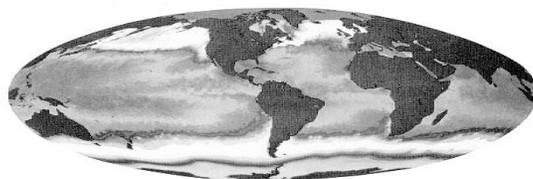


Venoco Paredon Oil & Gas Project: GHG Emissions



Richard Heede
Climate Mitigation Services
28 April 2008



Climate Mitigation Services

Principal Investigator: Richard Heede
heede@climatemitigation.com
1626 Gateway Road
Snowmass, CO 81654 USA
970-927-9511 office
970-343-0707 mobile

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Report commissioned by Environmental Defense Center
Santa Barbara, California
www.edcnet.org
805-963-1622
Linda Krop, Chief Counsel

Note on units: English units are used throughout this report, e.g., gas production in billion cubic feet (Bcf), fuel consumption in gallons, methane in tons. All emissions estimates are also converted to metric tonnes in the attached worksheets. One metric tonne = 1.1023 short tons. Methane is expressed in CO₂equivalent terms (CO₂e) at 21xCO₂.



Cover: image of the Paredon project gas fields and part of the pipeline route along the coast, DEIR.

Venoco Paredon Project: Estimated GHG Emissions & FEIR Review

To: Dave Durlflinger
City Manager
City of Carpinteria
5775 Carpinteria Avenue
Carpinteria, California 93103

Re: *Proposed Final Environmental Impact Report on the Venoco Paredon Project*

This report summarizes an analysis of greenhouse gas emissions arising from the Venoco Paredon oil and gas project based on a review of the *Proposed Final Environmental Impact Report on the Venoco Paredon Project* submitted by Marine Research Specialists (MRS) on behalf of the City of Carpinteria's Dept of Community Development in March 2008.

Climate Mitigation Services (CMS) was commissioned by the Environmental Defense Center to review the climate change sections of the *Proposed Final Environmental Impact Report (FEIR)*. CMS reviewed the emissions calculations in the FEIR and comments herein on the report's shortcomings with respect to project-related emissions of greenhouse gases. This author is not opposed to crude oil or natural gas production in Carpinteria. In fact, conscientious and careful fossil fuel production is better done locally than elsewhere with lax oversight, environmental controls, and concern for human health and that might involve trans-Pacific shipping. What this author does require in an EIR is clear and complete identification and quantification of sources of emissions for every stage of project development, the impacts of those emissions, and plans for mitigating those impacts.

With respect to the greenhouse gas section of the FEIR none of these requirements were met.

Figure 1. Location of the Paredon project and the underlying oil and gas fields



CMS has reviewed and — in some cases, corrected — the FEIR emissions estimates from project construction, drilling, and operation. While the FEIR does estimate emissions from both oil and gas end-use consumption and combustion, MRS considers combustion emissions from

the project's marketed production to be beyond the scope of their emission estimate since "the consumption of these refined products ... is not a function of the source of the gas or crude oil supply" (FEIR, page 4.2-52). This interpretation of what constitutes greenhouse gases emissions arising from a proposed energy project is flawed and runs counter to the State of California's binding efforts to reduce emissions. It is important for an environmental impact report to clearly identify and quantify sources of emissions arising from the project without regard to potential displacement of carbon fuels from other California or international sources. The FEIR argument is flawed in this regard, and CMS has attempted to remedy this oversight.

PAREDON OIL & GAS PROJECT EMISSIONS OF GREENHOUSE GASES.

