Expert Report of Greg Karras, Senior Scientist, Communities for a Better Environment (CBE)

Regarding:
The Draft Environmental Impact Report for the Proposed General Plan Update (PLN09-137), City of Richmond, California.

March 17, 2011

COMMUNITIES FOR A BETTER ENVIRONMENT

Communities for a Better Environment (CBE) has requested that I review the Draft Environmental Impact Report for the proposed General Plan Update (DEIR). Specifically, I was asked for my opinion on the DEIR's analysis of the Energy and Climate Element in the proposed Update, to address concerns about the treatment of industrial emissions in the General Plan Update.

My qualifications for this opinion include extensive experience, knowledge, and expertise gained from 27 years of industrial and environmental health investigation in the energy manufacturing sector, on toxic chemicals, and on petroleum refining in particular.

Among other assignments, I served as an expert for CBE and other non-profit groups in efforts to prevent pollution from 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. I serve as an expert for CBE and other groups in a project involving comprehensive investigation of environmental impacts of and alternatives to refining heavier, more contaminated oil.

I authored a technical paper on the first publicly verified pollution prevention audit of a California petroleum refinery in 1989 and the first comprehensive analysis of refinery selenium discharge trends in 1994. From 1992 through 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, California. 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. I authored the first peer-reviewed report to verify quantitative estimates and predictions for the effects of crude oil quality on the energy intensity and greenhouse gas emission intensity of petroleum refining, which was published by the American Chemical Society in the Journal *Environmental Science & Technology* in 2010. My curriculum vitae and list of publications are attached hereto as Attachment 1.

My opinion is set forth in this report and is summarized at the beginning of each section of the report in **boldface**.

1904 Franklin Street, Suite 600 • Oakland, CA 94612 • T (510) 302-0430 • F (510) 302-0437
In Southern California: 5610 Pacific Blvd., Suite 203 • Huntington Park, CA 90255 • (323) 826-9771

1. The description of the City's role in solving the climate problem is incomplete.

The DEIR fails to describe the energy problem that must be solved for climate protection.

The deep emission cuts needed to avoid severe climate disruption pose an energy problem: Achieving them will require monumental efforts to replace the old, entrenched fossil energy system with a portfolio of sustainable resources tapping different primary energy sources.[1] Further, because the old and new energy systems compete for land and money resources, and adding onto the fossil energy infrastructure will commit us to new emissions for decades, this requires us to stop building fossil energy *in order to build* the sustainable energy system we need.[2] Equally important, solving this energy problem to protect our climate will involve an enormous economic development opportunity—the "green jobs" scenario referenced by policy makers—as the new, sustainable energy system is put into place.

This problem applies doubly to Richmond. Here, replacing limited conventional crude with heavier, dirtier oil resources could eventually increase emissions[3] from a refinery that is already the largest greenhouse gas emitter of any industrial plant in California.[4] Land now committed to this refinery might otherwise generate more daytime solar power than the City could use.[5] The tenfold greater employment per dollar economic activity in all sectors of the economy on average as compared with employment per dollar revenue in oil refining[6] shows that this "green jobs" opportunity also exists in Richmond.

Although the proposed General Plan Update ("Project") includes an Energy and Climate Element, the DEIR does not describe or address this critically important context for climate analysis. In addition, the DEIR does not describe the importance of cutting industrial emissions in order to meet the total emissions reduction goal of the Project, and as a result does not actually propose to make these reductions. The Project sets a goal of cutting emissions back to 1990 emissions by 2020, and 80% below 1990 emissions by 2050 (Goal EC2; see also City Resolution 108-08).

---

[1] Hoffert, 2002. *Science* 298: 981–987. DOI: 10.1126/science.1072357; Meinshausen et al., 2009. *Nature* 458: 1158–1162. DOI: 10.1038/nature08017; Hoffert, 2010. *Science* 329: 1292–1294. DOI: 10.1126/science.1195449; Davis et al., 2010. *Science* 329: 1330–1333. DOI: 10.1126/science.1188566; Brandt and Farrell, 2007. *Climatic Change* 84: 241–263. DOI: 10.1007/s10584-007-9275-y; Karras, 2010. *Env. Sci. Technol.* 44(24): 9584–9589. DOI: 10.1021/es1019965.

[2] Davis et al., 2010. *Science* 329: 1330–1333. DOI: 10.1126/science.1188566; Hoffert, 2010. *Science* 329: 1292–1294. DOI: 10.1126/science.1195449.

[3] Karras, 2010. *Env. Sci. Technol.* 44(24): 9584–9589. DOI: 10.1021/es1019965; Brandt and Farrell, 2007 (DOI: 10.1007/s10584-007-9275-y) as referenced above; Kerr, 2009. *Science* 326: 1048; Meyer et al., 2007. *Heavy oil and natural bitumen resources in geologic basins of the world.* U.S. Geological Survey Open-File Report 2007-1084 (http://pubs.usgs.gov/of/2007/1084/.

[4] Calif. Air Resources Board, 2009. *Mandatory GHG Reporting Data.* See calendar year 2008.

[5] See e.g., estimated theoretical potential of 2,900 acre site after EIR SCH #2005072117 RTC at 2-18 (PV; peak 0.5–1 MW/acre less 15–19% capacity factor) vs 1 kW/household x 100,000/4.

[6] See U.S. Economic Census: employment vs annual sales, shipments, receipts or revenue data.

Figure 1 shows greenhouse gas (GHG) emissions and targets within the City's geopolitical boundaries. It shows the City's own estimates for every emission source or category except for the Richmond refinery today.

