Expert Report of Greg Karras
Communities for a Better Environment (CBE)
30 March 2016

Regarding the
Appeal of Planning Commission Actions on the Valero Benicia Crude by Rail Project and
Environmental Impact Report (EIR)
City of Benicia, California
State Clearinghouse #2013052074
Use Permit App. 12PLN–00063

Contents

I, Greg Karras, declare and say:

1. I reside in unincorporated Marin County and am employed as a Senior Scientist for Communities for a Better Environment (CBE). My duties for CBE include technical research, analysis, and review of information regarding industrial health and safety investigation, pollution prevention engineering, pollutant releases into the environment, and potential effects of environmental pollutant accumulation and exposure.

Qualifications

2. My qualifications for this opinion include extensive experience, knowledge, and expertise gained from more than 30 years of industrial and environmental health and safety investigation in the energy manufacturing sector, including petroleum refining, and in particular, refineries in the San Francisco Bay Area.

3. Among other assignments, I served as an expert for CBE and other non-profit groups in efforts to prevent pollution from oil refineries, to assess environmental health and safety impacts at refineries, to investigate alternatives to fossil fuel energy, and to improve environmental monitoring of dioxins and mercury. I served as an expert for CBE in collaboration with the City and County of San Francisco and local groups in efforts to replace electric power plant technology with reliable, least-impact alternatives.

4. I have served as an expert for CBE and other groups participating in environmental impact reviews of related refinery projects, including, among others, the "Contra Costa Pipeline Project," the "Phillips 66 Propane Recovery Project," the "Shell Greenhouse Gas Reduction Project," the "Chevron Richmond Refinery Modernization Project" and the "WesPac Pittsburg Energy Infrastructure Project" in the County of Contra Costa, and the "Phillips 66 Company Rail Spur Extension Project" now pending before the County of San Luis Obispo. My work as an expert for CBE and other non-profit groups in a 2007–2008 review of the proposed Chevron Richmond refinery "Hydrogen Renewal Project" was cited by the Appeals Court in support of CBE's subsequent successful advocacy regarding that proposed project (<u>See</u> *CBE v. City of Richmond* 184 Cal_Ap.4th).

5. During 2014 I served as an expert for the Natural Resources Defense Council in research on the effects of changes in oil feedstock quality on refinery air emission rates, specifically, on estimating toxic and particulate emissions from U.S. refinery cracking and coking of low quality, bitumen-derived "tar sands" oils.

6. As part of CBE's collaboration with the refinery workers union United Steelworkers (USW), community-based organizations, the Labor Occupational Health Program at UC Berkeley, and environmental groups, I serve as an expert on environmental health and safety concerns shared by refinery workers and residents regionally. In this role I serve as CBE's representative in the Refinery Action Collaborative of Northern California, and as an expert for CBE and other groups in the development of refinery emission control rules to be considered for adoption by the Bay Area Air Quality Management District.

7. I serve as one of CBE's experts supporting informal state-level climate and energy planning discussions with California State agencies and the Office of Governor Edmund G. Brown. In this capacity I participated in meetings organized and attended by

Governor Brown's senior advisors on 12 July 2013 in Oakland, California, and 13 April 2015 in Sacramento, California.

8. I authored a technical paper on the first publicly verified pollution prevention audit of a U.S. oil refinery in 1989 and the first comprehensive analysis of regional oil refinery selenium discharge trends in 1994. From 1992–1994 I authored a series of technical analyses and reports that supported the successful achievement of cost-effective pollution prevention measures at 110 industrial facilities in Santa Clara County. I authored the first comprehensive, peer-reviewed dioxin pollution prevention inventory for the San Francisco Bay, which was published by the American Chemical Society and Oxford University Press in 2001. I authored an alternative energy blueprint, published in 2001, that served as a basis for the Electricity Resource Plan adopted by the City and County of San Francisco in 2002. In 2005 and 2007 I co-authored two technical reports that documented air quality impacts from flaring by San Francisco Bay Area refineries, and identified feasible measures to prevent these impacts.

9. My more recent publications include the first peer reviewed estimate of combustion emissions from refining lower quality crude oils to be based upon data from U.S. refineries in actual operation, which was published by the American Chemical Society in the journal *Environmental Science & Technology* in 2010. I authored a follow up to this national study that extended this work with a focus on California and Bay Area refineries, which was peer reviewed and published by the Union of Concerned Scientists in 2011. I authored and presented invited testimony regarding *inherently safer systems* requirements for existing refineries that change crude feedstock at the U.S. Chemical Safety Board's 19 April 2013 public hearing on the Chevron Richmond refinery fire. I authored a research report, published in January 2015, on the results of work I conducted for the Natural Resources Defense Council on estimating toxic and particulate emissions from U.S. refinery cracking and coking of bitumen-derived "tar sands" oils.

10. My curriculum vitae and list of publications were provided to the City of Benicia with my previous comment in this matter. Please see the "Supplemental Technical Comments of Communities for a Better Environment regarding the Valero Benicia Crude by Rail Project ('project')" dated 15 September 2014, which I authored, for this information.