The CMS analysis identifies and quantifies all significant sources of greenhouse gas emissions inherently attributable to Paredon's exploration, drilling, production, processing, and delivery of natural gas to The Gas Company and crude oil to refineries in the Los Angeles Basin. Energy-related combustion and process emissions across the supply chain are thus within the boundary.¹ The chain ends with the combustion of the delivered gas and petroleum products by California consumers. The inventoried gases include carbon dioxide and methane from combustion sources, process emissions, and fugitive sources. Both the CMS and FEIR analyses include direct (on-site) and indirect (off-site) emission sources. CMS relies on quantitative information developed by MRS for the FEIR, such as diesel, natural gas, and electricity consumption data. CMS recalculated most of the emissions estimates in the FEIR. A few — such as the fuel combusted in on-site diesel trucks — are quantitatively similar.

Electricity demand. In estimating emissions from electricity usage from Southern California Edison (SCE), CMS took the FEIR estimated demand data (43,800 MWh/yr), but applied the SCE emission rate published in EPA's eGRID database of 752 lb CO₂ per MWh generated.² The FEIR, for reasons that are not clear, instead uses the Cal-ISO emission rate of 687 lb CO₂/MWh. In addition, since the SCE emission rate is based on electricity *generation*, CMS conservatively applies a 6 percent transmission and distribution loss factor in order to estimate emissions per *delivered* MWh of electricity. The final SCE emission rate is 800 lb CO₂/MWh and results in electricity-related emissions that are 2,473 tons CO₂ or 16 percent higher than the FEIR estimate.

Diesel fuel in on-site trucks & equipment, and gasoline for commuting. The FEIR estimates of emissions from combustion of diesel fuel are higher than the CMS estimates (by applying higher methane and nitrous oxide factors per gallon), even though the FEIR also misapplies an emission factor of 10.7 tons CO₂ per 1,000 gallons when the correct factor is 11.2 tons CO₂ per 1,000 gallons. Finally, CMS includes emissions from Paredon employees commuting to work at the facility, even though the FEIR excludes the source by stating that such emissions should not be attributed to Paredon inasmuch as 'commuter emissions do not have to be offset' (IST-37) and "because these vehicle trips would occur whether the CPF was operational and existed or not

¹ Emissions from the materials embodied in the supply chain, such as the thousands of tons of steel built into drilling rigs, crude oil storage tanks, compressors, waste water tanks, and other new capital equipment are not included. Emissions from cement manufacture, or transportation of construction materials from site of manufacture to Paredon are excluded. Nor does CMS include emissions from engineering and design services, site visits, and the extensive DEIR and FEIR process, which are relatively minor and typically put outside the inventory boundary. Note: the FEIR does include diesel fuel consumed in local and on-site trucks and equipment.

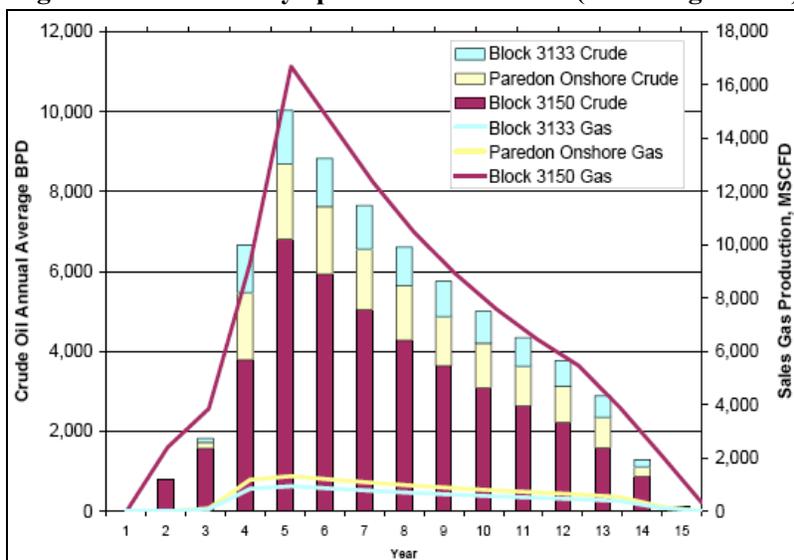
² US Environmental Protection Agency (2007) *eGRID: Emissions & Generation Resource Integrated Database*, www.epa.gov/cleanenergy/egrid/index.html

(the employees would obtain employment somewhere else and need to commute to the other job, too)” (FEIR p. 4.2-46). CMS finds this argument specious. Also, the estimated 2,000 gallons appears much too low, but CMS has been unable to find the calculation details (2,000 gallons corresponds to ~6 commuter vehicles/year). Note: see the caption to Table 1.

