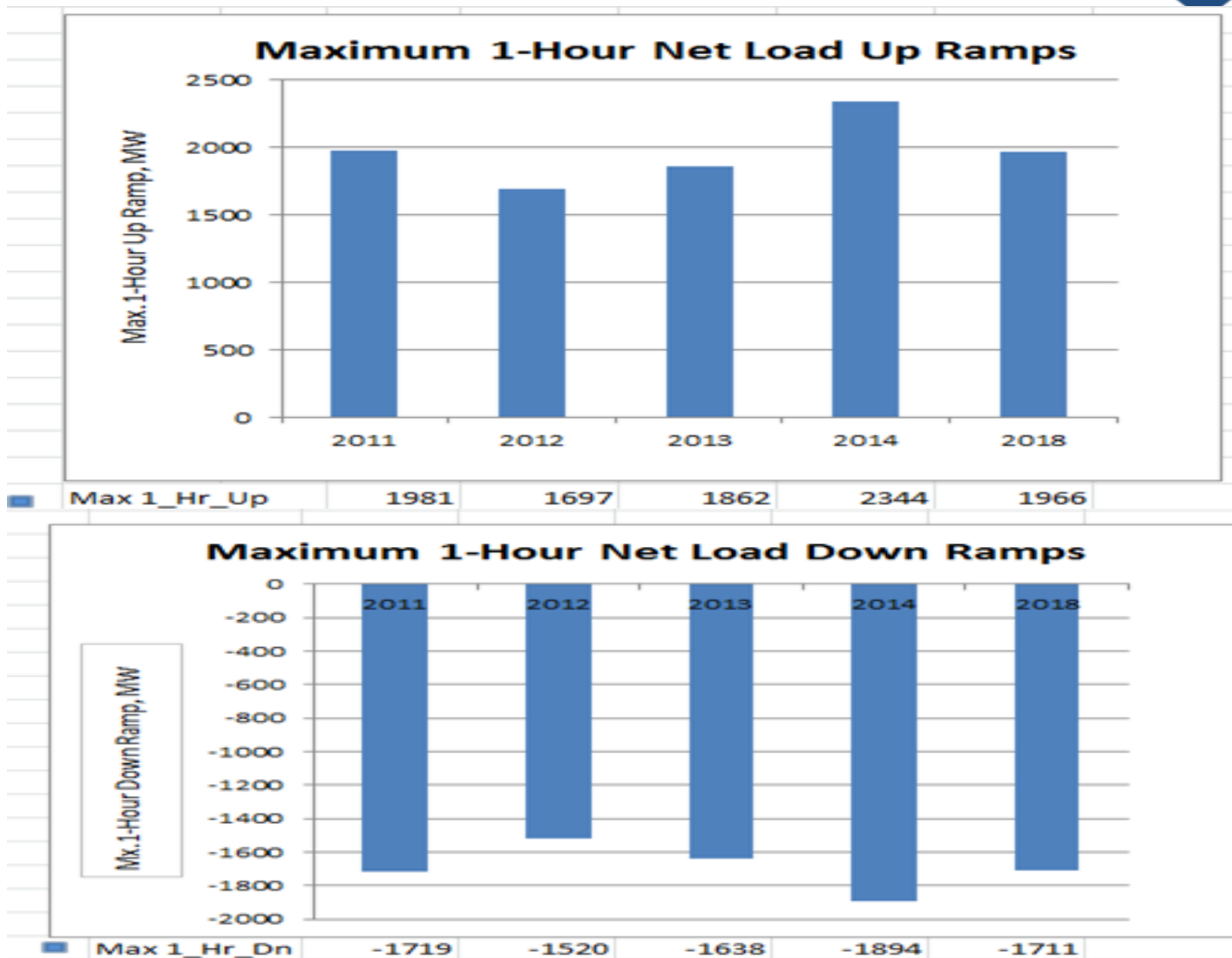


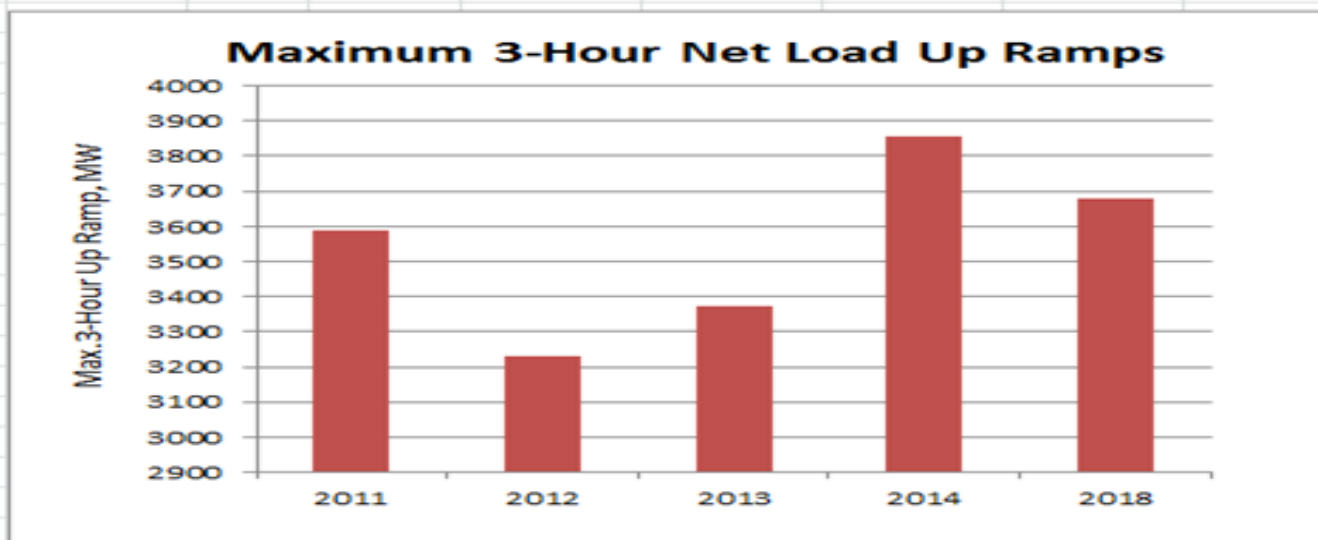
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
■ 2011_1h	-2,823	-2,939	-2,751	-2,758	-3,374	-3,771	-3,994	-3,920	-4,758	-3,267	-2,719	-3,252
■ 2012_1hr	-3,118	-7,240	-2,940	-3,056	-3,458	-3,457	-4,049	-3,919	-4,220	-3,972	-4,547	-3,043
■ 2013_1hr	-3,236	-2,663	-3,004	-3,194	-4,043	-3,820	-4,398	-4,140	-3,926	-3,026	-2,849	-3,044
■ 2014_1hr	-2,506	-2,510	-2,601	-3,554	-4,170	-3,728	-3,826	-3,830	-4,248	-3,453	-2,426	-2,795
■ 2018_1hr	-4,014	-4,078	-5,344	-4,593	-4,901	-4,672	-4,955	-5,316	-5,659	-4,997	-4,638	-4,590