Scope of Review

11. I have reviewed the project called the Valero Benicia Crude by Rail Project ("project") and the project's Environmental Impact Report ("EIR"), including the draft EIR ("DEIR"), revised draft EIR ("RDEIR") and final EIR ("FEIR") documents, and have previously provided expert comment in this matter.[1] I reassert my previous comments as they remain relevant and were not addressed in the EIR. The Planning Commission decided not to approve the land use permit for the project and decided not to certify the EIR on 11 February 2016. Valero Refining Company ("Valero") appealed these Planning Commission decisions to the City Council on 29 February 2016. (*See* the "Appeal of Planning Commission Resolution No. 16–1, Denying Use Permit Application 12PLN-00063 and Declining to Certify Final Environmental Impact Report for the Valero Benicia Crude-by-Rail Project [SCH #2013052074]"; letter from John J. Flynn III, Nossaman LLP to Lisa Wolfe dated 29 February 2016 [hereinafter "29 Feb letter"].)

12. Valero's appeal asserts conclusions regarding factual issues that were addressed by my previous comments. It asserts that: "All of the public discussion about the Project has focused on the impacts of rail operations." (29 Feb letter at ¶ 1.A.) Then it asserts the project will not result in any change to refinery emissions. (29 Feb letter at ¶ 1.D.) Then Valero asserts that "the only significant unmitigated Project-related environmental impacts result from rail operations." (29 Feb letter at ¶ 3.D.) Valero then concludes that "environmental review of Valero's Project has been exhaustive." (29 Feb letter at ¶ 4.) As to that assertion (Id.), among other things, Valero specifically disputes the Planning Commission's findings that the EIR failed to disclose and evaluate project changes in the refinery's crude slate, air quality impacts, and climate impacts sufficiently. (29 Feb letter at ¶ 3.D parts 9, 13.b, 13.c, and 14.)

13. My review of the project, EIR, and Valero appeal reported herein is focused on the assertions made by Valero in its appeal to the City Council that are identified in the paragraph directly above. My opinions on these matters and the basis for these opinions are stated in this report.

[1] *See* the "Supplemental Technical Comments of Communities for a Better Environment (CBE) regarding the Valero Benicia Crude by Rail Project ('project') Draft Environmental Impact Report ('DEIR'), Use Permit App. 12PLN-00063, SCH #2013052074, by Greg Karras, Senior Scientist, 15 September 2014."

The Appeal Misrepresents the Project Review

14. The assertion that "[a]ll public discussion about the Project has focused on the impacts of rail operations"[2] is inaccurate and misleading. Goodman and Rowan (2013) showed that the project could change the refinery's crude slate.[3] Fox (2013) showed this could cause significant impacts from refining operations.[4] By 1 July 2013 at least eleven groups, including CBE and the refinery workers union United Steelworkers (Local 675), sought full disclosure and analysis of the changes in refinery oil feedstock and emissions that could result from the project.[5] The EIR identified this potential for project-driven changes in its crude slate to cause impacts in the refinery as an "area of controversy."[6] Fox (2014),[7] Pless (2014),[8] Karras (2014),[9] Fox (2016),[10] Pless (2016)[11] and others[12] commented in detail on the EIR's failure to evaluate these and other refining impacts of the proposed project. Valero is on record acknowledging this focus of independent public comment on refining impacts of the project, as shown by the company's attempt, at the Planning Commission's Public Hearing, to rebut comments regarding these refinery impacts of the project,[13] in direct contradiction to its position on appeal.

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[2] This is quoted from paragraph 1.A of Valero's appeal document (29 Feb letter as cited above).
[3] http://www.ci.benicia.ca.us/index.asp?SEC=B7EDC93A-FFF0-4A14-9B1A-1C8563BC256A&Type=B_BASIC ("City Web Site"); Supplemental Documents for NRDC Comment on IS/MND; Goodman Group Report.
[4] City Web Site; Supplemental Documents for NRDC Comment on IS/MND; Report by Dr. Fox.
[5] City Web Site; Initial Study/Mitigated Negative Declaration; Public Comments Received May 30–July 1, 2013; Comment B3.
[6] DEIR at ES-7, 1-4, Appendices C.1 and C.2; FEIR at 4-13 through 4-18.
[7] City Web Site; SAFER California Comments on DEIR Attachment A.
[8] City Web Site; SAFER California Comments on DEIR Attachment C.
[9] City Web Site; CBE Karras Comments on DEIR.
[10] City Web Site; Additional Public Comments; January 29–February 8, 2016; 8 Feb 2016 comments of Dr. Fox (Attachment C to SAFER California Comments).
[11] City Web Site; Additional Public Comments; January 29–February 8, 2016; 8 Feb 2016 comments of Dr. Pless (Attachment D to SAFER California Comments).
[12] Many other comments provided evidence of the potential for these impacts and the failure of the EIR to address them: *see* e.g., 2 Oct 2014 comments of Attorney General Harris; and the 8 Feb 2016 comments of the Natural Resources Defense Council, Benicians for a Safe and Healthy Community, CBE, ForestEthics, and 16 other groups (City Web Site; Additional Public Comments; September 16–October 16, 2014; and January 29–February 8, 2016).
[13] City Web Site; Planning Commission Minutes, Presentation & Miscellaneous Information; Planning Commission February 9, 2016 Full Transcript; pp. 27–51 (*see esp.* page 27, lines 10–15; page 34 line 12 through page 35 line 4; and page 49 line 12 through page 51 line 4).

