BY ELECTRONIC MAIL

COMMUNITIES FOR A BETTER ENVIRONMENT

21 October 2015

Greg Nudd
Eric Stevenson
Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109

Re: **Supplemental Comment on Air District Staff Proposal, Rules 12-15 and 12-16; Evidence of Increasing Bay Area Refinery GHG and $PM_{2.5}$ Emissions**

Dear Mssrs. Nudd and Stevenson,

CBE believes that the Air District Staff has improperly rejected enforceable limits set to current actual emission rates in part because the Staff has not considered adequately, and has not informed the public and its Board about, the following data and information:

1. Air District data document and forecast increasing Bay Area refinery greenhouse gas emissions.

Air District actual and forecast greenhouse gas (GHG) emissions data are reported in the Air District GHG Emission Inventory that is appended hereto as Attachment 1.[1] The most recent actual GHG emissions data reported by the Air District, its Emission Inventory data for reporting year 2013, were provided with CBE's September 2015 comments in this matter and are appended hereto as Attachment 2.[2] These data are given by year, indicating data sources specifically, in the table below.

BAAQMD refinery GHG emissions & forecasts from 1990–2029 (MM metric tons CO_2e/year)

Year	Data type & source	Refining processes	Make gas burning	Natural & other gas	Liquid fuel burning	Solid fuel burning	Total (5 refineries)
1990	actual[a]	3.3	3.8	4.5	0.1	0.8	12.5
1993	actual[a]	3.5	4.0	4.3	0.1	0.9	12.8
1996	actual[a]	3.6	3.7	4.5	0.1	0.9	12.8
1999	actual[a]	3.7	4.4	4.5	0.1	0.9	13.6
2002	actual[a]	3.5	4.5	4.6	0.1	1.0	13.7
2005	actual[a]	3.4	4.7	4.8	0.1	1.0	14.0
2008	actual[a]	3.5	4.8	4.9	0.1	1.0	14.3
2011	forecast[a]	3.6	5.0	5.1	0.1	1.0	14.8
2013	actual[b]	*Sum of all sources at 5 refineries and 3 support facilities*[c]					15.9
2014	forecast[a]	3.7	5.1	5.2	0.1	1.1	15.2
2017	forecast[a]	3.8	5.3	5.4	0.1	1.1	15.7
2020	forecast[a]	3.9	5.4	5.5	0.1	1.1	16.0
2023	forecast[a]	4.0	5.6	5.7	0.1	1.2	16.6
2026	forecast[a]	4.2	5.8	5.9	0.1	1.2	17.2
2029	forecast[a]	4.3	5.9	6.1	0.1	1.2	17.6

(a) BAAQMD, Attachment 1 Table U; (b) BAAQMD, Attachment 2; (c) Two hydrogen plants and a cogeneration plant are included as support facilities; see CBE Sept. 2015 comments.

These AQMD data indicate that refinery emissions increased from 12.5 million metric tons in 1990 to 15.9 million metric tons in 2013, the most recent year actual refinery GHG emissions are reported. For Bay Area refineries in the aggregate, the AQMD data for reporting year 2013 (15.9 MM MT) compares to Air Resources Board 2013 data (16.2 MM MT) reasonably well.

AQMD forecasts further increasing emissions, with Bay Area oil refining emissions reaching 17.6 MM MT in 2029. However, this AQMD forecast was reported in 2010, and actual emissions in 2013 (15.9 MM MT) exceed this forecast for the later years 2014 (15.2 MM MT) and 2017 (15.7 MM MT). This indicates that as of 2013, Bay Area refinery GHG emissions are rising faster than AQMD had forecast in 2010.

2. Air District data document and forecast increasing Bay Area refinery particulate matter ($PM_{2.5}$) emissions.

AQMD's 2010 $PM_{2.5}$ emission inventory is appended hereto as Attachment 3.[3] This document reports refinery emissions, broken into "processes" (a category that includes waste water, cooling and flare systems as well as fugitives), product "evaporation" in refineries, and "external combustion" categories. AQMD's 2012 report *Understanding Particulate Matter* is appended hereto as Attachment 4.[4] Appendix A of this document reports the same 2010 $PM_{2.5}$ emission rate, uses the same refinery emission categories, and forecasts emissions in five-year intervals through 2030. An excerpt from an AQMD Staff March 2015 Workshop Presentation is appended hereto as Attachment 5.[5] In this document AQMD reports the same refinery $PM_{2.5}$ emissions rates for 2010 and 2015 along with emissions in 2000 and 2005. These data are given by year in the table below.