Maximum 3-Hour Downward Ramps

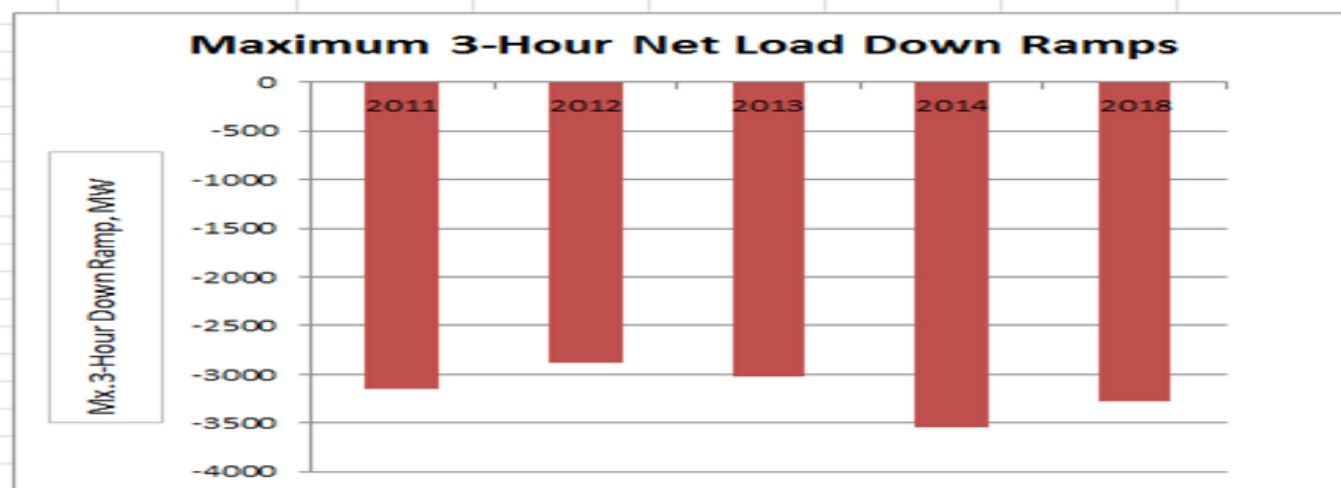


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
■ 2011_3hr	-7,091	-7,118	-6,711	-6,690	-8,276	-9,248	-10,362	-9,919	-11,684	-8,162	-6,900	-8,202
■ 2012_3hr	-7,083	-7,363	-6,900	-7,472	-8,472	-7,734	-9,804	-10,775	-10,195	-10,256	-6,865	-7,680
■ 2013_3hr	-7,600	-6,794	-6,806	-7,769	-9,908	-10,357	-10,023	-10,438	-10,136	-6,765	-6,643	-7,227
■ 2014_3hr	-6,258	-6,263	-6,350	-9,330	-10,538	-9,395	-9,813	-10,128	-10,981	-8,996	-6,346	-7,113
■ 2018_3hr	-8,815	-9,106	-9,086	-9,418	-12,068	-10,684	-11,676	-12,871	-13,143	-10,223	-8,541	-9,572