15. Comments on the EIR link the project's crude switch to many refinery impacts. Contaminants that are more concentrated in the new crude slate could pass through the refinery in greater amounts: for example, high-selenium crude can cause a refinery's releases of this toxic element to increase by a factor of up to ten times.[14] Refining properties of the new crude slate could require more intensive processing that increases refinery emissions: for example, peer reviewed work shows the potential for crude feed quality to drive processing changes that require burning 2–3 times more fuel energy per barrel of crude refined.[15] This more severe (intensive) processing environment also could increase the frequency and magnitude of hazardous incidents: for example, worsening oil quality worsened equipment corrosion that contributed to fatal fire and catastrophic air pollution incidents at Bay Area refineries.[16] Additional examples of refinery hazard and emission impacts from the placement and operation of new, existing and expanded refinery facilities that enable the feedstock switch are discussed below.

16. In fact, changing refinery feedstock is the sine qua non[17] of the project. The basic function of the project as proposed requires refining the oil to be received.[18] Because the Benicia plant already runs near capacity, refining crude received via its pipeline and wharf, the project thus requires replacing current refinery feedstock.[19] But the Alaskan, Californian, and globally sea-tankered crude streams the refinery receives by pipeline and ship cannot be accessed economically by rail, and the tar sands and fracked shale oils that project oil trains would access from the U.S. Great Plains and Alberta, Canada cannot be accessed economically at project volume by pipeline or ship.[20] Therefore, the project would both enable and require the refinery to change its crude slate.

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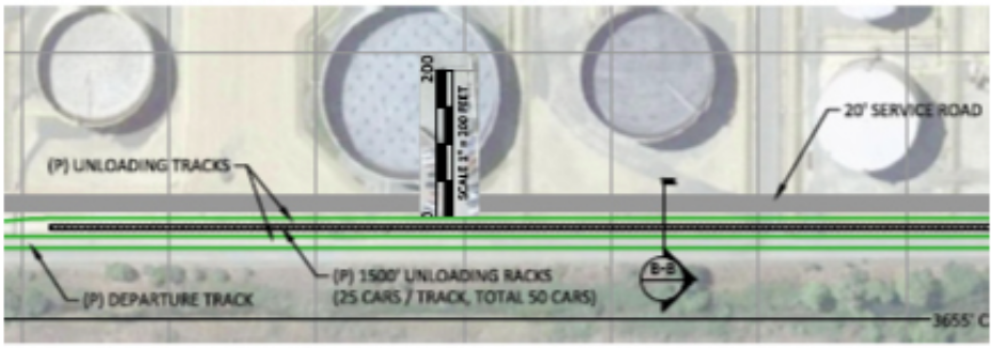
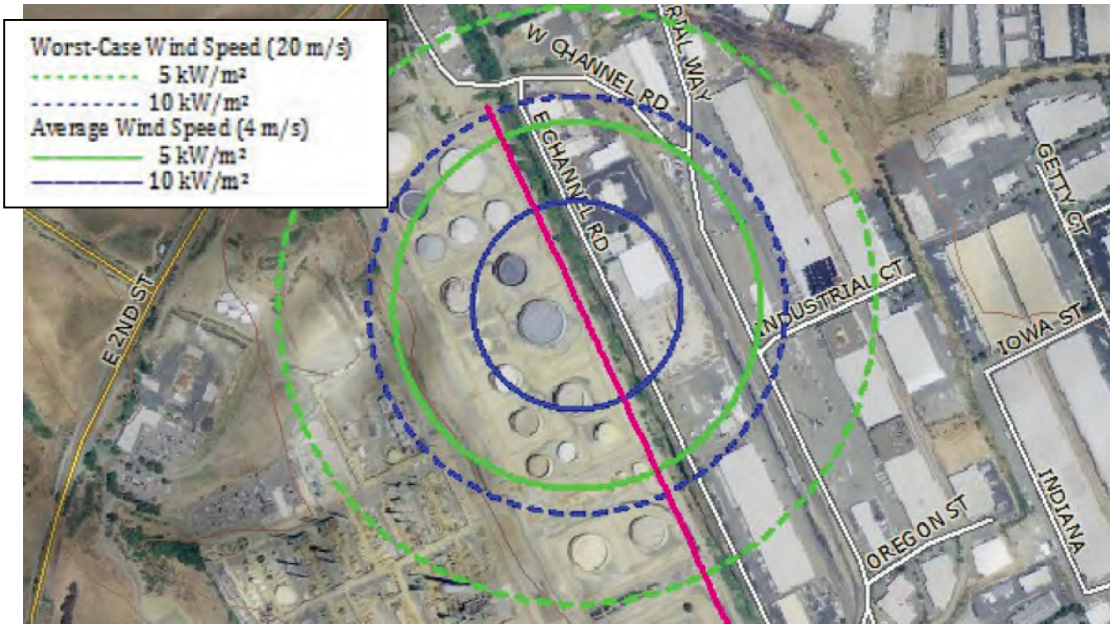
[14] *See* CBE Report 94-1, incorporated by reference in previous comment (Karras, 2014 at 15).
[15] *See* attachments KR 2–4, incorporated by reference in prior comment (Karras, 2014 at 17).
[16] *See* U.S. CSB, 2001; and CSB, 2013 (Attachment KR-5), incorporated in Karras, 2014 at 17.
[17] The essential element, without which it cannot come into existence as proposed.
[18] Valero does not propose exporting this crude and the EIR asserts Benicia will refine all of it.
[19] Valero asserts barrel-for-barrel replacement of current crude input; the EIR asserts crude slate volume will not change (*see* RDEIR at 2-6); and data in permit orders it cites (Att. KR-7) indicate that at least 55,000 b/d of the crude slate must be displaced at the 70,000 b/d project capacity.
[20] West Coast access to these landlocked high plains and Alberta oils via pipeline and ship is severely bottlenecked (Goodman and Rowan, 2013; Fox, 2013), as Valero's objective to "[a]llow for the delivery of up to 70,000 barrels per day of North American-sourced crude oil" (RDEIR at 2-2) implies. From 2010-2012 it proved able to get an average of only 2,210 b/d of Canadian tar sands "dilbit" crude (*see* Table 4 in Karras, 2014; 19–24 ºAPI, 3.5–3.9% sulfur), only 3.1% of its 70,000 b/d objective. Fox (2016), showing that rail-to-pipeline access for these landlocked and bottlenecked crude streams is an alternative version of the project, further proves the point.