The Energy and Climate Element relies on the City's 2005 *Greenhouse Gas Emission Inventory* estimate that the refinery emits 3.516 Megatons (Mt) per year (Table 12, page 12). However, the City admits that its industrial emission estimates are uncertain, and refinery emissions have increased (Framework at 28, 65). Indeed, more recent estimates of Richmond refinery emissions—4.304 Mt in 2007,[7] 4.792 Mt in 2008 and 4.519 Mt in 2009[8]—are much larger than the 3.516 Mt estimate from 2005. Using these 2007, 2008 and 2009 estimates, total citywide industrial and commercial emissions exceed the City's 2020 emission target by 386,000 tonnes/year, 874,000 t/yr, and 601,000 t/yr respectively. Thus, all more recent estimates indicate that the City cannot meet its emission reduction goal unless industrial and commercial emissions are reduced in Richmond. The 2009 refinery estimate is used in Figure 1.

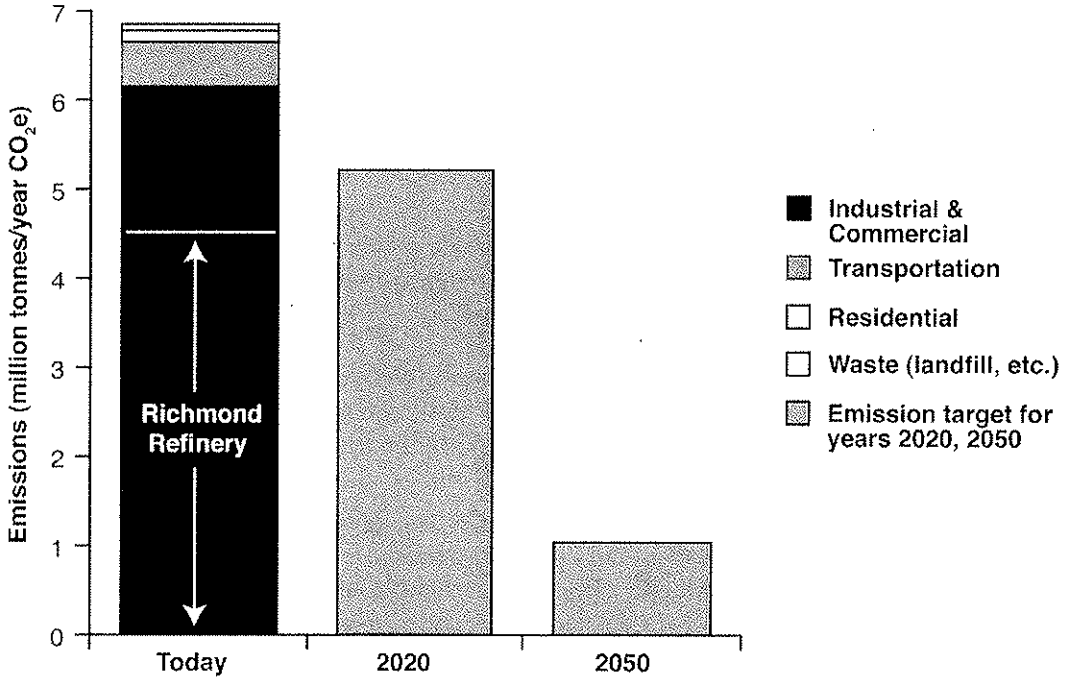

Figure 1. Greenhouse gas emissions, City of Richmond, CA. Richmond refinery emissions in 2009 (4.52 Mt/yr) from Calif. Air Resources Board. Emission targets from Energy and Climate Element: 1990 emissions by 2020; 80% cut in 1990 emissions by 2050; 1990 estimate from Table 3 in Chan, 2010. *Building a Framework for a Climate Action Plan in the City of Richmond.* All other estimates from City of Richmond *2005 Greenhouse Gas Emissions Inventory.*

---

[7] AQMD, 2010. *Source Inventory of Bay Area Greenhouse Gas Emissions.* Bay Area Air Quality Management District (AQMD). Updated: February 2010. See Table V.

[8] *Mandatory GHG Reporting Data.* California Air Resources Board (ARB). See emissions reported for calendar years 2008 and 2009.

Further, the DEIR presents an incomplete description of the City's role in addressing industrial emissions. It asserts that the City "has no jurisdictional control over" industrial and commercial operations that cause the majority of emissions from within the City (DEIR at 3.6–7). Despite this one unsupported reference in the DEIR, the City does in fact have land use authority to control industrial emissions. In one example, "the City made 'carbon neutrality' one of the conditions" of approval for an upgrade to the Chevron refinery in 2008 (Framework[9] at 28). In another example, on July 18, 2006 the City Council used its land use authority to avoid siting a large crematorium that would increase mercury emissions and was expected to receive the regional, state and/or federal environmental approvals necessary for its construction and operation.[10]

This practice of supplementing requirements imposed by regional, state, and federal government shows that the City does not rely solely on other levels of government for industrial emissions control. Thus, the DEIR's assertion of "no jurisdiction" is an incomplete description of the City's role in climate protection because it omits the ability and practice of curbing industrial emissions through land use authority. This omission is not cured elsewhere in the DEIR, possibly because the Energy and Climate Element proposes no City *requirement* to reduce or limit industrial emissions in Richmond.[11]

Finally, even though the City found that refinery GHG emissions and total emissions have increased since 1990 in Richmond[12] and the DEIR finds future emission reductions are uncertain,[13] the DEIR's "regulatory" discussion does not detail climate protection policies at other levels of government that affect GHG emitters in Richmond. Most importantly, the DEIR omits key details of two climate policy developments that affect major industrial sources of GHG statewide and may undermine efforts to meet the City's and Project's emissions reduction goal in Richmond.

First, on December 12, 2008 the Air Resources Board (ARB) adopted a scoping plan that would allow ARB to later adopt a "cap–and–trade" pollution trading scheme to implement California's AB 32 legislation.[14] This pollution trading scheme allows

---

[9] Chan, 2010. *Building a Framework for a Climate Action Plan in the City of Richmond.* Advanced Policy Analysis Conducted for the City of Richmond.