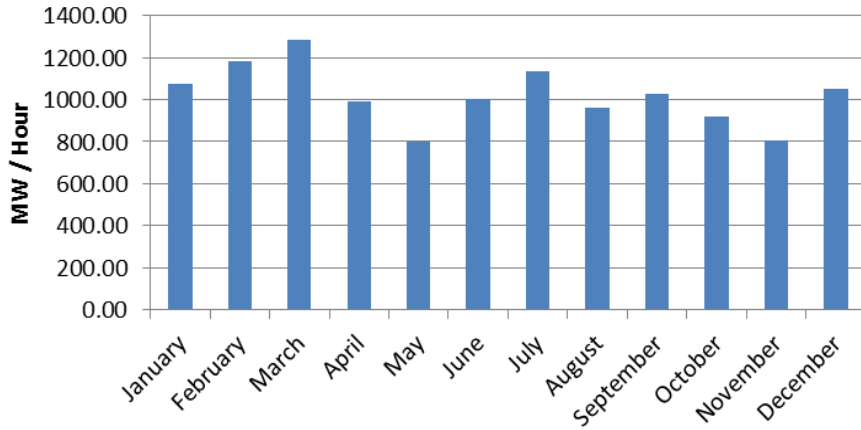


■ Max 3_Hr_Up	3589	3230	3372	3856	3680
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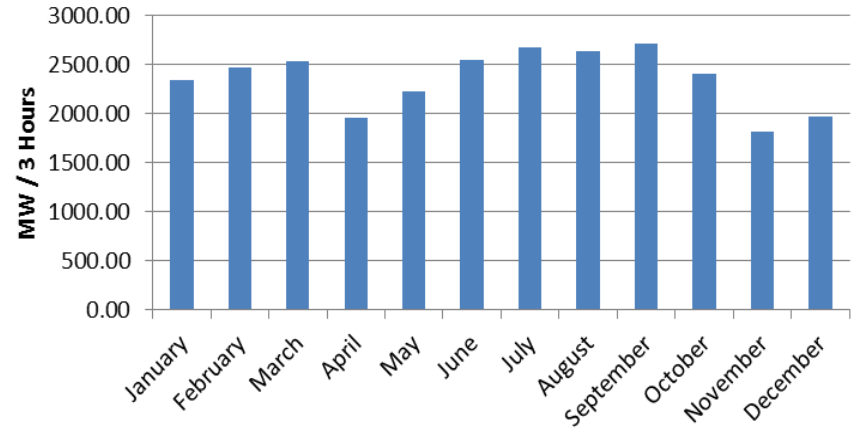


■ Max 3_Hr_Dn	-3152	-2885	-3025	-3547	-3282
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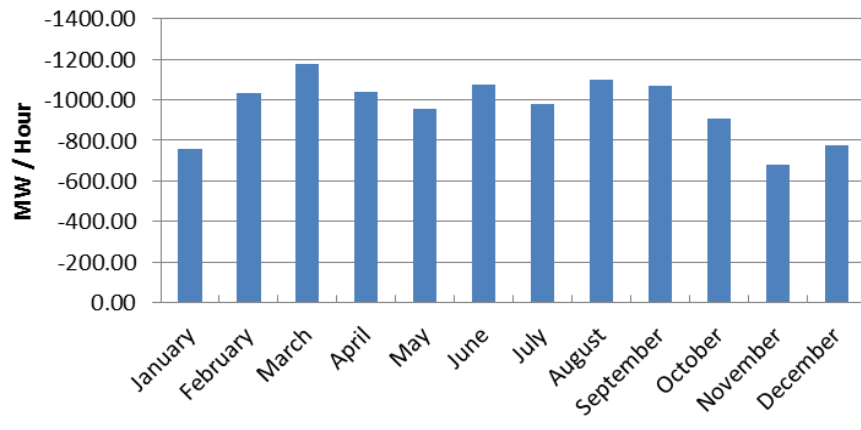
Maximum 1 Hour Up Ramp



