

Attachment 2 (CBE 09/27/11). Refinery CO₂ emission intensity observations and predictions.

PADD	Year	<i>EI</i>	density	sulfur	cap.	prod.	fuel mix	Obs. Emit	Predictions (95% conf. interval)			
		(GJ/m ³)	(kg/m ³)	(kg/m ³)	ut. (%)	ratio	(kg/GJ)	(kg/m ³)	(GJ/m ³)	(GJ/m ³)	(kg/m ³)	(kg/m ³)
1	1999	3.451	858.20	8.24	90.9	3.668	81.53	281	2.877	3.604	235	294
1	2000	3.430	860.18	8.00	91.7	3.489	80.34	276	2.987	3.711	240	298
1	2001	3.518	866.34	7.71	87.2	3.479	81.85	288	3.198	3.919	262	321
1	2002	3.426	865.71	7.45	88.9	3.605	81.08	278	3.152	3.870	256	314
1	2003	3.364	863.44	7.43	92.7	3.321	81.51	274	3.133	3.853	255	314
1	2004	3.416	865.44	7.79	90.4	3.397	81.46	278	3.209	3.927	261	320
1	2005	3.404	863.38	7.17	93.1	3.756	81.23	277	3.048	3.772	248	306
1	2006	3.440	864.12	7.17	86.7	3.522	80.40	277	3.054	3.780	246	304
1	2007	3.499	864.33	7.26	85.6	3.443	82.28	288	3.067	3.800	252	313
1	2008	3.551	863.65	7.08	80.8	3.400	83.26	296	2.972	3.733	247	311
2	1999	3.368	858.25	10.64	93.3	4.077	78.11	263	2.984	3.711	233	290
2	2000	3.361	860.03	11.35	94.2	4.132	77.56	261	3.104	3.832	241	297
2	2001	3.396	861.33	11.37	93.9	4.313	77.46	263	3.126	3.863	242	299
2	2002	3.393	861.02	11.28	90.0	4.345	77.90	264	3.068	3.796	239	296
2	2003	3.298	862.80	11.65	91.6	4.281	78.00	257	3.195	3.922	249	306
2	2004	3.376	865.65	11.86	93.6	4.167	77.25	261	3.369	4.098	260	317
2	2005	3.496	865.65	11.95	92.9	4.207	77.27	270	3.362	4.089	260	316
2	2006	3.738	865.44	11.60	92.4	3.907	75.84	284	3.380	4.095	256	311
2	2007	3.800	864.07	11.84	90.1	4.161	75.55	287	3.270	3.989	247	301
2	2008	3.858	862.59	11.73	88.4	4.333	74.97	289	3.154	3.875	236	291
3	1999	4.546	869.00	12.86	94.7	3.120	71.61	326	3.759	4.476	269	321
3	2000	4.563	870.29	12.97	93.9	3.120	71.87	328	3.813	4.531	274	326
3	2001	4.348	874.43	14.34	94.8	3.128	72.43	315	4.086	4.803	296	348
3	2002	4.434	876.70	14.47	91.5	3.251	72.71	322	4.140	4.859	301	353
3	2003	4.381	874.48	14.43	93.6	3.160	72.81	319	4.076	4.794	297	349
3	2004	4.204	877.79	14.40	94.1	3.228	73.43	309	4.213	4.930	309	362
3	2005	4.205	878.01	14.40	88.3	3.316	73.24	308	4.149	4.873	304	357
3	2006	4.367	875.67	14.36	88.7	3.176	74.15	324	4.067	4.798	302	356
3	2007	4.226	876.98	14.47	88.7	3.205	74.93	317	4.127	4.856	309	364
3	2008	4.361	878.66	14.94	83.6	3.229	74.48	325	4.165	4.915	310	366
5	1999	4.908	894.61	11.09	87.1	2.952	70.27	345	4.713	5.451	331	383
5	2000	5.189	895.85	10.84	87.5	3.160	69.09	358	4.725	5.460	326	377
5	2001	5.039	893.76	10.99	89.1	3.231	69.38	350	4.648	5.380	322	373
5	2002	4.881	889.99	10.86	90.0	3.460	69.15	338	4.450	5.178	308	358
5	2003	4.885	889.10	10.94	91.3	3.487	69.40	339	4.422	5.153	307	358
5	2004	4.861	888.87	11.20	90.4	3.551	69.89	340	4.410	5.140	308	359
5	2005	4.774	888.99	11.38	91.7	3.700	69.88	334	4.409	5.151	308	360
5	2006	4.862	887.65	10.92	90.5	3.615	69.32	337	4.331	5.060	300	351
5	2007	5.091	885.54	11.07	87.6	3.551	69.12	352	4.235	4.953	293	342
5	2008	4.939	890.16	12.11	88.1	3.803	68.39	338	4.456	5.191	305	355
Calif. average, 2004		899.23	11.46	93.0	3.633	70.82	354	4.881	5.632	346	399	
Calif. average, 2005		900.56	11.82	95.0	3.801	71.06	358	4.937	5.721	351	407	
Calif. average, 2006		899.56	11.73	91.5	3.845	72.65	384	4.861	5.616	353	408	
Calif. average, 2007		899.84	11.89	88.3	3.814	71.43	401	4.866	5.603	348	400	
Calif. average, 2008		902.00	12.85	91.0	4.087	71.02	383	4.980	5.759	354	409	
Calif. average, 2009		901.38	11.70	82.9	4.045	70.54	397	4.837	5.564	341	392	
Martinez 2008 ^a		932.08	9.86	91.0	4.087	71.02	497	6.076	6.931	432	492	
70/30 HO/CA blend ^b		948.39	22.59	90.8	3.469	73.77	--	7.576	8.595	559	634	
70/30 NB/CA blend ^b		1001.73	34.98	90.8	3.469	73.77	--	10.419	11.920	769	879	

EI: refinery energy intensity as measured by fuel energy consumed/vo. crude refined.

Cap. ut.: operable refinery capacity utilization as defined by U.S. EIA.

Prod. ratio: ratio by vol. of gasolines, distillate, kerosenes and naphtha to other products.

Fuel mix emission intensity measured from reported data as detailed in Table 2-1.

70/30 HO/CA: 2020 crude feed is 70/30 blend of heavy oil/California-produced crude.

70/30 NB/CA: 2020 crude feed is 70/30 blend of natural bitumen/California-produced crude.

California-produced crude quality is 2004–2008 average from Table 2-3.

Average heavy oil and natural bitumen densities and sulfur contents from USGS (*Attachment 1 refs. 1, 28*).

^a Prediction uses average 2004–2008 Calif. capacity utilization, products ratio & fuel mix inputs.

^b Prediction uses average 1999–2008 U.S. capacity utilization, products ratio & fuel mix inputs.

Data from Attachment 1, Table 2-1 and reference 1.