The Appeal Ignores Refinery Hazard Impacts

17. An excerpt from the DEIR showing that the new facilities would be very close to existing storage tanks on the refinery site that was presented in my previous comments, and a project oil fire hazard radius map of the same post-project onsite area from the RDEIR, are excerpted below. This evidence indicates a new catastrophic hazard from "knock-on" effects (e.g., project oil fires could catch nearby refinery tanks on fire).



Map 1. Storage tanks close to proposed crude-by-rail unloading rack.
Excerpt from DEIR Figure 3-3 (200' grid-scale indicator repositioned for reference).



Map 2. Excerpt from RDEIR Figure 4.7-8. "Worst-Case Facility Thermal Radiation Hazards." Existing refinery storage tanks within the inner hazard circle (10 kW/m^2 at 4 m/s wind speed) are those shown in the center of Map 1 above. Proposed unloading facilities are represented by the diagonal pink line in this map and by the horizontal green and black lines in Map 1.

A hydrocarbon tank fire that could result from this hazard, should it manifest, could cause catastrophic and irreversible impacts. This new knock-on impacts hazard would be caused by Valero's proposal to place and to operate new crude oil unloading facilities dangerously close to existing facilities within the refinery.

18. This evidence also reveals clear and significant errors in the EIR. Instead of responding to my previous comment that this knock-on hazard was not identified, evaluated, or addressed by the DEIR, the FEIR refers to a quantitative risk analysis in the RDEIR,[21] but that referenced analysis (RDEIR at 2-106 to 2-108; RDEIR Appendix F) does not include any analysis of this knock-on hazard. The EIR thus fails to respond to comment, and fails to identify or address a significant potential hazard impact of the project. Valero ignores this evidence that directly contradicts its position on appeal.

The Appeal Obscures Refinery Emission Impacts

19. Comments on the EIR provide abundant evidence for significant impacts from increased refinery emissions of toxic, criteria, and climate-disrupting air pollutants that would be caused by project changes in properties of the refinery crude slate that are not disclosed, evaluated, or addressed in the EIR or by Valero's appeal.[22] An example of this evidence that was summarized in my testimony before the Planning Commission is presented in Table KR-1 and the discussion below.

20. Refining hydrogen-rich engine fuels from hydrogen-poor tar sands oils requires adding hydrogen to the oils during processing, and the intentional production of this hydrogen in fossil fuel-fed steam reforming plants is a major greenhouse gas (GHG) emitter in refineries.[23] Hydrogen is the most abundant atom in crude, and at $1/12^{th}$ the mass of carbon, small differences in hydrogen wt. % represent larger differences in H_2 deficiency among crude oils. The 1.0–1.9 lb/b H_2 deficiency of project tar sands blends as compared with the Alaskan crude and Brazilian/Iraqi blend in Table KR-1 represents an additional 70,000–133,000 lb/d of H_2 production to refine post-project crude slates that replace 70,000 b/d of these current crude feeds with project tar sands blends.