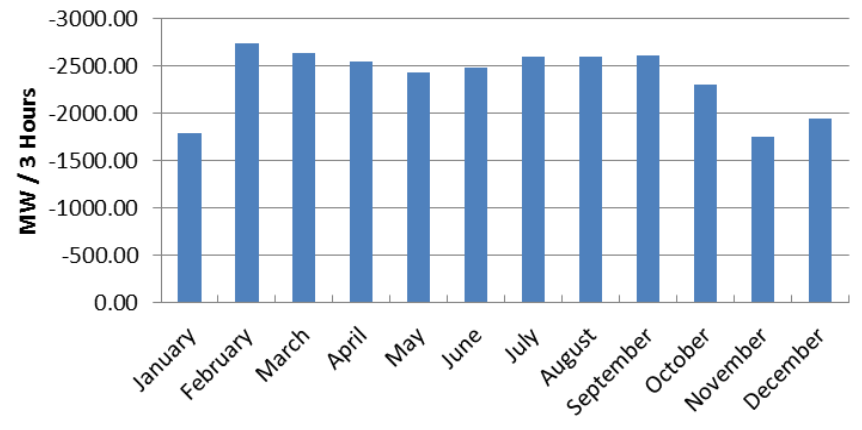
Maximum 3 Hour Up Ramp



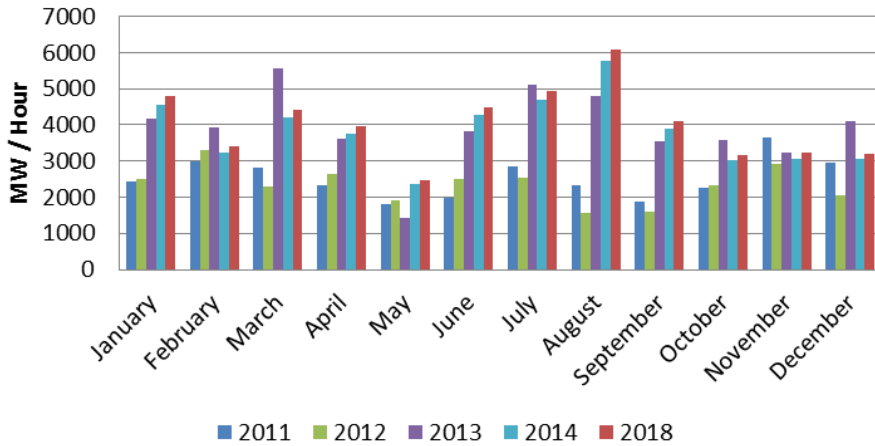
Maximum 1 Hour Down Ramp



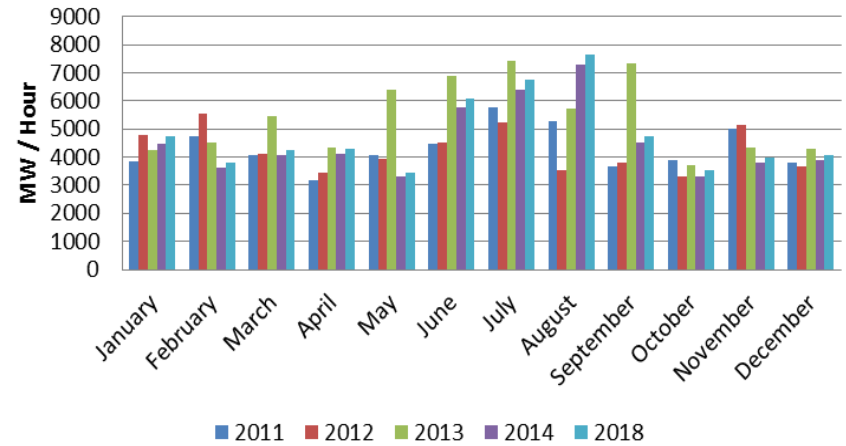
Maximum 3 Hour Down Ramp



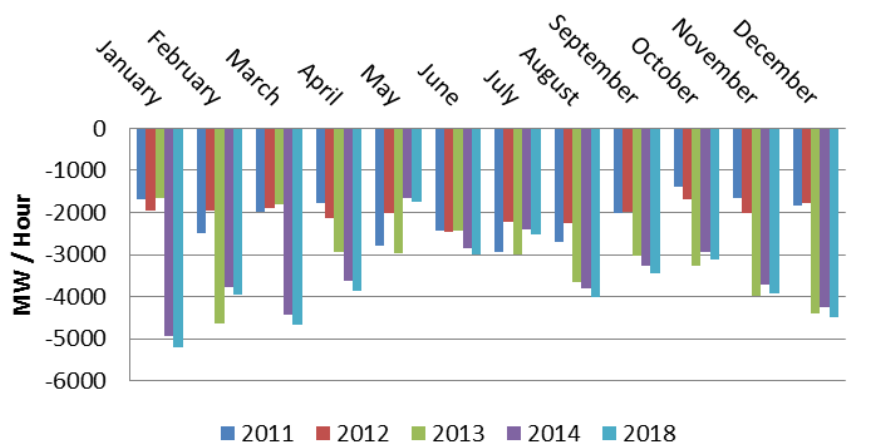