BAAQMD direct emissions of $PM_{2.5}$ from refineries, emissions & forecasts: 2000–2030

Year	BAAQMD data source	$PM_{2.5}$ Emissions from Bay Area Oil Refineries (short tons/day)	(short tons/year)
2000	a	2.3	839
2005	a	2.4	876
2010	a, b, c	2.7	985
2015	a, c	2.8	1,020
2020	c	3.0	1,090
2025	c	3.1	1,130
2030	c	3.2	1,170

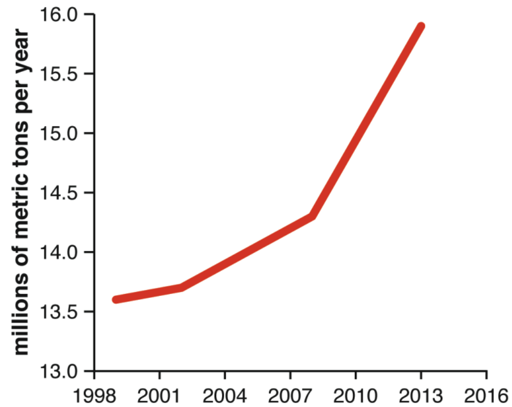
(a) BAAQMD, Attachment 5; (b) BAAQMD, Attachment 3; (c) BAAQMD, Appendix A in Attachment 4.

Emissions increased from 839 short tons in 2000 to 985 tons in 2010 and 1,020 tons in 2015. Emissions could continue to increase (in a 'business as usual' scenario) and could reach 1,170 tons emitted in 2030, according to the forecast reported by AQMD in 2012.

The AQMD Emissions Inventory (Attachment 2) provides a partial check on these data. It shows that the refineries emitted ≈1,300 tons of particulate matter in reporting year 2013. This value (1,300 tons PM) exceeds AQMD's 2015 refinery PM_{10} emissions reported in Attachment 4 (3.0 tons/d or 1,095 tons/y). Approximately 93% of this 1,300 tons (≈ 1,210 tons) was $PM_{2.5}$ based on the ratio of $PM_{2.5}$ to PM_{10} emitted by refineries in 2010 and 2015 from AQMD's data in Attachment 4, and this 2013 estimate (1,210 tons $PM_{2.5}$) exceeds the estimate for 2015 in attachments 4 and 5 (1,020 tons). Refinery emission measurements by Sánchez de la Campa and others, appended hereto as Attachment 6,[6] provide support for AQMD's high $PM_{2.5}$ to PM_{10} emission ratio. However, if the AQMD data in Attachment 4 overestimate the percentage of refinery PM emissions that are $PM_{2.5}$ then actual 2013 $PM_{2.5}$ emissions could be closer to 1,020 tons. These data indicate that refinery $PM_{2.5}$ emissions are increasing at least as fast as the AQMD forecast.

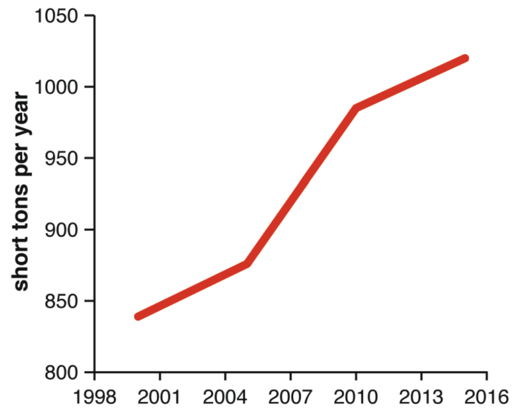
Greenhouse Gas (CO_2e) Emissions from Bay Area Oil Refineries, 1999–2013.

Data from Bay Area Air District: see attachments 1 and 2.



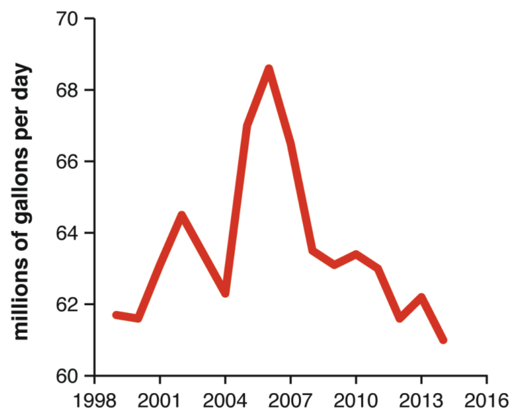
Particulate Matter ($PM_{2.5}$) Emissions from Bay Area Oil Refineries, 2000–2015.

Data from Bay Area Air District: see attachments 3–5.



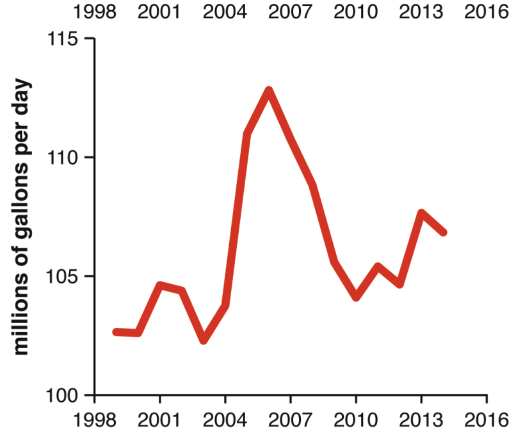
U.S. West Coast (PADD 5) Sales of Gasoline, 1999–2014.

Data from USDOE, Energy Information Information Administration (EIA): see Attachment 8.



U.S. West Coast (PADD 5) Sales *and* Exports of Gasoline, Distillate Oil (including diesel) & Kerosene Jet Fuel, 1999–2014.

Data from EIA: see attachments 8 & 9.



3. Air District data document increasing refinery emissions despite declining engine fuels demand in the markets served by the refineries.