[10] See City Council July 18, 2006 Minutes; proposal to amend Mun. Code Chapter 15.04.

[11] *See esp.* Goal EC3; policies EC3.2, EC5.2 and EC5.3; and actions EC1.A, EC3.D, and EC5.D. The Framework further clarifies that Action EC1.A (Climate Action Plan) is limited to targeting emission reductions from residential energy usage, local vehicle transportation, and waste disposal (Framework at 7), which are defined to exclude industrial emissions, among other excluded emissions (Framework at 25–31; 2005 City Emission Inventory).

[12] Framework, Table 31; and compare Framework, Table 3 with Inventory, Appendix A.

[13] The DEIR concludes that emission reductions from regional, state and federal actions are too uncertain to be relied upon by its environmental impact analysis. See esp. DEIR at 3.3-21 through 3.3-25: (Describing measures to monitor air quality, support regional policies and efforts that improve air quality and "conform to" AQMD standards for stationary sources and concluding that even though this mitigation "would be implemented, the impact of operational emissions remains uncertain and, therefore, would be considered *significant*"). *Emphasis in original.* See also DEIR at 3.3-17; 3.3-30; 3.6-14; 3.6-28.

[14] See ARB "AB 32 Scoping Plan" (http://www.arb.ca.gov/cc/scopingplan/scopingplan.htm).

industrial facilities to continue or even increase GHG emissions in Richmond by obtaining "emission credits" that represent promises to reduce emissions elsewhere.[15] Because oil infrastructure is more deeply entrenched than other major emitters, the emission credits are *expected* to flow from other sectors to oil, according to ARB's own technical advisors from the University of California, resulting in continued or increased emissions from oil infrastructure.[16]

Second, on April 23, 2009 ARB adopted California's Low Carbon Fuel Standard (LCFS). ARB's LCFS sets standards that apply a single statewide average emission rate to direct emissions from each refinery in the state.[17] The LCFS thus does not measure changes in direct emissions from individual refineries and therefore fails to control them. Therefore, ARB's requirements would control direct GHG emissions from refineries through its cap–and–trade scheme, which allows refineries to obtain emission credits.

These AB 32 and LCFS requirements are the only regional, state or federal GHG control requirements applicable to industrial sources in Richmond adopted to date.[18] Despite evidence that crude oil quality is the dominant driver of emissions from refinery fuel combustion[19] and the worsening quality of refinery crude inputs[20] nationwide, there is no regional, state or federal monitoring of, or direct limit on, this cause of substantially increasing emissions.

In sum: ARB plans to address industrial emissions in a way that allows industrial emitters to continue or increase emissions if they obtain emission credits. Refiners are expected to obtain the credits from other business sectors.[21] Separately, emissions from refineries regionally,[22] and industrial/commercial sources in Richmond,[23] are projected to increase.

Information that the DEIR omits suggests the need to continue or expand the City's use of industrial land use authority in order to meet the Project's emission reduction goal.

---

[15] See e.g., ARB, 2011. Emissions Trading Program Overview. Air Resources Board website (www.arb.ca.gov/cc/capandtrade/capandtrade.htm). Downloaded March 14, 2001. See esp. Major program elements: Scope (~350 businesses totaling 600 facilities included), Offsets (includes forestry, livestock management, and ozone-depleting substance removal now; may expand internationally), and Linkage to Other Greenhouse Gas Emissions Trading Schemes (intended to expand beyond California to other western U.S. states; may expand to New Mexico and Canada).

[16] Farrell et al. *A low-carbon fuel standard for California, part 1: Technical analysis;* UCD-ITS-RR-07-07; University of California, Institute of Transportation Studies: Davis, CA, 2007; http://pubs.its.ucdavis.edu/publication_detail.php?id=1082. See pages 22, 23.

[17] ARB Resolution 09–31; CCR §95486, esp. (b)(1) references (A) and (C) and tables 6 and 7.

[18] SB 1368 (2006) is not applicable here: there are no coal-fired power plants in Richmond.

[19] See Karras, 2010. *Env. Sci. Technol.* 44(24): 9584–9589. DOI: 10.1021/es1019965.

[20] Energy Information Administration (www.eia.gov/dnav/pet/pet_pnp_crq_dcu_nus_a.htm).

[21] Farrell et al., 2007. (UCD-ITS-RR-07-07) as referenced above. See page 23.

[22] Framework at 65 (52% increase in Bay Area refinery emissions from 2005–2020 in Table 31).

[23] City of Richmond *2005 Greenhouse Gas Emission Inventory* at 19 (31.9% increase in commercial/industrial GHG emissions projected from 2005–2020 in Table 19).

2. Project-related industrial emissions could cause significant potential air quality and climate impacts that the DEIR fails to identify, analyze, lessen or avoid.

Increasing industrial emissions are reasonably foreseeable in Richmond as a result of the Project. Refinery emissions and industrial/commercial emissions of greenhouse gases (GHG) have been increasing (Framework at 29, 65). The City projects that without additional action these refinery and industrial/commercial emissions will continue to increase (Framework at 29, 65; Inventory at 19). This would be allowed by the state's "cap–and–trade" pollution trading scheme, so long as local polluters obtain "credits" that promise to reduce emissions elsewhere, and refineries are expected to obtain these emission credits.[24] Continued reliance on oil could continue the trend of refining heavier, higher-sulfur crude[25] that is replacing limited conventional oil[26] with vast heavy oil and tar sands resources,[27] which burn more fuel in processing and could—by 2030—increase refinery emissions dramatically.[28]

Crucially important for environmental health and justice, these emissions include GHG and GHG "copollutants." The fact that burning fossil fuels emits toxic and smog-forming combustion products along with carbon dioxide (CO_2) is beyond reasonable dispute. Thus, the covariance of GHG and copollutant emissions is shown by the dominance of CO_2 by mass among GHG emissions from refineries (>99%) and regionally (92%).[29] Combustion emissions from the refinery and port are linked to disparately high GHG-copollutant exposures in Richmond, including health-threatening exposures to fine particulate matter,[30] the major cause of air pollution-related health risk regionally.[31] Therefore, increasing GHG emissions in Richmond could worsen disparately high environmental health risks in Richmond.