Maximum 1 Hour Up Ramp



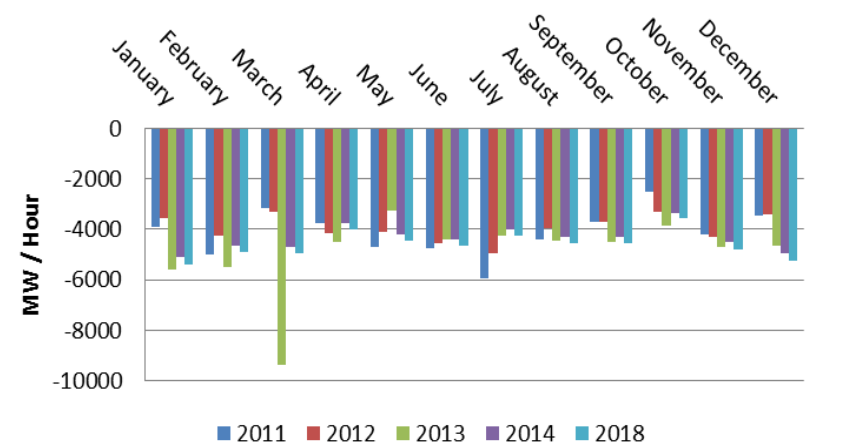
Maximum 3 Hour Up Ramp

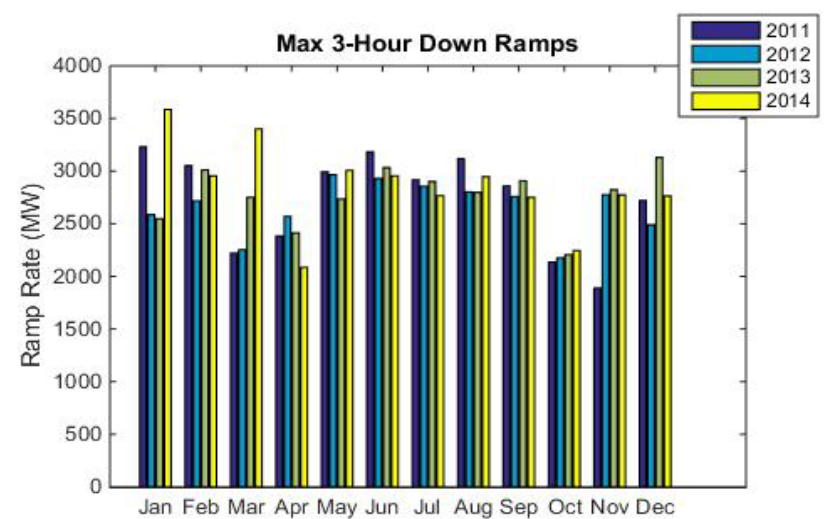
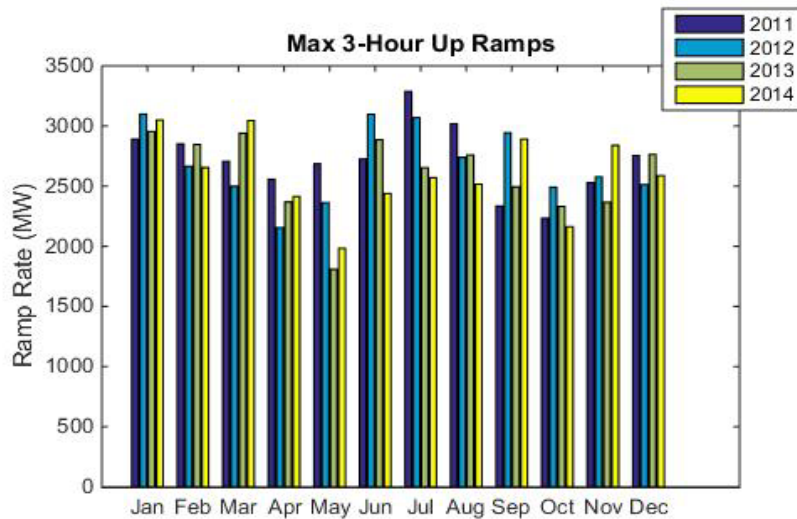
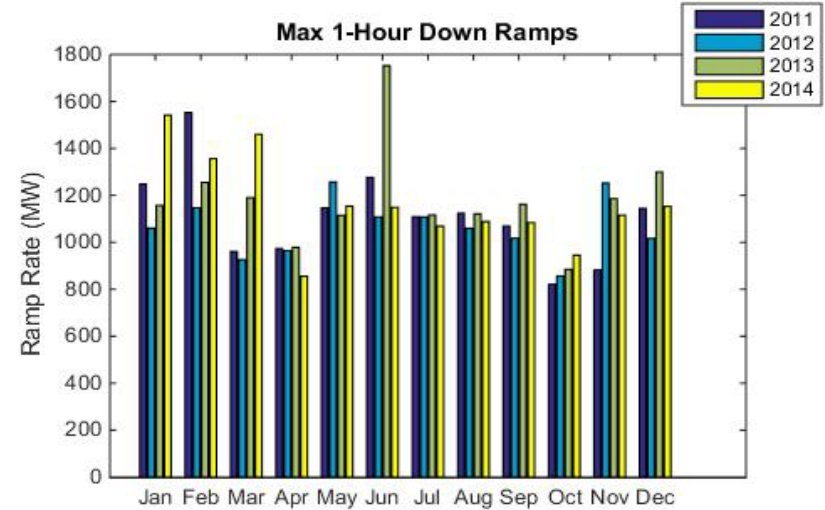
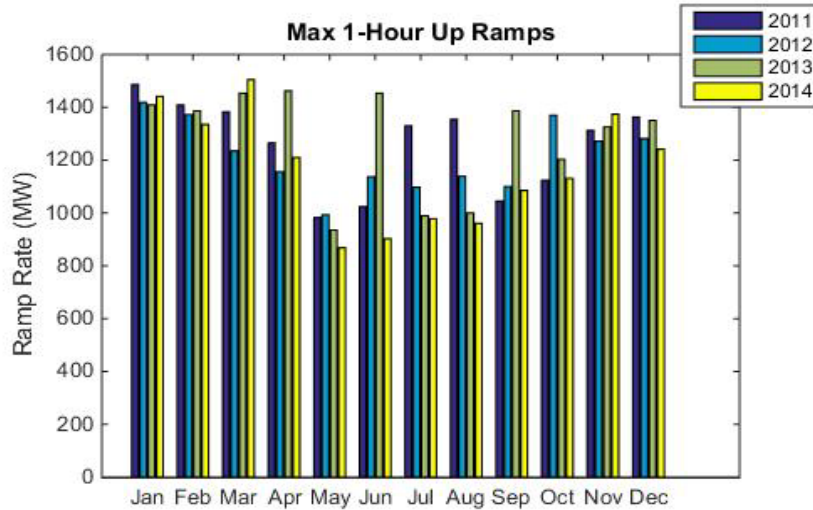