US Energy Information Administration (EIA) data for refined product movements between US regions are appended hereto as Attachment 7.[7] These data indicate domestic markets for engine fuels refined in the Bay Area are limited to the West Coast (PADD 5). EIA data for West Coast refined product sales are appended hereto as Attachment 8.[8] These data show that West Coast gasoline demand has declined since 2006. EIA data for exports of refined product from the West Coast are appended hereto as Attachment 9.[9] These data show that although total refined product exports increased strongly, total West Coast sales plus exports of engine fuels (gasoline, distillate and diesel, and kerosene jet fuel) still declined after 2006. These data, shown with Bay Area refinery emissions of GHG and $PM_{2.5}$ in the charts above, demonstrate that changes in the demand for engine fuels cannot explain the increase in these Bay Area refinery emissions.

4. Air District data demonstrate that GHG and $PM_{2.5}$ co-emit from fossil fuel combustion sources in Bay Area refineries.

Source-specific data excerpted from the AQMD Emissions Inventory documents in Attachment 2 for reporting year 2013 are appended hereto as Attachment 10.[10] Sources in Attachment 10 are categorized as in the AQMD Inventory documents: equipment that is permitted to emit for each specific fuel or feed material fed to that equipment. These data show that PM, the PM precursor NO_x, the PM precursor SO_2, or more than one of these pollutants that cause $PM_{2.5}$ air pollution co-emit with GHG from at least 379 sources in the Bay Area refining industry.

Data in Attachment 6 further show that refinery PM emissions include environmentally significant amounts of metalliferous ultra-fine PM (UFPM). UFPM is not currently measured or controlled effectively by AQMD or other air officials. Thus, the $PM_{2.5}$ that co-emits with GHG from refineries includes otherwise unregulated air pollutants.

The AQMD data in Attachment 3 and in Appendix A of Attachment 4 indicate that combustion caused 89% (2.4 tons/day) of the total Bay Area refinery $PM_{2.5}$ emissions (2.7 tons/day) in 2010, and 89% (2.5 out of 2.8 tons/day) of these refinery emissions in 2015. Similarly, combustion of make gas, natural gas, other gases and liquid and solid fuels accounts for 75% of total refinery GHG (CO_2e) emissions based on the AQMD data in Table U of Attachment 1. Including process emissions from hydrogen plants, which burn and otherwise consume substantial amounts of fossil fuels, the use of fossil fuels for process energy causes more than 90% of refinery CO_2e emissions.

These data demonstrate that GHG and $PM_{2.5}$ co-emit from the same sources and proximate cause—fuel consumption—in Bay Area refineries. Consuming more fossil fuel in refineries would further increase refinery emissions of these co-pollutants.

5. Peer-reviewed science shows that severe processing needed to maintain engine fuels production from lower quality oil increases refinery energy intensity, thereby increasing refinery fuel combustion emissions.

A 2007 report on USEPA's study of mercury in refinery oil feedstock that was peer reviewed and published by the American Chemical Society in *Environmental Science & Technology* is appended hereto as Attachment 11.[11] This study found a wide range of mercury concentrations among individual crude streams, and it shows that USEPA has long recognized the need to monitor feedstock quality for environmentally significant differences in emission potential among industries and among individual facilities.

Robinson and Dolbear wrote a chapter in a technical reference book on heavy oils and residua, published in 2007, that is appended hereto as Attachment 12.[12] They state rapid changes in oil feed quality cause hydroprocessing upsets, and quantify the greater heat, pressure and hydrogen production requirements for hydroprocessing denser cuts of crude. This document examples the fact that the industry has long known making the same product slate from lower quality oil increases refinery fuel energy consumption.

A CBE report on combustion emissions from refining lower quality oil that was peer reviewed and published by the American Chemical Society in *Environmental Science & Technology* is appended hereto as Attachment 13.[13] It reports detailed quantitative analysis of data from operating refineries—data from actual, real-world operating conditions—across 97% of the U.S. industry. A peer-reviewed report on modeling of factors driving refinery CO_2 intensity, also published in 2010, is appended hereto as Attachment 14.[14] A peer reviewed 2011 report that built in part on the work in Attachment 13 and encompassed the full fuel cycle of Canadian tar sands oils is appended hereto as Attachment 15.[15] A report that built on the work in Attachment 13 and was peer reviewed and published by the Union of Concerned Scientists in 2011 is appended hereto as Attachment 16.[16] A peer reviewed report on detailed public data-based modeling of crude quality and process configuration impacts on refinery energy and GHG intensities that was published in 2012 is appended hereto as Attachment 17.[17] A report for the Natural Resources Defense Council on emissions of toxic and criteria air pollutants from delayed coking and catalytic cracking in scenarios where diluted bitumen oils replace 20–50% of the current US crude feed, published in 2015, is appended hereto as Attachment 18.[18] Also in 2015, the Carnegie Endowment built on the refinery energy and GHG emissions work in Attachment 17, and argued for public oil quality monitoring and to "think before building new infrastructure" for low-quality grades of oil, in a report that is appended hereto as Attachment 19.[19]

The data and information in attachments 12–19 demonstrate that making engine fuels from lower quality oil increases the energy intensity, fuel consumed for that energy, and emissions of oil refining. These impacts are driven by physical (e.g., volatility) and chemical (e.g., molecular structure; hydrogen and contaminants content) differences among crude oils and their fractional components that—for well mixed multi-plant blends of many crude oils—correlate with crude feed density and sulfur content.