However, the DEIR assesses air quality impacts based on its analysis that quantifies potential future emissions solely from increased vehicle-miles-traveled (VMT), which, it estimates, will increase 50.1% by 2030.[32] This assumes that only vehicle tailpipe emissions will increase. The DEIR's air quality analysis omits readily available information to estimate post-Project industrial emissions—including the City's own projections cited above. By estimating potential emissions based solely on one source category (transportation) that accounts for less than 10% of emissions (Inventory at 10), the DEIR underestimates potential air quality impacts in Richmond drastically.

---

[24] Farrell et al., 2007. (UCD-ITS-RR-07-07) as referenced above.

[25] *US Refinery Crude Input Qualities.* EIA (www.eia.gov/nav/pet/pet_pnp_crq_dcu_nus_a.htm).

[26] Kerr, 2009. *Science* 326: 1048.

[27] Meyer et al., 2007. (http://pubs.usgs.gov/of/2007/1084/) as referenced above.

[28] Karras, 2010. (DOI: 10.1021/es1019965) as referenced above.

[29] See SI Table S7 in Karras (2010) as referenced above; AQMD, 2010 as referenced above.

[30] Brody et al., 2009. *Am J Public Health* 2009(99): S600–S609. 10.2105/AJPH.2008.149088; Pastor et al., 2010. *Minding the Climate Gap: what's at stake if California's climate law isn't done right and right away.* USC Program for Environmental and Regional Equity: Los Angeles, CA (http://college.usc.edu/pere/publications).

[31] See AQMD's 2010 Clean Air Plan at ES-4.

[32] DEIR at 3.3-12; 3.3-18 (VMT increase from 1,668,000 now to 2,503,000 in 2030); 3.3-25.

Figure 2 shows three projections of the reasonably foreseeable emissions increase resulting from the Project. Its caption documents the projections and shows that, with one exception discussed below, they are based on the City's data. The projections are very different because one of them (DEIR) excludes the potential for industrial emissions to increase, and one (Oil Quality) includes the potential effects of continued reliance on oil of ever-worsening quality through 2030.

Note that the comparison in Figure 2 isolates the effect of ignoring the potential for industrial emissions to increase in a way that tends to minimize the DEIR error: the DEIR air quality analysis projection (2030-A) assumes no mitigation; the Inventory (2030-B) and Oil Quality (2030-C) projections assume the DEIR's mitigation. The Oil Quality projection also assumes no change in the volume of oil refined (it assumes no growth % for the refinery). Note also that the Inventory and Oil Quality projections should be interpreted as bounding a reasonably foreseeable range of emissions resulting from the Project, assuming other levels of government continue to allow locally increased industrial emissions through pollution trading.

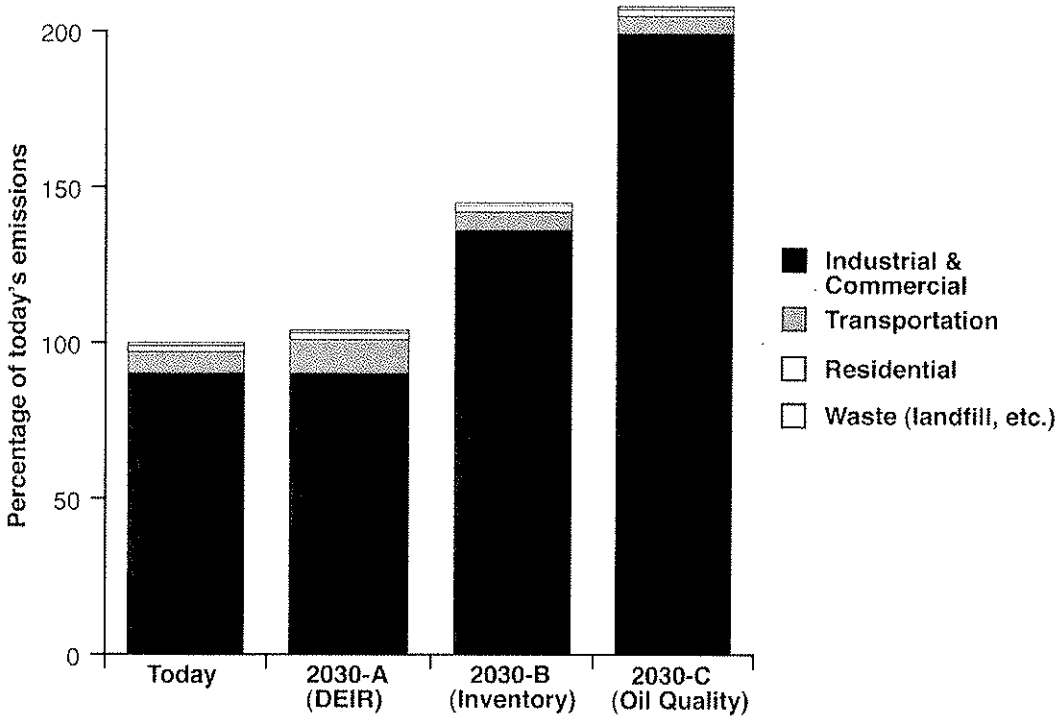

Figure 2. Three projections of post-project emission potential in 2030, Richmond, CA. ***Today:*** Current pre-project emissions from Figure 1. ***2030-A:*** DEIR air quality analysis projection; assumes only transportation emissions increase from a 50.1% increase in VMT; no change in vehicle fuels, efficiency or emission control. ***2030-B:*** City 2005 Inventory projection; assumes annual % growth from Inventory Table 19 and emission mitigation (difference of EIR tables 3.6-1, 3.6-2) for each sector. ***2030-C:*** Oil quality change projection; identical to 2030-B except for refining; assumes no Inventory growth % for refining; assumes refinery emissions consistent with nationwide industry observations from Karras (2010) for a year-2030 crude input that is 50% heavy oil and 50% natural bitumen.