[21] FEIR Response to Comments at comment B9-39.
[22] Goodman and Rowan (2013); Fox (2013); CBE et al. (2013); Fox (2014); Pless (2014); Karras (2014); Harris (2014); NRDC et al. (2016); Fox (2016), and Pless (2016). (Footnotes 3–5; 7–12.)
[23] *See* attachments KR-1 through KR-4 appended hereto. These documents were incorporated by reference in previous comments and are re-supplied herein for the City Council's convenience.

Table KR-1. Potential CO_2 emissions increment from Benicia Refinery hydrogen production to process hydrogen-deficient tar sands oils enabled by the project.

Crude oil data[a]	Density (°API)	Density (lb/bbl)	Sulfur content (wt. %)	Sulfur content (lb/bbl)	Hydrogen content (wt. %)	Hydrogen content (lb/bbl)
Baseline crude oils/blends						
Alaska North Slope (ANS)	31.4	304	0.85	2.59	12.8	39.0
Brazil Lula (BL)	29.3	308	0.27	0.83	12.7	39.3
Iraq Basra (IB)	30.2	306	2.66	8.15	12.5	38.4
50% BL / 50% IB blend	30.0	307	1.46	4.49	12.6	38.8
Tar sands dilbit oils						
Cold Lake (CL)	20.7	325	3.89	12.7	11.2	36.4
Seal Heavy (SH)	20.6	326	5.14	16.7	10.6	34.5
W. Canadian Select (WCS)	20.5	326	3.38	11.0	11.2	36.5
Tar sands SCO oils						
Husky Synthetic Blend (HSB)	32.6	302	0.09	0.27	12.9	38.8
Suncor Synthetic A (OSA)	33.1	301	0.16	0.48	12.7	38.2
Syncrude Synthetic Bld (SSB)	31.5	304	0.14	0.42	12.5	38.1
Tar sands rail import blends						
50% WCS / 50% OSA blend	26.7	313	1.84	5.75	11.9	37.4
45% CL / 55% HSB blend	27.2	312	1.87	5.85	12.1	37.8
30% SH / 70% SSB blend	28.3	310	1.71	5.32	11.9	37.1

	Crude slate change (hydrogen deficiency) from:	
	replacing ANS with WCS/OSA blend (lb H_2/bbl)	–1.60
	replacing BL/IB with CL/HSB blend (lb H_2/bbl)	–1.00
	replacing ANS with SH/SSB blend (lb H_2/bbl)	–1.90
CO_2 emission factor[b]	H_2 steam reforming emissions (kg CO_2/lb H_2 produced)	4.68

Emissions increase from H_2 production to offset the decreased H_2 content of the post-project crude slate	CO_2 emission increment from:	kg/bbl	MTY @ 70 kbpd
	replacing ANS with WCS/OSA	+ 7.49	+ 191,000
	replacing BL/IB with CL/HSB	+ 4.68	+ 120,000
	replacing ANS with SH/SSB	+ 8.89	+ 227,000

CO_2 emissions from refinery hydrogen production could increase by ≈ 120,000–227,000 metric tons per year to make up the hydrogen deficiency from replacing 70,000 barrels per day of the current Benicia refinery crude slate with tar sands oil imports, a likely result of Valero's proposed project.
MTY: metric tons per year. **kbpd:** thousand barrels per day. **Dilbit:** blend of diluent oil and bitumen to enable transport of the crude oil. **SCO:** synthetic crude oil; bitumen that is partially upgraded before refining.
(a) Crude oil data are from Abella and Bergerson (*see* also www.ucalgary.ca/lcaost/prelim) and are given in Attachment KR-4. Blends within the refinery's 20–36 °API and 0.4–1.9 % sulfur crude slate envelope the EIR reports were calculated from mass/barrel data. For example, the 50% BL / 50% IB blend was calculated from the Brazil Lula (BL) and Iraq Basra (IB) data as follows: 0.5 x 308 + 0.5 x 306 = 307 lb/bbl (30.0 °API); 0.5 x 0.83 + 0.5 x 8.15 = 4.49 lb/bbl sulfur (1.46 wt. % of the 307 lb bbl); and 0.5 x 39.3 + 0.5 x 38.4 = 38.8 lb/bbl hydrogen. In addition to the Alaska North Slope crude (ANS) it was designed for, the Benicia refinery runs significant amounts of crude from Brazil and Iraq with the density and sulfur content of Lula, and Basra, respectively. *See* Karras (2014) Table 4. Tar sands oils shown span the range of density, sulfur, and hydrogen in Canadian bitumen-derived oils that the project allows the refinery to run in much larger volume.
(b) Refiners must add hydrogen to H_2-deficient crude oils such as bitumen to make H_2-rich engine fuels, and refiners produce the additional H_2 by steam reforming, a major CO_2 emitter in refineries. (Atts. KR 1–4.) The refinery has begun to expand its H_2 production capacity. (*See* Att. KR-7.) The emission factor of 4.68 kg CO_2 per pound of H_2 production is a conservative estimate from the peer reviewed literature. (Att. KR-2 Table S1 [16.4 MJ/m^3 H_2 and 52.7 kg CO_2/GJ in steam reforming], and USDOE H_2 conversion [5.42 m^3 per lb. H_2]).