Emissions from combustion of marketed oil and natural gas. CMS first had to estimate product sales from scant data in the FEIR. CMS used FEIR Figure 2-9 (since no table of oil and gas production per year is shown) to estimate sales data for natural gas and crude oil over the anticipated 15-year duration of the Paredon field development. Details are shown in the attached worksheet Tables 6 and 7. CMS’s estimate concurs with the FEIR that 43 Bcf will be produced and marketed (shown as “sales gas production” in Figure 2), which averages 2.87 Bcf per year over the 15-year project duration.³ Similarly, CMS and the FEIR estimate crude production of 23.5 million bbl, averaging 1.57 million bbl per year. The CMS worksheet shows estimated production from years 2 through 15 as well as associated methane emissions and carbon dioxide emissions from the marketed fuels; resulting annual emissions are shown in Figure 6.

CMS reduces emissions from marketed crude oil by accounting for non-fuel use of 8.6 percent of crude oil deliveries. See worksheet Table 7 for details.

Figure 2. Paredon 15-yr production schedule (FEIR Figure 2-9)



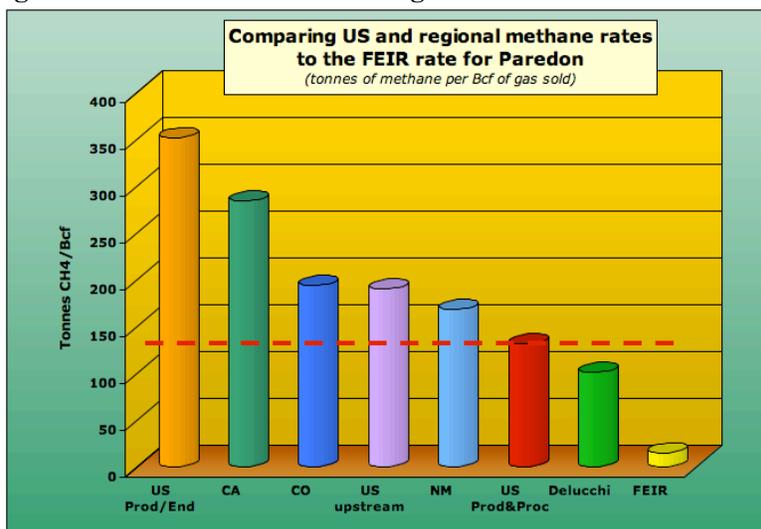
Refinery and transportation emissions, “wells to wheels.” CMS calculates emissions from energy inputs — such as steam, natural gas, petroleum coke, and natural gas — at refineries or in transporting the products by pipeline or tanker trucks. (Note: The FEIR notes that “GHG emissions associated with refining would increase these emissions by an estimated 13-17 %.”) CMS has reviewed several studies of fuel cycle energy inputs and emissions from refinery and processing operations, computed the added emissions as a percent of the CO₂ emissions from product end use, and added the average fuel cycle emissions (20.7 percent) to the crude oil shipped to refineries *after* deducting for non-fuel uses.

³ The FEIR is unclear about the disposition of produced natural gas, and CMS cannot glean data on total production, re-injected gas, or marketed gas with any confidence, either annually or over the lifetime of the project. Nor are quantities of separated CO₂ estimated, although the FEIR states that CO₂ removed from the processed gas will also be re-injected, and no entrained CO₂ (up to 8 percent CO₂) will be emitted to the atmosphere.