Projections 2030-B and 2030-C describe the potential future emissions range because of uncertainty about future industrial emissions, which drive changes in Richmond's total emissions; and more specifically, uncertainty about the quality of crude refined, the major driver of changes in refinery combustion emissions. The Inventory projection (2030-B) may underestimate potential emissions because it assumes no worsening of crude quality through 2030, which may be unrealistic given the global trend in oil quality discussed above. The Oil Quality projection (2030-C) is based on peer reviewed evidence for the average increase in refinery fuel combustion and resultant CO_2 emissions derived from observations across 97% of the U.S. refining industry over ten years, assuming no other relevant change in circumstances.[33] Since crude feed quality drives refinery emissions, the major uncertainty in this projection involves the assumption of future crude quality. If the refinery crude feed does not become as heavy or high in sulfur as the 50% heavy oil, 50% tar sands feed[34] this projection assumes by 2030, projection 2030-C may overestimate potential emissions.

The DEIR's use of air quality thresholds based solely on local tailpipe emissions[35] is inappropriate for analysis of air quality impacts in Richmond. As Figure 2 illustrates, the DEIR's analysis based on a +50.1% increase in VMT would change total emissions in Richmond very little (+4%) while the Project's proposal to weaken industrial land use requirements could result in greater future industrial emissions that increase total emissions in Richmond dramatically (+45% to +108%). This analysis shows that the DEIR could have estimated potential future industrial emissions, and, had it done so, could have found that the air quality impacts resulting from Project industrial emissions would be significant. However, having failed to identify and describe that proposal, the DEIR does not analyze the potential air quality impacts that could result from this aspect of the Project.

Indirect emissions will add to these increased direct emissions over time. Replacement or expansion of long-lived fossil energy infrastructure that could be allowed by the Project would commit us to new emissions for decades.[36] For example, a major equipment replacement or expansion project is foreseeable at the Richmond refinery.[37] Since the

---

[33] Karras, 2007. (DOI: 10.1021/es1019965) as referenced above. Relevant changes in circumstances that may affect this estimate (other than crude density and sulfur) include unanticipated significant changes in: the product slate; the fuel mix; the balance of carbon rejection and hydrogen addition technologies; equipment or catalyst efficiency via modernization; the portion of anomalous oils or synthetic crude oil (SCO) in the crude feed.

[34] This feed would have a density of 995.5 kg/m^3 and be 3.68% sulfur by weight, based on the average heavy oil and natural bitumen qualities reported by Meyer et al. (2007).

[35] DEIR at 3.3-12 through 3.3-16; 3.3-18; 3.3-25; 3.3-26.

[36] Davis et al., 2010. (DOI: 10.1126/science.1188566) as referenced above.

[37] See: Chevron Corp (CVX) 10-K Annual report pursuant to section 13 and 15(d) filed on 2/24/2001 with the Securities and Exchange Commission at 26, 36, FS-61 (stating that the company is considering its options regarding proceeding with a previously-proposed major refinery expansion project in some form); City Staff Agenda Report, Chevron Renewal Project Application, March 1 2011 Council Meeting (recommending that the City Council adopt a resolution encouraging the project application to proceed).

emissions and their impacts are cumulative over time,[38] prolonging them over time would increase cumulative pollution and climate impacts. Indirect impact analysis is especially important for oil. Petroleum is the biggest GHG emitter among primary energy sources in California and in the U.S., and petroleum-fueled transport is the biggest emitter among energy end uses statewide and in the U.S.[39] Among regional producers of those transport fuels, the largest refinery in northern California is the Richmond refinery.[40] However, despite the City's admission that GHG emissions analysis should account for emissions "that occur as a result of activities that take place within the geopolitical boundary of the local government, but that occur at sources outside" Richmond,[41] the DEIR ignores indirect emissions from the refinery (3.6-11 through 3.6-13).

A substantial body of scientific work demonstrates the interdependence of refining with each step in the petroleum fuel cycle and quantifies GHG emissions from well to wheel, at each step from oil extraction to the vehicle tailpipe.[42] The City could have used this readily available information to estimate indirect emissions from the Richmond refinery. For example, the City could have used ARB's statewide average percentage of fuel cycle emissions from refineries for gasoline (14.43%) and diesel (12.11%),[43] the California Energy Commission's statewide average refinery gasoline and diesel outputs,[44] and direct refinery GHG emissions[45] to estimate indirect emissions. Had it done so, the DEIR could have estimated fuel cycle emissions of roughly 33.0 Mt/y and indirect emissions of roughly 28.5 Mt/yr associated with Richmond refinery activities.[46] These indirect emissions would add to the potential direct emissions discussed above. The City could improve on this rough estimate using refinery-specific products data and estimates for potential extraction of future heavier and more viscous oils, and it should be noted that those extraction estimates would likely increase estimated indirect emissions.