Compared with so-called conventional or lighter crude, a larger portion of denser, more contaminated, lower quality oil refinery feedstock is very different from gasoline, diesel or jet fuel both physically and chemically. Making the same amounts of engine fuels from these very different oils requires more severe processing that requires more energy, requires more hydrogen, and creates dirtier-burning byproducts in greater amounts. Most of this hydrogen must be produced by steam reforming that consumes still more energy, and substantial portions of those dirtier byproducts are burned in-plant as part of the basic design of processes such as fuel gas recovery and catalytic cracking. The net result is consuming more and dirtier-burning fossil fuel for the energy needed to process each barrel of denser, more contaminated oil refined. Making engine fuels from denser, more contaminated oil feedstock increases refinery energy intensity, and thereby increases refinery fuel combustion emissions intensity—the refinery emissions of combustion products such as CO_2 and PM per barrel of crude refined.

6. Average oil feed quality is lower and average refinery emission intensity is higher in the Bay Area as compared with other parts of the US.

Attachment 13 documents the average refinery crude feed density and sulfur content, the energy and emission impacts explained by those feed properties, and actual emissions observed from refineries in the BayArea and other U.S. refining regions. Recent EIA data for average crude input qualities in the other regions are appended hereto as Attachment 20.[20] Comparison of attachments 13 and 20 shows the other regions' crude feed qualities that distinguish them from Bay Area refineries in Attachment 13 persist. The table below excerpts data from Table S8 in Attachment 13.

Average refinery crude feed oil quality (OQ) observed, refinery energy intensity (EI) predicted by OQ, and actual refinery CO_2 emission intensity observed in 2008 by region.

Region	Actual crude feed quality (OQ)		EI predicted by OQ	Actual emissions
	Density (kg/m^3)	Sulfur (kg/m^3)	(Gigajoule/m^3 oil)	(kg CO_2/m^3 oil)
East Coast PADD 1	864	7.08	3.35	296
Midwest PADD 2	863	11.7	3.51	289
Gulf Coast PADD 3	879	14.9	4.54	325
S.F. Bay Area	900	11.9	5.31	360

Data from CBE's peer reviewed work in Attachment 13. *See* Table S8.

As shown by the data in this table, on average, refineries in the Bay Area process denser crude, process lower quality crude as gauged by energy consumed per barrel refined, and emit more CO_2 per barrel refined than those in other major U.S. oil refining regions.

7. Refining greater amounts of bitumen-derived 'tar sands' oils would further lower the quality of the average Bay Area refinery crude feed.

A 2007 U.S. Geological Survey report on bitumen ('tar sands') oils and heavy oils is appended hereto as Attachment 21.[21] Data in attachments 13, 18 and 21 show that the average density and sulfur content of tar sands bitumen (1,04 kg/m^3 *d;* 45.5 kg/m^3 *S*) and those of Canadian tar sands diluted bitumen 'dilbit' (926 kg/m^3 *d;* 35.2 kg/m^3 *S*) are greater than those of the Bay Area refinery crude feed (900 kg/m^3 *d*; 11.9 kg/m^3 *S*). Thus, adding tar sands oil to the Bay Area refinery crude feed would increase its density and sulfur content.

A 2010 California Energy Commission report that forecasts continuation of the long-observed trend of replacing dwindling Californian and Alaskan oil with foreign oil inputs to refineries statewide is appended hereto as Attachment 22.[22] Comparison of data in attachments 16 and 21 shows that the average density and sulfur content of bitumen are greater than those of the Californian and Alaskan crude streams refined in the Bay Area. Thus, replacing declining Californian and Alaskan crude supplies with tar sands bitumen would increase the density and sulfur content of the Bay Area refinery crude feed.

Data in Attachment 21 show that compared with other types of crude, the hydrogen content and gasoline-range distillation yield is lower, the yield of 'residuum' that does not boil off in distillation is higher, and the concentrations of nitrogen, acids, aluminum, copper, iron, lead, nickel, titanium, and vanadium are higher, in tar sands bitumen. Data in Attachment 18 show that the yield of distillate oils (including kerosene and diesel) from Canadian tar sands dilbit is very low compared with the averages for the U.S. crude feed and Strategic Petroleum Reserve. Available data on the density and sulfur content of gas oil—the densest cut of crude that boils off in distillation—are appended hereto as Attachment 23.[23] Comparison of data in attachments 18 and 23 shows that the average gas oil distilled from tar sands dilbits (964 kg/m^3 *d*; 32.8 kg/m^3 *S*) is denser than 99% of all 404 gas oils reported from non-bitumen crude oils and higher in sulfur than 98% of those non-bitumen gas oils. Thus, data on many processing characteristics confirm the low quality of tar sands crude that is predicted by its extreme density and sulfur content.