Maximum 1 Hour Down Ramp



Maximum 3 Hour Down Ramp





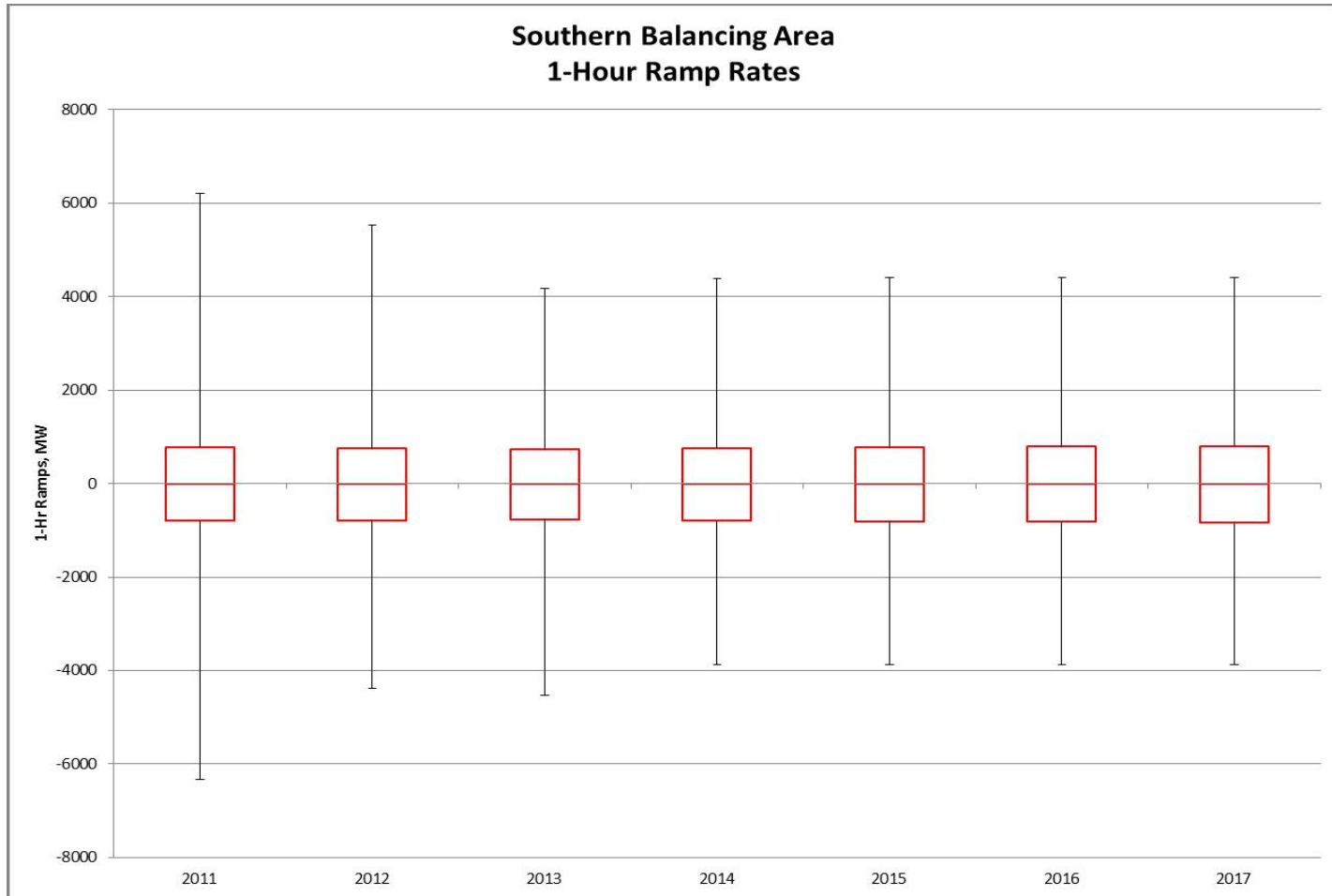
Measure 6

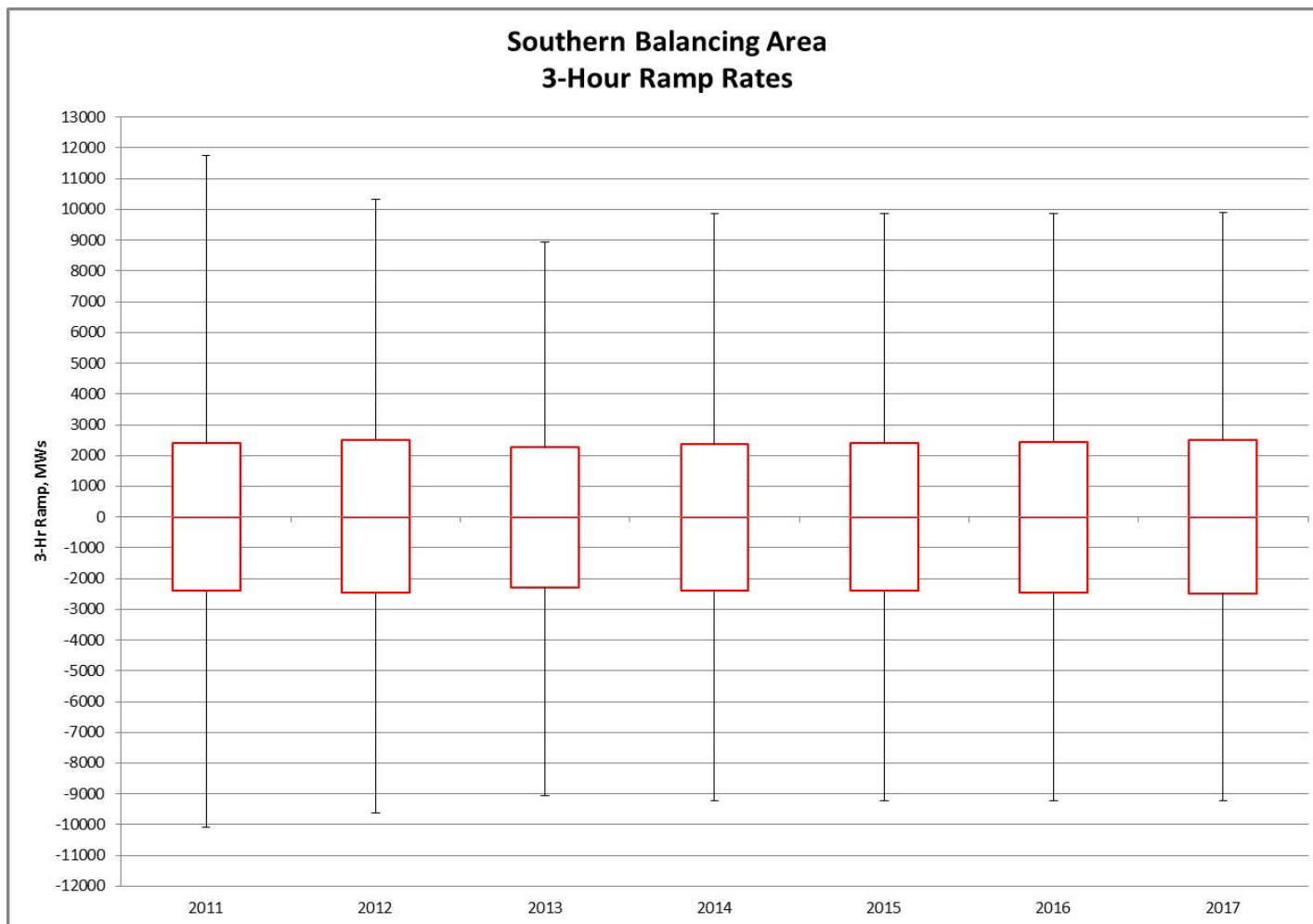
Ramping Capability Measures

The historical and projected maximum one-hour up, one-hour down, three-hour up, and three-hour down net load ramps (actual load less production from VERs) using one minute data.

