Load Shift Working Group:
Grid Needs: Oversupply Analysis

May 2018

Anja Gilbert, PG&E

Oversupply Analysis: Heat Map Data Overview

Data Represents

- A heat map of average MW by hour per month of when CAISO's non-dispachable GHG-free generation exceeds CAISO load for 2018, 2022, 2026, and 2030.
- Data is publicly available from the IRP, CAISO's resource mix, and the load forecasts from the IEPR.
- Heat maps in slides display two scenarios:

  Scenario 1: Total MW of curtailment without exports

  Scenario 2: Total MW of curtailment, assuming that exports (up to their current limit of 2,000 MW) are more economic than other tools available to mitigate over supply.

Data Granularity Missing

- Data provided is CAISO-wide; IOUs will have different needs and each Local Capacity Area will have its own needs
- Analysis does not differentiate between week days and weekends
  - The Excess Supply Pilot has found there is ~ 20% greater need on weekends vs. week days and a greater need in early hours on week days and later hours on weekends

Recommendation: It will be of value to have a product that can respond to more granular grid needs than system-wide CAISO conditions.

2018 Heat Map: MW of forecasted curtailment

2018: Assuming no Exports

2018	1	2	3	4	5	6	7	8	9	10	11	12
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	28	-	-	-	-	-	-	-
9	-	-	2	8	221	27	-	-	-	32	-	-
10	108	-	173	20	323	114	-	-	72	146	43	-
11	277	5	389	16	478	145	-	-	106	118	104	65
12	295	101	408	160	681	160	-	-	124	242	135	64
13	430	168	481	256	705	77	-	-	114	404	145	37
14	382	181	458	299	601	73	-	-	83	321	152	6
15	252	41	302	246	558	29	-	-	46	161	103	-
16	60	16	44	143	315	-	-	-	-	-	-	-
17	-	-	-	-	36	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-

2018: Assuming Exports

2018	1	2	3	4	5	6	7	8	9	10	11	12
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	11	-	-	-	-	-	-	-
10	-	-	-	-	34	-	-	-	-	-	-	-
11	53	-	-	-	30	-	-	-	-	-	-	-
12	65	-	-	-	38	-	-	-	-	6	12	-
13	80	-	-	-	14	-	-	-	-	59	22	-
14	69	-	-	-	-	-	-	-	-	36	29	-
15	41	-	-	-	7	-	-	-	-	-	-	-
16	-	-	-	-	2	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-

CAISO has the following tools available to it today to manage oversupply:

- Exports
- Curtailment
- Storage

If exports are more economic than a load shift product, the hours above represent the hours of need for the load shift product.

2022 Heat Map: MW of forecasted curtailment

2022: Assuming no Exports

2022	1	2	3	4	5	6	7	8	9	10	11	12
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	37	22	-	-	-	-	-	-
7	-	-	-	14	532	332	4	-	-	-	-	-
8	-	44	923	1,002	2,370	1,619	141	50	401	759	101	-
9	622	1,292	3,845	4,408	4,322	3,882	138	376	1,351	3,215	2,291	862
10	3,384	3,717	5,847	5,790	5,668	5,310	230	933	2,253	4,628	4,262	3,490
11	5,500	4,178	7,810	7,211	6,603	4,416	234	1,028	3,170	6,364	6,030	3,920
12	7,126	5,937	8,155	7,956	7,671	4,570	165	1,134	3,837	7,127	5,444	4,948
13	7,725	6,132	7,914	7,754	7,396	4,158	164	1,431	3,359	6,033	5,327	5,150
14	7,101	5,564	7,256	7,276	7,432	4,080	139	1,181	3,659	6,846	3,611	4,195
15	5,467	4,117	6,713	5,894	6,766	2,542	258	913	3,005	4,118	2,137	2,830
16	1,739	3,274	4,770	4,072	4,381	2,124	-	413	1,511	1,941	197	197
17	-	31	824	1,188	1,756	598	-	-	52	-	-	-
18	-	-	-	-	15	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-

2022: Assuming Exports

2022	1	2	3	4	5	6	7	8	9	10	11	12
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	48	-	-	-	-	-	-	-
8	-	-	87	31	880	447	-	-	9	120	-	-
9	150	196	1,563	1,644	1,910	1,533	-	47	493	1,124	646	74
10	1,186	1,451	2,906	2,811	2,642	2,352	-	169	878	1,903	1,676	1,231
11	2,611	1,704	4,563	3,908	3,264	1,981	-	223	1,372	3,139	2,968	1,617
12	4,081	3,053	4,826	4,579	4,182	2,171	-	353	1,876	3,805	2,406	2,389
13	4,563	3,217	4,562	4,410	4,047	1,992	-	551	1,524	2,849	2,271	2,558
14	3,979	2,808	4,025	4,036	4,126	1,933	-	413	1,817	3,568	1,446	1,739
15	2,708	1,769	3,557	2,850	3,619	971	-	245	1,324	1,870	755	977
16	518	1,146	2,157	1,730	2,058	750	-	33	453	508	36	-
17	-	-	-	168	564	51	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-