8. The oil industry reports plans to refine more tar sands oil here.

A 2007 report in *Oil & Gas Journal* describing industry plans to expand the market for price-discounted oil produced in the Canadian oil sands by, among other things, sending large amounts of this oil to California refineries as a new potential growth market, is appended hereto as Attachment 24.[24]

Note that in industry jargon, the terms "oil sands" and "Canadian heavy crude" refer to bitumen-derived tar sands oils, and the term "cost-advantaged," in reference to North American crude, refers to tar sands oil, fracked shale oil, or both depending on context.

A paper published by the Society of Petroleum Engineers in 2009 concluding that the Canadian tar sands is "the most promising source for California refineries" to replace dwindling current crude supplies in the long term is appended hereto at Attachment 25.[25]

A 2013 Alberta Energy Resources Conservation Board report that describes projects to send tar sands oil to California if standards in this state allow the resultant emissions, and noting "90 per cent of its refinery capacity is able to process heavier crudes," is appended hereto as Attachment 26.[26] These "heavier" oils include tar sands bitumen and bitumen-derived dilbit; fracked shale oils such as North Dakota Bakken are very light oils.

Excerpts from a 2013 report to investors by Valero are appended hereto as Attachment 27.[27] In these excerpts Valero reports its "strategy" to refine "cost-advantaged crude oil" and its plan to bring that "cost advantaged" oil to its Benicia refinery by train. They also include a chart showing that Western Canadian Select (WCS), a tar sands dilbit, is the most price-discounted crude targeted, costing much less than shale oil from the Bakken.

A 2013 report to investors by Phillips 66 stating its plans for "moving Canadian crudes down into California … refineries" is appended hereto as Attachment 28.[28] A 2014 report to investors by Phillips 66 stating its plans to bring "advantaged crude into California" by train and ship via Ferndale, WA and by train to Santa Maria is appended hereto as Attachment 29.[29] This Santa Maria project would bring tar sands oil through the Bay Area by rail for processing at the Phillips 66 San Francisco Refinery (SFR) refining facilities at Nipomo and Rodeo. A map downloaded from a Phillips 66 website on 16 October 2015 showing crude oil delivery arrows pointing from the Canadian tar sands to the SFR is appended hereto as Attachment 30.[30]

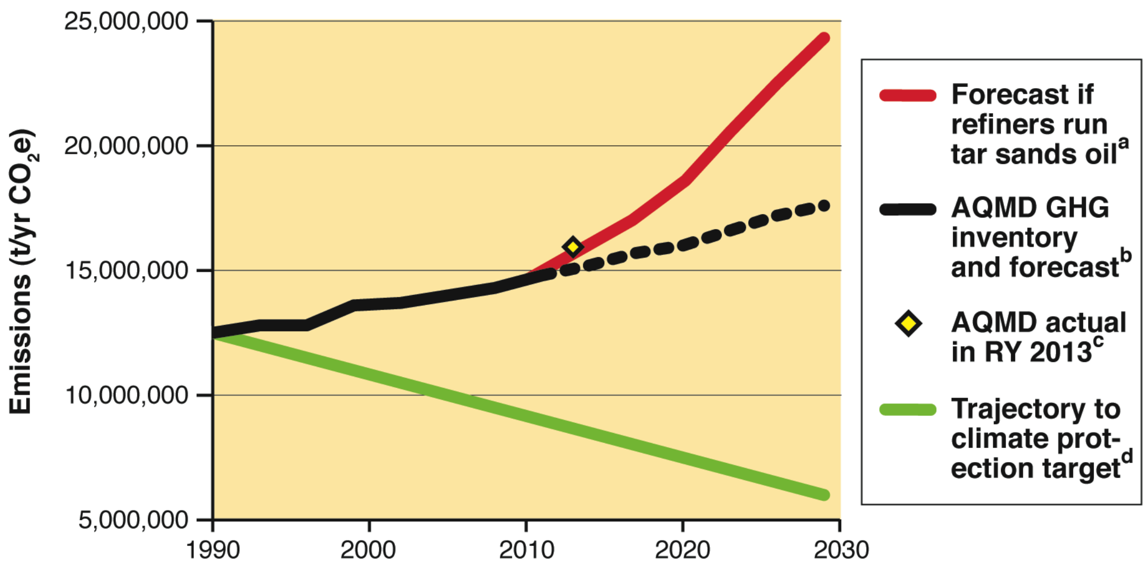
A 2014 presentation to investors by Tesoro is appended hereto as Attachment 31.[31] In Slide 12 of this document Tesoro reports projects to "strengthen refinery conversion capability" for "feedstock flexibility." In Slide 14 of this document Tesoro reports greater future crude production in the Canadian tar sands than any other "key Tesoro market." In Slide 17 of this document Tesoro reports that its rail-to-marine terminal project in Vancouver would be "competitive with direct rail cost to California."

A 2015 Canadian Association of Petroleum Producers crude oil forecast, markets, and transportation report is appended hereto as Attachment 32.[32] This report describes, among other things, plans for exporting more tar sands oil to California refineries via pipeline, ship, and rail. A 2015 report by CBE and ForestEthics that identifies oil industry projects which could potentially replace up to 40–50% of California refinery crude feed by rail alone is appended hereto as Attachment 33.[33]

The evidence in attachments 24–33 documents oil industry plans to refine more tar sands oil at Bay Area refineries.