Year	One-hour Up	One-hour down	Three-hour Up	Three-hour Down
2011	6166	-6325	11714	-10096
2012	5560	-4376	10385	-9614
2013	4192	-4521	9034	-9072
2014	4423	-3868	9911	-9236
2015	4423	-3868	9911	-9236
2016	4423	-3868	9911	-9236
2017	4423	-3868	9911	-9236

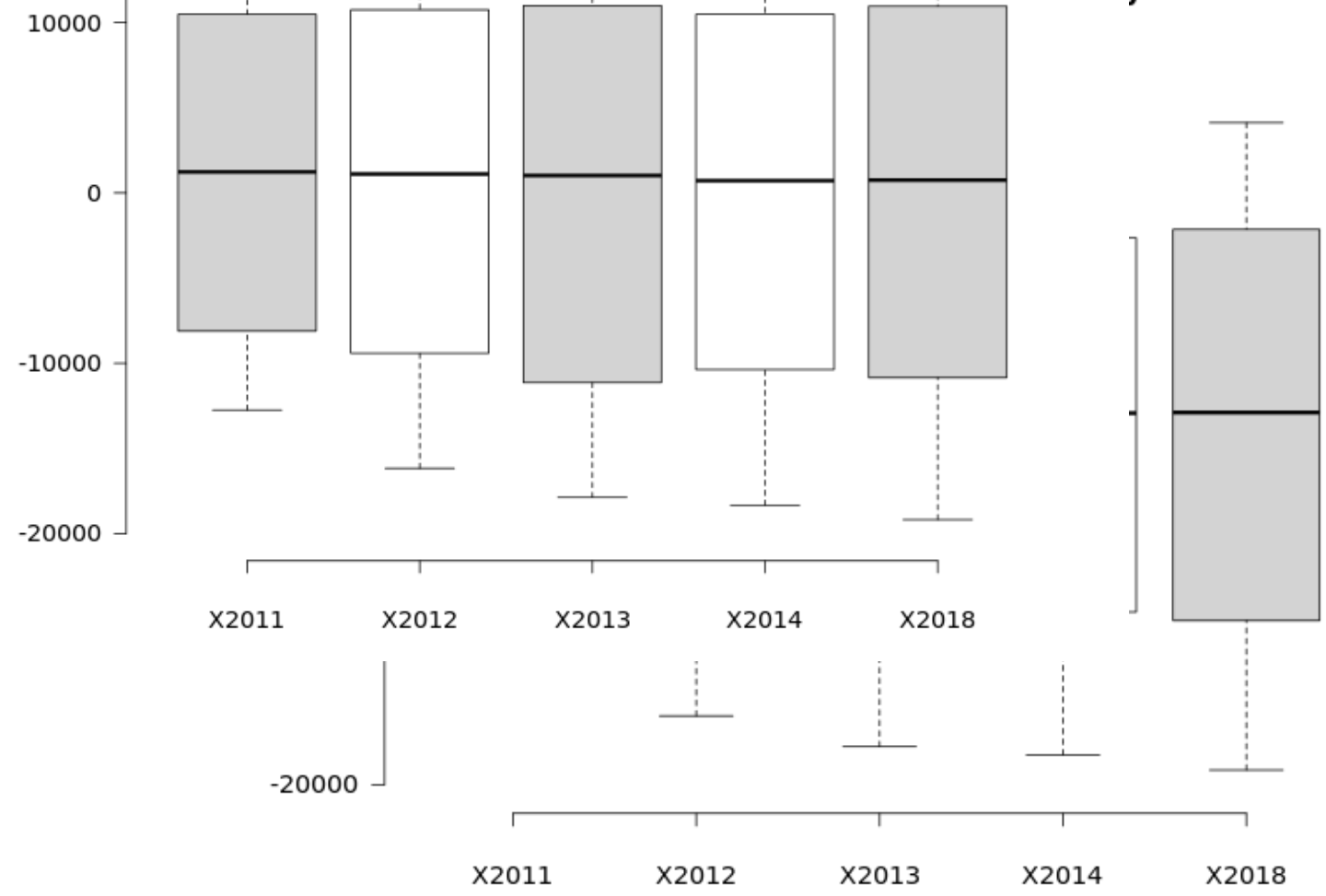
Year	Wind Capacity, MW	PV, MW
2011	0	0
2012	0	0
2013	202	46
2014	404	50
2015	404	1182
2016	654	1182
2017	654	1670