2026 Heat Map: MW of forecasted curtailment

2026: Assuming no Exports

2026	1	2	3	4	5	6	7	8	9	10	11	12
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	204	21	-	-	-	-	-	-
8	-	-	435	385	1,746	921	49	-	278	455	4	-
9	601	724	3,200	3,581	4,958	2,545	111	231	1,258	2,314	1,937	539
10	2,768	3,950	5,667	6,012	5,138	4,883	178	689	2,216	3,832	3,924	1,875
11	5,084	4,186	7,787	7,180	6,427	4,586	217	880	3,121	5,912	4,762	3,561
12	6,796	5,374	8,172	7,578	7,158	4,037	163	1,051	3,958	6,990	5,301	4,856
13	7,351	5,517	8,043	7,309	6,682	5,086	250	1,085	3,415	6,263	4,975	5,002
14	6,721	4,861	7,300	6,832	7,519	4,072	112	1,205	3,200	6,237	3,410	3,922
15	4,914	3,597	6,638	5,343	6,170	2,798	187	839	2,795	4,924	1,745	3,210
16	1,455	2,315	3,968	3,843	3,930	1,925	-	299	1,050	1,355	104	51
17	-	-	275	600	1,043	102	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-

2026: Assuming Exports

2026	1	2	3	4	5	6	7	8	9	10	11	12
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	8	-	584	95	-	-	-	19	-	-
9	146	76	1,194	1,090	2,241	1,033	-	15	474	813	527	46
10	962	1,683	2,792	3,050	2,392	2,161	-	114	892	1,528	1,517	243
11	2,357	1,810	4,597	3,943	3,193	2,117	-	178	1,362	2,805	2,089	1,397
12	3,839	2,643	4,855	4,253	3,788	1,888	-	302	1,989	3,711	2,397	2,374
13	4,327	2,848	4,710	4,063	3,526	2,636	-	361	1,571	3,090	2,125	2,517
14	3,759	2,424	4,101	3,697	4,240	1,956	-	443	1,503	3,147	1,410	1,613
15	2,414	1,460	3,600	2,466	3,265	1,171	-	214	1,217	2,374	605	1,237
16	404	546	1,690	1,635	1,856	672	-	-	317	307	-	-
17	-	-	-	-	188	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-

2030 Heat Map: MW of forecasted curtailment

2030: Assuming no Exports

2030	1	2	3	4	5	6	7	8	9	10	11	12
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	215	104	-	-	-	-	-	-
8	-	-	819	2,299	2,311	4,187	103	145	621	731	71	-
9	904	4,126	3,541	2,893	5,827	1,977	634	311	1,775	3,858	2,384	1,892
10	1,944	1,963	6,134	5,528	5,920	3,960	358	637	2,342	4,035	4,856	1,501
11	4,913	4,207	8,730	7,415	7,299	4,832	290	1,027	3,286	6,441	6,891	3,965
12	6,941	5,729	9,236	8,672	8,097	5,175	262	1,269	3,986	7,671	5,979	5,441
13	7,492	5,848	8,781	8,102	7,753	4,367	157	1,541	3,524	6,994	5,570	5,581
14	7,625	5,076	9,424	8,149	8,629	4,560	269	1,779	5,078	6,821	3,990	4,334
15	5,383	3,996	8,279	6,213	7,710	3,043	723	1,394	3,732	6,970	1,702	2,024
16	1,888	3,398	5,692	3,327	4,734	1,631	86	504	1,703	2,697	228	247
17	-	-	562	1,115	1,152	789	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-

2030: Assuming Exports

2030	1	2	3	4	5	6	7	8	9	10	11	12
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	80	464	899	1,631	-	-	103	121	-	-
9	314	1,749	1,430	753	2,728	731	122	37	723	1,498	755	336
10	705	461	3,217	2,679	2,876	1,737	44	105	978	1,684	2,225	141
11	2,289	1,894	5,486	4,209	3,935	2,281	9	243	1,496	3,268	3,809	1,739
12	4,037	2,991	5,907	5,307	4,621	2,606	1	451	2,024	4,348	2,917	2,880
13	4,537	3,206	5,443	4,837	4,450	2,187	-	639	1,656	3,735	2,590	3,030
14	4,580	2,664	6,143	4,942	5,216	2,322	-	790	2,900	3,643	1,751	1,922
15	2,834	1,807	5,014	3,189	4,435	1,355	35	565	1,913	3,784	611	591
16	580	1,333	2,913	1,367	2,355	530	-	70	587	1,022	47	-
17	-	-	-	139	252	86	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-

Heat Map: Data provided and remaining research needed

Heat map data provides:

- MW of real time oversupply by hour, month, and season

Additional research needed:

- Variance with locational need – IOU/LCA
- Frequency of dispatch
- Response time
- kW needed by location
- Duration of event

Recommended Next Steps: IOUs will identify local needs at the IOU and sub-LAP level.