9. The Air District-forecast increase in Bay Area refinery emissions underestimates potential emissions from oil feedstock switching.

The data and information in attachments 12–23 show that increasing the amount of bitumen-derived oil in the Bay Area refinery crude feed could further increase Bay Area refinery GHG and PM emissions. Data and information in attachments 16, 22, and 24–33 show that more than half of Bay Area refinery crude feed could potentially be replaced by bitumen-derived tar sands oil before 2030. Attachment 16 quantifies the potential GHG emissions from California refineries in this scenario based on data and information in attachments 13 and 16. Potential emissions from Bay Area refineries in this 'tar sands' scenario, based on Attachment 16, are compared with the Air District's reported and forecast refinery GHG emissions in the chart below.



Refinery greenhouse gas emissions and forecasts, S.F. Bay Area, 1990–2029
[a]CBE *after* UCS (2011). [b]BAAQMD *GHG Inventory* (2010). [c]BAAQMD 2013 Em. Inventory. [d]–80% from 1990 rate by 2050.

AQMD's forecast is illustrated by the dashed black line in this chart. As stated above, in 2010 the AQMD forecast that Bay Area refinery GHG emissions could increase to 17.6 million metric tons per year by 2029. But in the scenario where refiners replace declining Californian, Alaskan, and other crude supplies with bitumen oils, the forecast potential emissions rise more steeply, as illustrated by the solid red line in the chart, and approach 25 million metric tons/year by 2029. In RY2013, the most recent year for which AQMD reports emissions—illustrated by the yellow diamond in the chart—actual emissions exceed the AQMD forecast and are close to those in the tar sands scenario forecast.

This evidence indicates that the increase in Bay Area refinery emissions forecast by the Air District in 2010 underestimates the potential increase in Bay Area refinery emissions from a switch to tar sands oil feedstock.

10. Oil train traffic, emissions, and health and safety hazards could worsen if a further increase in Bay Area refinery emissions is allowed.

An image of the Bay Area excerpted from the State of California's Rail Risk and Response interactive map is appended hereto as Attachment 34.[34] Comparison of attachments 33 and 34 shows that many communites in the Northeast, East and South Bay could be impacted by nearby oil train traffic—including Fairfield, Benicia, Oakley, Antioch, Pittsburg, Vine Hill, Martinez, Port Costa, Crockett, Rodeo, Pinole, San Pablo, Richmond, El Cerrito, Albany, Berkeley, Emeryville, Oakland, San Leandro, Hayward, Livermore, Pleasanton, Union City, Fremont, Alviso, Milpitas, Santa Clara, San José, Morgan Hill, Gilroy, and others.

Attachment 33 summarizes and cites evidence that oil train operations and derailments cause serious health and safety hazards, including acute and chronic air pollution, and it documents disparately severe oil train hazards in communities of color, low-income communities and linguistically isolated communities.

A report for Shell Oil Co. showing that plant design configurations prevent Bay Area refineries from processing large amounts of light crude efficiently is appended hereto as Attachment 35.[35] Evidence in attachments 13–19, 24, and 25 strongly supports this finding. This inability to process large amounts of much lighter crude, such as fracked shale oils from the Bakken, is consistent with the industry's stated plans, documented above, for oil trains to deliver tar sands oils, which are denser, to Bay Area refineries. However, as Attachment 26 suggests, and as attachments 13–35 document, industry plans to greatly increase oil train delivery of tar sands oils to Bay Area refineries are contingent on whether environmental requirements allow the increased refinery emissions that would result from processing tar sands oil in the Bay Area. Thus, allowing Bay Area refinery emissions to further increase could worsen health and climate hazards from oil trains as well as those from direct refinery emissions.

Conclusion

Data the Air District reports elsewhere document a substantial long-term increase in Bay Area refinery emissions of GHG and $PM_{2.5}$ that co-emit from refinery fuel combustion. EIA data show that refined fuels demand cannot explain the reported emissions increase. Peer reviewed science shows that refining lower quality oil contributed to this emissions increase and could further increase emissions from Bay Area refineries if their current, declining, crude oil supply is replaced with bitumen-derived 'tar sands' oil.

Forecasts the Air District reports elsewhere show that Bay Area refinery GHG and $PM_{2.5}$ emissions could further increase. The peer reviewed science shows that Bay Area refinery emissions could greatly exceed even these forecasts if the refiners replace their declining current oil supply with bitumen-derived tar sands oil. In fact, industry reports document plans to replace Bay Area (and California) refiners' declining current oil supplies with that tar sands oil—if the resultant emissions increase is allowed.

Moreover, those industry-reported plans include a major expansion of Bay Area oil train traffic that—since Bay Area refineries cannot process very large amounts of light shale oils efficiently—could be allowed here ***if*** the emissions increase from refining the large amounts of tar sands oil these trains would deliver is allowed.

CBE requests that the Air District revise and recirculate its environmental analysis of rules 12-15 and 12-16 to report the information documented here to the public and its Board transparently, consider and address this information properly, and address the health and climate impacts identified adequately.