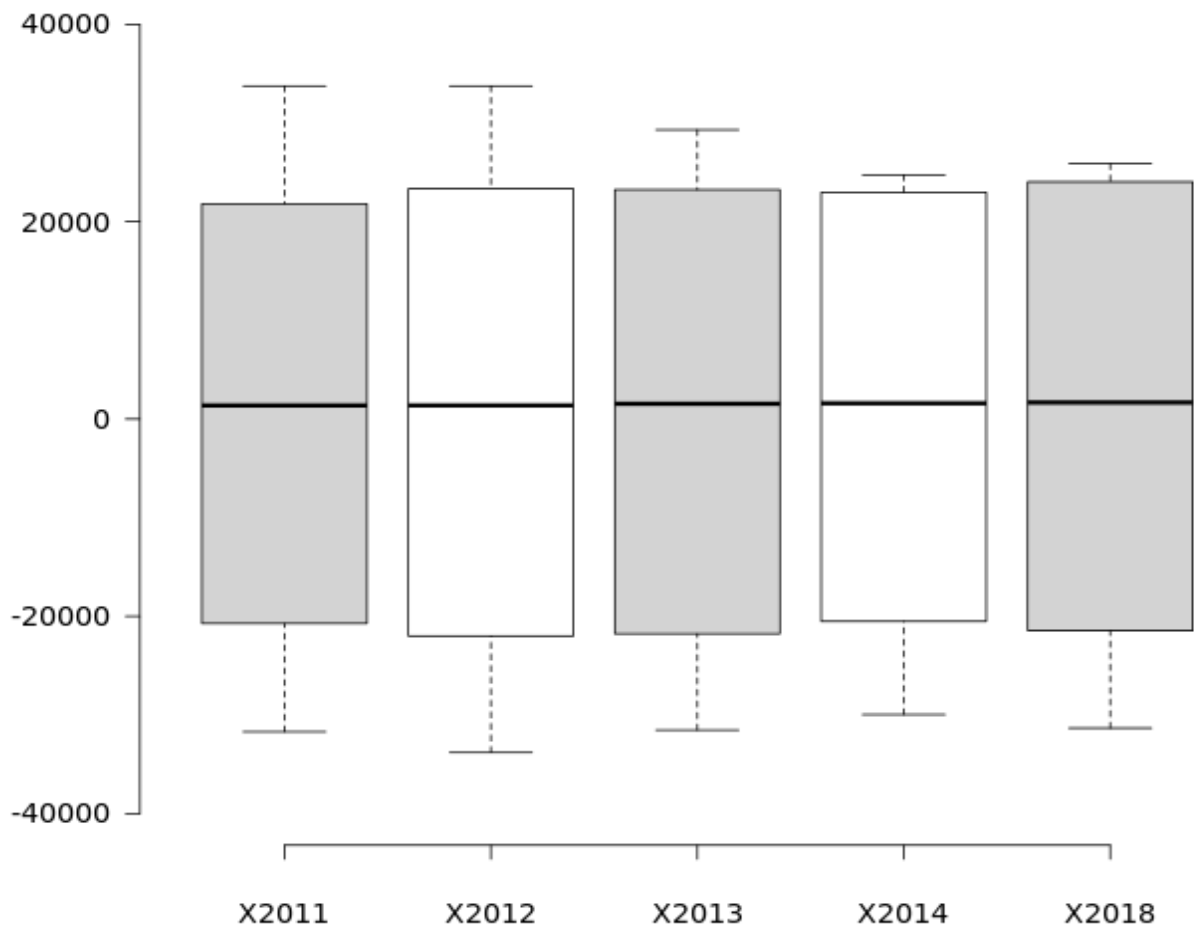
Mean (x): 53.266702416667
 Median: 747.7132295
 Mode: No
 Lowest value: -19183.25128
 Highest value: 16915.22376
 Range: 36098.47504
 Interquartile range: 22086.8686825
 First quartile: -11117.5180775
 Third quartile: 10969.350605
 Variance (s^2): 131505719.42393
 Standard deviation (s): 11467.594317202
 Quartile deviation: 11043.43434125
 Mean absolute deviation (MAD): 10865.657613558

Hour Net-Ramping Variability



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3-Hour Net-Ramping Variability





Questions and Answers