21. Crude density, sulfur, and H_2 data shown in the table were reported by a peer-reviewed study in previous comment. (Att. KR-4.) The project could replace 70,000 b/d of the current crude slate—including Alaskan North Slope crude (ANS; Att. KR-2), and oils from Brazil and Iraq with API Gravity and sulfur content matching the Brazil-Lula and Iraq-Basra oils in Table KR-1[24]—with the tar sands oil blends shown in the table.[25] Individual current (Lula, Basra) and project (dilbit and SCO) crude oils fall outside the crude slate envelope reported in the EIR for sulfur, but all the blends of these oils shown in the table are within the 20–36 ºAPI and 0.4–1.9% sulfur crude slate envelope it reports. The project enables this switch to crude with a 1.0–1.9 pounds per barrel H_2 deficiency.

22. Producing each pound of this extra hydrogen would emit ≈ 4.68 kilograms of carbon dioxide (CO_2) from hydrogen steam reforming. This is a conservative estimate from my peer-reviewed work.[26] The steam reforming process runs at extremely high temperature and pressure, requires a large fuel energy input, and co-produces H_2 and CO_2 from its hydrocarbon feed as major reaction products. At 4.68 kg CO_2/lb H_2, making up the 1.0–1.9 lb/b H_2 deficiency shown in the table would emit ≈ 4.68–8.89 kilograms more CO_2 for each barrel of ANS, 50% Lula / 50% Basra blend—or other oils in the current crude slate with similar hydrogen content—that the project enables Valero to replace with the tar sands rail import blends in Table KR-1.

23. This evidence indicates that, at the project potential to replace 70,000 b/d of current crude feed with tar sands bitumen-derived oils, hydrogen production to make up the hydrogen deficiency of the new crude oil slate enabled by the project could increase refinery CO_2 emissions by ≈ 120,000–227,000 metric tons/year.[27] This refinery emission increment exceeds the EIR's significance threshold (10,000 MTY) by 11–22 times.

24. As stated (¶ 19), the EIR does not disclose, evaluate, or mitigate any of the significant refinery emission impacts documented by comments. The EIR does not even disclose the changes in refinery crude slate quality that would be enabled by the project and would drive these impacts. (*See* Karras, 2014; Fox, 2016; and atts. KR 1–6.) Both

[24] Compare Table 4 in Karras (2014) to the BL and IB crude data shown in Table KR-1 herein.
[25] Tar sands oil is the likely rail import: Goodman and Rowan (2013); Fox (2013); Karras (2014).
[26] Attachment KR-2 at Table S1 (16.4 MJ/m^3 H_2 product and 52.7 kg CO_2/GJ in steam reforming) and 16.4/1,000 x 52.7 = 0.864 kg/m^3 H_2; or 0.864 x 5.42 m^3/lb H_2 = 4.68 kg CO_2/lb H_2 produced. The 5.42 m^3/lb H_2 value is from the U.S. Department of Energy hydrogen conversion calculator.
[27] Low end from 4.68 kg/b crude x 70,000 b/d x 365 d/y ÷ 1,000 kg/ton = 119,574 metric tons/y; high end from 8.89 kg/b crude x 70,000 b/d x 365 d/y ÷ 1,000 kg/ton = 227,140 metric tons/y.

Valero and the EIR argue against these disclosures, arguing that the crude oil data are confidential and that there is no need for further disclosure. Specifically, they assert that any feedstock-driven impacts in the refinery would be correlated with the API Gravity (density) and sulfur content of its crude slate, and would remain within such a narrow refinery operating envelope ("range") of oil density, oil sulfur, and process capacity limits that no such impacts could occur.[28] These assertions are clearly erroneous.

25. Karras (2010) showed that density and sulfur alone did not predict anomalously high hydrogen requirements that were documented at Rocky Mountain States refineries running crude slates including tar sands oils. (Att. KR-2.) Abella and Bergerson (2012) showed that accurate prediction of crude slate impacts on a refinery's processing and emissions requires evaluation of other crude oil properties besides density and sulfur, such as distillation properties and hydrogen content. (Att. KR-4.) Fox (2016) showed that many other properties of the crude slate that could cause significant impacts in the refinery do not correlate with its density and sulfur content. In fact, refiners routinely model new crude slates based on many other properties including detailed distillation properties and hydrogen content. (*See* Atts. KR-3, KR-4.) Valero's insistence on the fallacy that density and sulfur content correlate with and predict all potential impacts of its crude slate on its refinery's processing appears disingenuous: it could not operate its refineries efficiently if it actually put this fallacy into practice.