---

[38] Meinshausen et al. (2009) as referenced above; Allen et al., 2009. *Nature* 458: 1163–1166. DOI: 10.1038/nature08019 (total mass of CO_2 emitted drives peak and average climate impacts).
[39] *Annual Energy Outlook 2010,* U.S. Energy Information Administration, App., table A18, A19; *California Greenhouse Gas Inventory for 2000–2008,* Air Resources Board, 2010; DEIR at 3.6-6.
[40] *Oil & Gas Journal* Worldwide Refining Survey–2009 (30% of crude charged in N. California).
[41] City of Richmond *2005 Greenhouse Gas Emissions Inventory* at 7.
[42] See: Wang et al., 2004. *Int. J. Life Cycle Assess.* 9(1): 34-44; Brandt and Farrell (2007) as referenced above; Skone and Gerdes, 2008. *Development of baseline data and analysis of life cycle greenhouse gas emissions of petroleum-based fuels,* U.S. DOE. DOE/NETL-2009/1346; Gerdes and Skone, 2009. *An evaluation of the extraction, transport and refining of imported crude oils and the impact on life cycle greenhouse gas emissions,* U.S. DOE. DOE/NETL-2009/1362; Karras (2010) as referenced above; *Detailed CA-GREET pathway for California reformulated gasoline blendstock for oxygenate blending (CARBOB) from average crude refined in California, Version 2.1,* ARB, 2009; *Detailed CA-GREET pathway for ultra low sulfur diesel (ULSD) from average crude refined in California, Version 2.1,* ARB, 2009.
[43] See ARB (2009) Detailed CA-GREET pathways (CARBOB and ULSD) as referenced above.
[44] *Input & Output at California Refineries,* California Energy Commission, 2011 (gasoline/diesel ratio of 2.15 on an energy basis from 2007 and 2008 outputs of RBOB and distillate < 15 ppm).
[45] ARB, 2010. *Mandatory GHG Reporting Data.* See emissions reported for calendar year 2009.
[46] From data noted above and: (0.1443 x 2.15/3.15) + (0.1211 x 1/3.15) = 13.69% of fuel cycle emitted by refining (gasoline & diesel); and 4.52/0.1369 = 33.0 Mt/yr as fuel cycle emissions.

These indirect emissions represent roughly 80% of total (direct and indirect) emissions associated with activities in Richmond. Thus, the commitment to future emissions for decades noted in the climate literature cited above clearly applies to the prospect of expanding or replacing long-lived fossil infrastructure in Richmond. Locking these refinery fuel cycle emissions into place for decades would make the deep emissions cuts needed to protect climate even more difficult for other sources to achieve, and—if the targets could still be achieved—continuing refinery fuel cycle emissions of 33 Mt/y would represent more than one-third of total statewide GHG emissions by 2050.[47]

Air quality impacts of these emissions could be substantial. For example, particulate matter emissions generally increase with the increasing fuel combustion that would drive GHG emission increases in Richmond, as discussed above. Fine particulate matter concentrations associated with fuel combustion at the Richmond refinery and port are disparately high in the air outside Richmond homes and even higher inside Richmond homes, where $PM_{2.5}$ exceeds the state's ambient air standard in nearly half the homes sampled.[48] Further, $PM_{2.5}$ already dominates high *regional* air pollutant health risks.[49] Thus, potential air quality impacts resulting from Project industrial emissions can be considered significant.

Climate impacts from "business as usual" scenarios, as listed in the DEIR, could be catastrophic, and the Project's potential contribution to these impacts could be substantial as documented above. Unfortunately, the DEIR's general description of Richmond as "well situated" to weather climate change omits potential food security impacts for which Richmond is not well situated. Very little of the food consumed in Richmond is grown here; most foods are imported from hundreds or thousands of miles away; this global food market makes Richmond residents vulnerable to potential food supply and price disruptions. Climate disruption is likely to cause such food supply and price disruptions. The probability that climate change will cause unprecedented crop failures on multiple continents simultaneously may reach 90% by the end of this century.[50] Thus, global *and* local climate impacts resulting from the Project can be considered significant.

Cumulative impacts would result from these air quality and climate impacts locally. In addition to the physical facts of combined increases in CO_2 and toxic copollutant emissions, and simultaneous exposure to resultant air quality, flooding, and food security risks, *Perera* notes that climate change could increase childhood asthma risks by increasing both smog formation and pollen exposures.[51] Since these potential air quality and climate impacts could be significant individually, their cumulative or combined impacts could be significant. The DEIR does not identify or analyze the potential cumulative impacts of combined exposures to these risks on local community health.

---

[47] ~80 Mt/y, based on the targeted -80% from 1990 levels, which are approximately 20% below total statewide emissions of 473.76 Mt/y in 2008 as reported ARB's Inventory referenced above.

[48] Brody et al., 2009 (10.2105/AJPH.2008.149088) as referenced above; Pastor et al., 2010. (http://college.usc.edu/pere/publications) as referenced above.

[49] See AQMD's 2010 Clean Air Plan at ES-4.

[50] Battisti and Naylor, 2009. *Science* 323: 240–244. DOI: 10.1126/science.1164363.

[51] Perera, 2008. *Env. Health Perspectives* 116(8): 987–990. DOI: 10.1289/ehp.11173.

No mitigation or alternative addressing these potential industrial pollution impacts is identified, analyzed, or proposed in the DEIR (See eg., DEIR Table ES-2, 5.3, 5.4). The DEIR thus ignores substantial evidence that industrial emission reductions are feasible.

Industrial equipment designs have become more efficient (less fuel intensive) and leak resistant during the decades long service life of existing, aging equipment: equipment replacement can thus reduce emissions by reducing fossil fuel combustion and fugitive leaks. The lower-emitting replacement technology available for the currently proposed Chevron Tanks Replacement project[52] is an example of this feasible option.

Intrinsically less carbon-intensive, less emission-intensive fuels and feedstocks lower or eliminate emissions. Even industrial uses that cannot yet switch to 100% renewable fuels can often partially repower with such zero-emission fuels and less carbon-intensive fossil fuels or feedstocks. Grid purchases favoring renewable electricity resources while avoiding coal (see e.g., SB 1368), and relatively lighter and lower-sulfur crude feedstock,[53] are examples of this feasible emissions reduction measure.

By increasing passengers-per-vehicle, expanding public transit reduces fuel use in both vehicles and refineries through conservation, making transportation both less costly and less polluting. The vast technical capacity for quickly expanding public transit can thus curb emissions while freeing up money for the new energy system that replaces fossil energy. It could slow emission impacts while conserving resources needed to build the new infrastructure that lights our homes and powers our cars with renewable energy.