A safeguard against further increasing refinery emissions is needed without further delay. The Air District, however, proposes no such safeguard that is specific, enforceable upon adoption, and would apply to refineries facility-wide. Therefore, given the absence of any other such safeguard proposal, CBE's September 2015 proposal for limits set to current facility emission rates, and the community-proposed moratorium on permits for projects to enable lower quality oil, should be considered favorably in your revisions.

Respectfully submitted,

Greg Karras
Senior Scientist

Copy: Ken Alex, Office of the Governor
John Gioia, Stationary Source Committee Chair
Air District Board members
Richard Corey, Air Resources Board
Jack Broadbent, Air Pollution Control Officer
Interested organizations and individuals

Attachments—*see* attachments list herein below.

Attachments List (four pages).

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[1] Attachment 1. *Source Inventory of Bay Area Greenhouse Gas Emissions;* Updated February 2010. Bay Area Air Quality Management District: San Francisco, CA.

[2] Attachment 2. *Bay Area Air Quality Management District Emissions Inventory;* includes facility- and source-specific oil refinery and refinery support facility emissions data for reporting year 2013. Files are attached as provided in response to CBE's request for review pursuant to the California Public Records Act. See CBE's September 2015 Comment-1 on Rule 12-16 for additional information. Eight tables in Excel format.

[3] Attachment 3. *Table 1. Bay Area Winter Emissions Inventory for Primary $PM_{2.5}$ and PM Precursors: Year 2010;* adopted by the BAAQMD Board for State Implementation Plan review by USEPA. Bay Area Air Quality Management District: San Francisco, CA.

[4] Attachment 4. *Understanding Particulate Matter: Protecting Public Health in the San Francisco Bay Area;* November 2012. Bay Area Air Quality Management District: San Francisco, CA. Includes Appendix A. Bay Area Winter Emissions Inventory for Primary PM + PM Precursors: 2010–2030.

[5] Attachment 5. *Regulations to Track and Mitigate Emissions from Petroleum Refineries Regulation 12, Rules 15 and 16: Refinery Emission Trends 1980–2015 and Main Causes of Reductions;* Excerpt from BAAQMD Staff's March 2015 Workshop Presentation for proposed rules 12-15 and 12-16. Includes an insert by CBE facilitating reference to scale. Bay Area Air Quality Management District: San Francisco, CA.

[6] Attachment 6. Sánchez de la Campa et al., 2011. Size Distribution and Chemical Composition of Metalliferous Stack Emissions in the San Roque Petroleum Refinery Complex, Southern Spain. *Journal of Hazardous Materials* **190:** 713-722. DOI: 10.1016/j.jhazmat.2011.03.104.

[7] Attachment 7. *Movements by Tanker, Pipeline, Barge and Rail between PAD Districts;* includes annual data on petroleum and petroleum project movements from West Coast PADD 5 to other US regions (PADDs 1–4); U.S. Energy Information Administration: Washington, D.C. Attachment includes four documents labeled 7A through 7D.

[8] Attachment 8. *PADD 5 Prime Supplier Sales Volumes of Petroleum Products;* U.S. Energy Information Administration: Washington, D.C.

[9] Attachment 9. *West Coast (PADD 5) Exports of Crude Oil and Petroleum Products;* U.S. Energy Information Administration: Washington, D.C.

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[10] Attachment 10. *Data Excerpted from the BAAQMD Emission Inventory for 5 Refineries and 3 Refinery Support Facilities, Reporting Year 2013: Sources Reported as Emitting GHG along with PM, PM Precursors, or Both.* Excerpts from Attachment 2. See CBE's September 2015 Comment-1 in this matter for additional details.

[11] Attachment 11. Wilhelm et al., 2007. Mercury in Crude Oil Processed in the United States (2004). *Environmental Science & Technology* **41**(13): 4509–4514. DOI: 10.1021/es062742j.

[12] Attachment 12. Robinson and Dolbear, 2007. Commercial Hydrotreating and Hydrocracking. In *Hydroprocessing of Heavy Oils and Residua;* Ancheyta and Speight, Eds.; Chemical Industries; CRC Press, Taylor & Francis Group: Boca Raton, FL; Vol. 117, pp. 281–311.

[13] Attachment 13. Karras, 2010. Combustion Emissions from Refining Lower Quality Oil: What is the Global Warming Potential? *Environmental Science & Technology* **44**(24): 9584–9589. DOI: 10.1021/es1019965. Supporting Information is included.

[14] Attachment 14. Bredeson et al., 2010. Factors Driving Refinery CO_2 Intensity, with Allocation Into Products. *International Journal of Life Cycle Assessment* **15:** 817–826. DOI: 10.1007/s11367-010-0204-3.

[15] Attachment 15. Brandt, 2011. Variability and Uncertainty in Life Cycle Assessment Models for Greenhouse Gas Emissions from Canadian Oil Sands Production. *Environmental Science & Technology* **46**: 1253–1261. DOI: 10.1021/es202312p.

[16] Attachment 16. Karras, 2011. *Oil Refinery CO_2 Performance Measurement;* report peer reviewed and published by the Union of Concerned Scientists (UCS). Technical analysis prepared by Communities for a Better Environment (CBE) for UCS. Union of Concerned Scientists: Berkeley, CA. Supplemental Information is included.