26. Valero's assertion that the "narrow" range of its crude slate operating envelope will prevent refining impacts is similarly inaccurate and misleading. The significant H_2 impacts discussed above would occur within this envelope. (¶ 21.) Increased crude slate sulfur content that stayed within the Richmond refinery's operating envelope greatly worsened corrosion of the pipe that failed catastrophically in the August 2012 fire that sent some 15,000 people to area hospitals. (Att. KR-5.) Moreover, the alleged range is not so "narrow" as Valero asserts: actual operating data from U.S. refineries predict that a U.S. crude slate change of much less than this 20–36 ºAPI and 0.4–1.9% sulfur range, from 33.0 to 26.5 ºAPI and 0.93 to 1.21 wt. % sulfur, could cause the average U.S. refinery's CO_2 emissions to increase by ≈ 30%, from ≈ 270–350 kg/m^3 crude refined.[29]

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[28] *See* Valero Data Response #1 at pp. 1–2; Valero appeal (29 Feb letter) at ¶¶ 1.D, 3.D, and 4; DEIR at 3-22 through 3-24; RDEIR at 2-6, 2-23; FEIR Response to Comments at comments A20-1, B9-63 through B9-78, and J3-4; and FEIR at 4-13 through 4-18.

[29] Attachment KR-2; *esp.* Table S8, PADDs 1 and 5, 2000 (33.0–26.5 ºAPI, 0.93–1.21% sulfur). Note: ºAPI = (141.5 ÷ SG)–131.5, where SG (specific gravity) = crude density in kg/m^3 ÷ 1,000.

As Harris (2014)[12] and others correctly commented on this same error in the EIR, the project could cause impacts by changing the proportion of low quality crude in the refinery's slate, whether or not it stays within the asserted operating envelope range.

27. Valero's assertion that its current refinery capacity and permit limits prevent any change in its crude slate, processing, or emissions also is inaccurate and misleading. Based on the data in Attachment KR-7,[30] the refinery's permitted capacity allows it to increase its crude feed rate by ≈ 18 % (from 140,000–165,000 b/d), its catalytic cracking feed rate by ≈ 10 %, its coking rate by ≈ 35 %, and its hydrocracking rate by ≈ 23 %. Further, its air permit allows hydrogen production to increase by at least 16 % (+26 MMSCFD), upon commissioning of its concurrent hydrogen plant expansion.[31] The EIR admitted Valero was concurrently considering this hydrogen expansion (DEIR at 3-12), but then committed the same clear error as Valero's appeal: asserting permit conditions that allow changes in processing will prevent changes in processing. The increase in maximum permitted hydrogen production upon completing Valero's concurrent plant expansion (+26 MMSCFD) represents ≈ 50,500,000 lb/y of additional H_2 production,[32] which could emit ≈ 236,000 metric tons/y of CO_2,[33] consistent with the emission increment that could be driven by the project's crude switch.

28. The crude density, sulfur, and hydrogen data presented in Table KR-1 are public data. (Att. KR-4.) This also is true of the refinery-specific crude source and crude slate density and sulfur content data in Table S9 of Attachment KR-2; the refinery-specific imported crude source, density, and sulfur data in Table 4 of Karras (2014); the detailed ANS assay data in Table 5 of Karras (2014); and the refinery-specific crude slate density, sulfur, cadmium, mercury, nickel, selenium, vanadium, and distillation data reported in Attachment KR-6. Public data are not secret. Thus, the assertion that the EIR properly omitted disclosure and evaluation of these data as confidential information is false. The Attorney General's comment that the EIR is deficient because of this nondisclosure that results from its "overly broad determination of trade secrets" (Harris, 2014)[12] is correct.

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[30] Excerpts from permit orders issued to the refinery by the Air Quality Management District and the Regional Water Quality Control Board that were cited and relied upon by the EIR; *compare* limits for S#s 1006, 5, 6, and 1003 in Table II A with process-specific throughputs in Table F-1E.

[31] Attachment KR-7 at Table II A, sources S-1010 and S-1062.

[32] Based on 365 days/y 26,000,000 SCF/d ÷ 188 SCF/lb H_2 = 50,478,723 lb H_2/year.

[33] Based on 50,500,000 lb H_2/y x 4.68 kg CO_2/lb H_2 x 1/1,000 tons/kg = 236,340 metric tons/y CO_2 emission. The emission factor (4.68 kg CO_2/lb H_2) is from Att. KR-2 as described in ¶ 22.

By relying on a false assertion of confidentiality to withhold disclosure and evaluation of the changes in crude slate properties that would result from the project and would affect refinery processing and emissions, Valero's appeal—and its EIR—obscure significant potential refining impacts of the project.

29. A U.S. Energy Information Administration report that identifies the Benicia refinery as exporting refined engine fuels product overseas is appended hereto as Attachment KR-8.[34] This evidence is relevant because Valero asserts its project will reduce emissions by reducing ship traffic, but it has not disclosed or accounted for growing exports, which move by ship. Valero's assertion is unsupported. Even if the project replaces crude that is delivered by ship rather than by pipeline,[35] Valero would likely use the wharf capacity this frees up to increase its product exports, in order to offset the trend of California gasoline demand decline—a trend which has continued over the past decade, and would continue under state climate policy. It also would avoid any obligation to comply with the state's Low Carbon Fuel Standard, for the refined fuels its refinery exports. Valero's unsupported claim that reduced ship traffic emissions will offset project emissions further obscures refinery-related impacts of its project.