It is technically feasible to light our buildings and power our transportation system with wind, solar photovoltaic, and concentrating solar energy—with minimal "baseload" operation of existing fossil power plants for nighttime lighting until renewable energy storage "batteries" are developed and deployed. Technology to accomplish this is available now.[54] Comparisons of societal costs indicate it is more cost effective than continued reliance on fossil fuels.[55] The barrier is the relative cost of renewable resources, which is largely driven by "perverse" incentives: fossil fuel subsidies much greater than renewable energy subsidies.[56] Land use requirements could leverage the unique values of industrial land in Richmond to overcome this barrier *and* leverage "green" investment locally. The tenfold greater employment per dollar for all sectors in the general economy than that of oil refining[57] points to a dramatic potential for local economic benefits—which may drive and accelerate the implementation of these measures once they are adopted and those benefits begin to be realized.

---

[52] *Comments of Communities for a Better Environment (CBE) and West County Toxics Coalition (WCTC) on the Proposed Chevron Tank Replacements, Project No. PLN10-179.* 2/18/2011.

[53] Karras, 2010. (DOI: 10.1021/es1019965) as referenced above.

[54] See e.g., Hoffert (2010) as referenced above (solar PV power ~10–15¢/kWh with extensive development "scale up" totaling >10–100 Gigawatts peak power); and Farrell et al., 2007 as referenced above at 106–107 (electric vehicles cost-effective at today's gas prices).

[55] See e.g., Perera, 2008. *Env. Health Perspectives* 116(8): 987–990. DOI: 10.1289/ehp.11173.

[56] See e.g., Hoffert, 2010. (DOI: 10.1126/science.1195449) as referenced above.

[57] See U.S. Economic Census: employment vs annual sales, shipments, receipts or revenue data.

Based on this information, it would be technically and economically feasible[58] to implement a policy, set of goals, and plan that achieves the following results locally:

Integrated plan

- A planned, coordinated transition from fossil energy production and use toward a new energy system that provides for light, power and transportation using a portfolio of renewable energy sources, and leverages investments preferentially in Richmond.

Major industrial/commercial construction/reconstruction requirements

- Replace old and outdated equipment with efficient least-emitting equipment.
- Demonstrate maximum feasible energy efficiency (minimum fuel energy burned/unit production or other relevant activity) for fossil fueled uses.
- Prohibit reduced efficiency (increased fuel energy burned/per unit production or other relevant activity) by existing fossil fueled uses.
- Demonstrate minimum feasible carbon intensity (intrinsic emission intensity) of fuels and feedstocks.
- Prohibit increased carbon intensity (intrinsic emission intensity) of fuels and feedstocks by existing fossil fueled uses.
- Demonstrate financial support for public transit access to serve 100% of direct and indirect transportation needs associated with major industrial/commercial uses.
- Prohibit use of emission credits or offsets related to emission reductions outside of Richmond for projects in Richmond (in order to ensure that pollution trading will not cause increased emissions locally and that benefits of regional, state and federal emission requirements applied in Richmond will accrue in Richmond).

In addition to suggesting a specific solution to the problems discussed above, these feasible measures show that, had the DEIR analyzed potential industrial emission impacts, it could have found ways to lessen or avoid them.

Unfortunately, having failed to identify or describe potential impacts of industrial emissions that could result from the Project, the DEIR fails to analyze them. The DEIR then fails to mitigate these potential impacts or analyze appropriate alternatives that could lessen or avoid these potential impacts.

---

[58] Note that community participation and consent may be critically important factors in the political feasibility of local plans for energy transition, however; political feasibility is not addressed in this technical review. Note also that this partial list of feasible measures is focused on the industrial component of the energy and emissions problem, and is not meant to be comprehensive.

3. The finding that air quality and climate impacts are unavoidable is incorrect.

The DEIR concludes that significant potential air quality and climate impacts from Project-related increases in emissions are unavoidable (3.3-17; 3.3-21; 3.3-24; 3.6-14; 3.6-28; 4-1; 4-2; 4-3). This conclusion lacks any evidentiary support because the DEIR did not analyze mitigation or alternatives that could lessen or avoid larger changes in the cause of impact (combustion emissions of GHG and copollutants) from industrial sources in the same location (Richmond).

GHG and copollutant emissions from industrial sources could decrease if the feasible measures identified at the end of the previous section are adopted. An example of this is documented in Table 1. Note that, although the exact covariance of GHG and copollutant emissions can change with changes in fuels, combustion conditions and abatement, this uncertainty is limited for the scenarios shown in Table 1 because differences among these scenarios are driven by refinery emissions. The GHG emission/copollutant exposure link is strong for refinery emissions in Richmond, as shown in section 2 of this report.

The equipment replacement, fuel efficiency, fuel and feedstock, conservation, and partial repowering with renewables measures in the previous section would support Richmond refinery emission reductions consistent with ARB's AB 32 "cap." Requiring the refinery to comply with ARB's cap without using pollution trading "credits" would result in a 1.7 Mt/yr (37%) reduction in its emissions by 2030. Those measures at the refinery alone would overwhelm the City's projected increases in emissions from all other sources, causing total emissions of GHG and copollutants to *decrease*. Therefore, since feasible measures can avoid the potential emissions increase causing the impacts, the DEIR's finding that these impacts are unavoidable is demonstrably incorrect.