[17] Attachment 17. Abella and Bergerson, 2012. Model to Investigate Energy and Greenhouse Gas Emissions Implications of Refining Petroleum: Impacts of Crude Quality and Refinery Configuration. *Environmental Science & Technology* DOI: 10.1021/es3018682.

[18] Attachment 18. Karras, 2015. *Toxic and Fine Particulate Emissions from U.S. Refinery Coking and Cracking of 'Tar Sands' Oils;* Report on work conducted for the Natural Resources Defense Council at part of a technical assistance contract. Natural Resources Defense Council: San Francisco, CA. Supplemental Information is included.

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[19] Attachment 19. Gordon et al., 2015. *Know Your Oil: Creating a Global Oil-climate Index;* By Deborah Gordon, Adam Brandt, Joule Bergerson and Jonathon Koomey; Carnegie Endowment for International Peace: Washington, D.C. www.CarnegieEndowment.org/pubs.

[20] Attachment 20. *Refinery Crude Oil Input Qualities;* Data from US EIA for the years 2009–2014; table of data downloaded from www.eia.gov/petroleum/data.cfm on 14 October 2015. U.S. Energy Information Administration: Washington, D.C.

[21] Attachment 21. Meyer et al., 2007. *Heavy Oil and Natural Bitumen Resources in Geologic Basins of the World;* USGS Open-file Report 2007-1084, available at http://pubs.usgs.gov/of/2007/1084/. U.S. Geological Survey: Washington, D.C.

[22] Attachment 22. Schremp et al., 2010. *Transportation Energy Forecasts and Analyses for the 2009 Integrated Energy Policy Report;* Final Staff Report; CEC-600-2010-002-SF; California Energy Commission: Sacramento, CA. *See* pp. 134–142.

[23] Attachment 23. All publicly available data for gas oil density and sulfur content, compiled by CBE in April 2014, with selected crude oil assay data. Ten-page table.

[24] Attachment 24. *Canadian, US Processors Adding Capacity to Handle Additional Oil Sands Production;* Special report in: *Oil & Gas Journal;* **105**(26). 9 July 2007. www.ogj.com/articles.

[25] Attachment 25. Croft and Patzek, 2009. The Future of California's Oil Supply. Paper prepared for presentation at the 2009 Society of Petroleum Engineers Western Regional Meeting held in San Jose, California, USA, 24–26 March 2009. SPE-120174-PP.

[26] Attachment 26. *ST98-2013: Alberta's Energy Reserves 2012 and Supply/Demand Outlook 2013–2022;* ISSN 1910–4235. May 2013. Energy Resources Conservation Board: Calgary, Canada. www.ercb.ca. *See* esp. page 1-10.

[27] Attachment 27. *Valero Investor Presentation: November 2013;* excerpts from report at: http://www.sec.gov/Archives/edgar/containers/fix034/1035002/000119312513439300/d627324dex9901.htm downloaded October 2015.

[28] Attachment 28. *Phillips 66 2013 Barclays CEO Energy-Power Conference: Greg Garland, Chairman and CEO, Phillips 66;* 2013 Barclays CEO Energy-Power Conference, 12 September 2013, 11:05 a.m. ET. Nine pages.

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[29] Attachment 29. *03-Sep-2014 Phillips 66 (PSX) Barclays CEO Energy-Power Conference;* September 2014. Corporate participants: Greg C. Garland, Chairman & Chief Executive Officer, Phillips 66; other participants: Paul Cheng, Analyst, Barclays Capital, Inc. Corrected Transcript. Eleven pages.

[30] Attachment 30. *Phillips 66 Advantaged Crude Activities: Updated May 2013;* Image from Phillips 66 info-graphic downloaded on 16 October 2015 from its Web Site: http://www.phillips66.com/EN/Advantaged%20Crude/index.htm.

[31] Attachment 31. *Tesoro: Transformation through Distinctive Performance;* Presentation including forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995. Simmons Energy Conference. 27 February 2014.

[32] Attachment 32. *Crude Oil Forecast, Markets & Transportation;* Canadian Association of Petroleum Producers (CAPP); June 2015. Report by Canada's oil and natural gas producers. http://www.capp.ca/publications-and-statistics/publications/264673. *See* pages iii, iv, 20-22, and 29-34.

[33] Attachment 33. Krogh et al., 2015. *Crude Injustice on the Rails: Race and the Disparate Risk from Oil Trains in California;* report by Communities for a Better Environment and ForestEthics. June 2015. *See* esp. pp. 8, 12, 15, 18, and 21–26.

[34] Attachment 34. *Rail Risk and Response;* excerpt from the State of California interactive map entitled "Rail Risk and Response." The image copied shows BNSF and UPRR rail lines, major refineries, existing and proposed oil train terminals, hospitals and geologic faults near rail, active petroleum pipelines, rail-stream intersections, and place names, in the Bay Area. California Office of Emergency Services: Sacramento, CA. http://california.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=928033ed043148598f7e511a95072b89.

[35] Attachment 35. Vautrain, 1992. *Submission to the Regional Water Quality Control Board, San Francisco Bay Region, Prepared on Behalf of Shell Oil Company;* December 1992; report on technical considerations for crude substitution at Bay Area refineries in relation to selenium discharge prevention;13 pages; Purvin & Gertz: Los Angeles, CA.