30. Comments to the Bay Area Air Quality Management District on the ongoing development of a proposed petroleum refining emission limits and risk thresholds rule, Regulation 12, Rule 16, that were submitted by Valero in September 2015 are appended hereto as Attachment KR-9. Valero opposes this proposal "to cap refinery emissions" (prevent them from increasing), arguing, among other things, that its Benicia refinery "will be significantly impacted" because it needs the "operational flexibility" to increase emissions up to its maximum currently permitted potential to emit. (Att. KR-9 at 1–3.) The company's position in this concurrent regional policy proceeding—that it will be "significantly impacted" unless its refinery emissions are allowed to increase—stands in contradiction the position it has taken before the City Council on appeal, that there will be "no change to refinery emissions."[36]

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[34] Following questions about possible current or future exports from the refinery that were asked by the Planning Commission during its hearing on the project, this document (Att. KR-8) was presented during the Planning Commission hearing for the record.

[35] Available evidence suggests that crude delivered by rail as a result of the project is at least equally likely, and is probably more likely, to replace crude deliveries by pipeline than to replace crude deliveries by marine transport over the Benicia refinery's wharf (Karras, 2014).

[36] *Compare* Attachment KR-9 at pp. 1–3 with Valero's appeal (29 Feb letter) at ¶ 1.D.

Opinion

31. Changing refinery feedstock is the essential element of the proposed project. The switch to a lower quality, higher tar sands oil-content crude slate that is enabled by the project, and the operation of project oil delivery facilities onsite very close to existing refinery facilities, would likely result in significant refinery emission and hazard impacts. Instead of disclosing and addressing these impacts the EIR obscures them. The EIR claims to evaluate a hazard it did not evaluate, fails to disclose crude slate quality impacts of the project, and argues against this disclosure based on assertions that are clearly false. It asserts that public data are secret, that non-correlated crude slate impacts are correlated, that significant ranges in these impacts are insignificant, and that capacity limits allowing these impacts will prevent them. Valero's appeal misrepresents the project review and perpetuates this nondisclosure based on these same clearly false assertions while omitting evidence that its own export and policy activities suggest increasing refinery emissions. Valero thereby further obscures the refinery impacts of its project.

32. I have given my opinions on these matters based on my knowledge, experience and expertise and the data, information and analysis discussed in this report.

I declare under penalty of perjury that the foregoing is true of my own knowledge, except as to those matters stated on information and belief, and as to those matters, I believe them to be true.

Executed this 30th day of March 2016 at Richmond, California

Greg Karras

Attachments List

Attachment KR-1. Meyer et al., 2007. *Heavy Oil and Natural Bitumen Resources in Geological Basins of the World;* U.S. Geological Survey Open-File Report 2007–1084.

Attachment KR-2. 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. Includes Supplemental Information (SI).

Attachment KR-3. Bredeson et al., 2010. Factors Driving Refinery CO_2 Intensity, with Allocation into Products. *International Journal of Life Cycle Assessment* **15:** 817–826.

Attachment KR-4. Abella and Bergerson, 2012. Model to Investigate Energy and Greenhouse Gas Emissions Implications of Refining Petroleum. *Environmental Science & Technology*. **46:** 13037–13047. DOI: 10.1021/es3018682. Includes excerpts from crude oil inventory data developed for this analysis from www.ucalgary.ca/lcaost/prelim.

Attachment KR-5. U.S. Chemical Safety and Hazard Investigation Board, 2013. *Interim Investigation Report: Chevron Richmond Refinery Fire;* final report adopted at Richmond, California on 19 April 2013.

Attachment KR-6. Excerpts from the *Chevron Refinery Modernization Project Environmental Impact Report;* State Clearinghouse No. 2011062042; Lead Agency: City of Richmond, California; excerpts including Appendix 4.3-URM (Unit Rate Model) and Six Element Test Reports. Richmond, CA.

Attachment KR-7. Excerpts from Valero Benicia Refinery permits including refinery capacity and utilization data: pages 8–37 from the Major Facility Review (Title V) Permit issued to the Valero Refining Co. Benicia Facility as revised by the Bay Area Air Quality Management District on 30 April 2013; and Attachment F-1 of Order No R2-2015-0037 for renewal of NPDES Permit No. CA0005550, adopted by the Valero Benicia Refinery by the San Francisco Bay Regional Water Quality Control Board on 12 August 2015.

Attachment KR-8. U.S. Energy Information Administration, 2015. *PADD 5 Transportation Fuels Markets;* Energy Information Administration (USEIA), U.S. Department of Energy: Washington, D.C. September 2015.

Attachment KR-9. Cuffel, 2015. *Proposed Petroleum Refining Emissions Limits and Risk Thresholds Rule: Regulation 12, Rule 16, Comments from Valero.* Comments to the Bay Area Air Quality Management District dated 25 September 2015. Valero Refining Company-California: Benicia, CA.