Table 1. Comparison of unmitigated EIR scenarios with on-site compliance with AB 32 by the Richmond refinery, emissions in 2030 within Richmond, CA

Scenario	Emissions by sector, Megatons per year (Mt/y)				Total (Mt/y)
	Industrial/ Commercial	Transpor-tation	Resid-dential	Waste & Landfill	
Emissions today[a]	6.14	0.51	0.13	0.08	**6.86**
DEIR–GHG[b]	9.74	0.76	0.15	0.07	**10.72**
DEIR-Air Quality[c]	6.14	0.76	0.13	0.07	**7.11**
Refinery–2030[d]	5.41	0.76	0.15	0.07	**6.39**

[a] Current emissions as shown and documented in Figure 1 of this report.
[b] City 2005 Inventory projection: assumes annual % growth from Inventory Table 19 without mitigation.
[c] DEIR air quality analysis projection: assumes only transportation emissions increase from a 50.1% increase in VMT with no change in fuels, efficiency, emission control or other mitigation.
[d] Assumes refinery emissions decrease by the amount targeted by ARB's AB 32 statewide emissions cap: emissions reduced by 15% (–15%) by 2020 followed by –3%/yr thereafter; all other industrial, commercial, residential and waste emissions increase as in the GHG–2030 scenario (note b).

The documents identified in the "Attachments list" appended to this report were copied, in portable document file (PDF) format, to a compact disk submitted with 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 17 day of March, 2011 at Oakland, California.

Greg Karras

Attachments list

1. Curriculum vitae and list of publications, Greg Karras.
2. Allen et al. 2009. Warming caused by the cumulative carbon emissions towards the trillionth tonne. *Nature* 458: 1163–1166.
3. AQMD, 2008. *Chevron–Richmond Refinery Proposed Energy and Hydrogen Renewal Project: Findings and Supporting Facts Regarding the Environmental Impact Report.*
4. AQMD, 2010. *Source Inventory of Bay Area Greenhouse Gas Emissions.* Bay Area Air Quality Management District (AQMD). Updated: February 2010.
5. ARB, 2009. *Mandatory GHG Reporting Data.* California Air Resources Board. Emissions reported for calendar year 2008.
6. ARB, 2009. *Detailed CA-GREET pathway for California reformulated gasoline blendstock for oxygenate blending (CARBOB) from average crude refined in California, Version 2.1.* Air Resources Board.
7. ARB, 2009. *Detailed CA-GREET pathway for ultra low sulfur diesel (ULSD) from average crude refined in California, Version 2.1.* Air Resources Board.
8. ARB, 2010. *Mandatory GHG Reporting Data.* California Air Resources Board. Emissions reported for calendar year 2009. Total emissions: Chevron Products Company–Richmond Refinery.
9. ARB, 2010. *California Greenhouse Gas Inventory for 2000–2008,* Air Resources Board.
10. Battisti and Naylor. 2009. Historical warnings of future food security with unprecedented seasonal heat. *Science* 323: 240–244. DOI: 10.1126/science.1164363.
11. Brandt and Farrell, 2007. Scraping the bottom of the barrel: greenhouse gas emission consequences of a transition to low-quality and synthetic petroleum resources. *Climatic Change* 84: 241–263.
12. Brody et al., 2009. Linking exposure assessment science with policy objectives for environmental justice and breast cancer advocacy: The northern California household exposure study. *Am J Public Health* 2009(99): S600–S609.
13. CEC, 2011. *Input & Output at California Refineries,* California Energy Commission.
14. Davis et al., 2010. Future CO_2 emissions and climate change from existing energy infrastructure. *Science* 329: 1330–1333.
15. Farrell et al., 2007. *A low-carbon fuel standard for California, part 1: Technical analysis;* UCD-ITS-RR-07-07; University of California, Institute of Transportation Studies: Davis, CA.

16. Gerdes and Skone. 2009. *An evaluation of the extraction, transport and refining of imported crude oils and the impact on life cycle greenhouse gas emissions,* U.S. DOE. DOE/NETL-2009/1362.

17. Hoffert et al., 2002. Advanced technology paths to global climate stability: Energy for a greenhouse planet. *Science* 298: 981–987.

18. Hoffert, 2010. Farewell to fossil fuels? *Science* 329: 1292–1294.

19. Karras, 2010. Combustion emissions from refining lower quality oil: What is the global warming potential? *Env. Sci. Technol.* 44(24): 9584–9589.

20. Kerr, 2009. Splitting the difference between oil pessimists and optimists. *Science* 326: 1048.

21. Meinshausen et al., 2009. Greenhouse-gas emission targets for limiting golbal warming to 2° C. *Nature* 458: 1158–1162.

22. Meyer et al., 2007. *Heavy oil and natural bitumen resources in geologic basins of the world.* U.S. Geological Survey Open-File Report 2007-1084 (http://pubs.usgs.gov/of/2007/1084/.

23. Pastor et al., 2010. *Minding the Climate Gap:what's at stake if California's climate law isn't done right and right away.* USC Program for Environmental and Regional Equity: Los Angeles, CA.

24. Perera, F. P. 2008. Children are likely to suffer most from our fossil fuel addiction. *Env. Health Perspectives* 116(8): 987–990. DOI: 10.1289/ehp.11173.

25. Skone and Gerdes. 2008. *Development of baseline data and analysis of life cycle greenhouse gas emissions of petroleum-based fuels,* U.S. DOE. DOE/NETL-2009/1346.

26. U.S. Energy Information Administration, 2010. *Annual Energy Outlook 2010; Appendixes.* Includes Table A18, *Carbon dioxide emissions by sector and source,* and Table A19, *Energy-related carbon dioxide emissions by end use.*

27. U.S. Energy Information Administration, 2010. *Crude oil input qualities.* Downloaded from www.eia.gov/dnav/pet/pet_pnp_crq_dcu_nus_a.htm; release date: 7/29/2010.

28. Wang et al. 2004. Allocation of energy use in petroleum refineries to petroleum products: Implications for life-cycle energy use and emission inventory of petroleum transportation fuels. *Int. J. Life Cycle Assess.* 9(1): 34-44.

29. Worldwide Refining Survey–2009. *Oil & Gas Journal* Koottungal, L., Ed. Figures as of 1 January 2010.