Fugitive methane. CMS also revises the fugitive methane estimate in the FEIR, which, in the FEIR, is calculated on the basis of a fraction of total Reactive Organic Compounds (ROCs), but the calculations are hidden and the methodology is not transparent and CMS cannot evaluate their results. Instead, CMS compared the results to other methane benchmark emissions rates — i.e., tonnes of methane emitted per billion cubic feet (Bcf) of natural gas produced — for the U.S. natural gas industry (three levels of emissions) and for several state methane emission rates, including California.

The Paredon methane emission rate is 15 tonnes CH₄/Bcf, whereas the other regional rates are 6.2 to 21.7 times higher. CMS conservatively applies the U.S. upstream rate of 131 tonnes CH₄/Bcf, resulting in estimated emissions of 413 tons CH₄, which converts to 8,679 tons of CO₂e per average year. Note that the California rate is 283 tonnes CH₄/Bcf.⁴ CMS has been unable to review the details of the FEIR methane estimation methodology, but our conclusion is that the FEIR estimate is too low and is erroneously based not on a methane emission inventory protocol but on a methodology that may under-estimate actual methane emissions. See worksheet Tables 3a, 3b, & 3c for details of the CMS methodology.

Figure 3. Chart of national and regional methane emission rates.



U.S. natural gas industry methane emissions rates: “US Prod/End” covers all gas industry emissions from production to end use, “US upstream” includes production and processing emissions but transport and end use reduced by 40 and 90 percent, and “US Prod&Proc” includes only upstream emissions; these are compared to methane emission rates in Colorado, New Mexico, and California; all are compared to the rate computed for the FEIR. The red line represents the conservative methane rate applied by CMS to estimate Paredon methane emissions.

OVERALL RESULTS

CMS reviewed the FEIR methodology and results, revising some estimates and including new sources ignored in the FEIR. The CMS and FEIR results are difficult to compare inasmuch as the FEIR disavows inclusion of several important emissions sources. CMS evaluates emissions over the same three project phases calculated in the FEIR. These phases are:

⁴ The California rate is computed on the basis of methane emissions from production through pipeline delivery. Methane estimate from CEC (2006, revised in 2007); California gas production (320 Bcf) from US EIA. The FEIR fugitive methane estimate is 51 tons CH₄.

1. Construction,
2. Annual drilling and operations,
3. Total over the presumed 15-year project period.⁵

Construction phase emissions. CMS’s estimated construction emissions agree reasonably well once an apparent FEIR miscalculation regarding off-site diesel fuel consumption is corrected. The CMS result is 276 tons CO₂e, compared to the FEIR of 360 tons CO₂e (uncorrected).

Table 1. Paredon: comparing CMS & FEIR estimates of construction phase emissions

Segment	CMS estimate tons CO ₂ e/yr	FEIR estimate tons CO ₂ e/yr
Diesel fuel, on-site trucks & equipment	204	221
Natural gas, on-site use	not estimated	not estimated
Diesel fuel, off-site trucks	52	139
Gasoline, commuting (2,000 gallons)	20	not estimated
Total construction phase	276	360

CMS estimates emissions from commuting fuel (FEIR estimates 2,000 gallons, page 4.2-8), even though the FEIR calculates but invalidates emissions from commuters’ use of gasoline. FEIR: “The drilling project phase would generate up to 39 commuter vehicles ... Drilling would take six years.” (p. 4.8-12). CMS has not included the fuel use and emissions from the 39 commuter vehicles (except for the 2,000 gallons above). A modest 3-mile commute twice a day in a 20 mpg vehicle would result in fuel consumption of 17,550 gallons and 172 tons CO₂ over six years.

Annual drilling and operational emissions. CMS and FEIR estimates of annual emissions differ in several respects. CMS has corrected large over-estimated emissions in the FEIR on product emissions, although the FEIR does not provide details of its assumptions, basic oil and gas production data, and methodology, making a careful assessment impossible. As noted above, the FEIR disavows including product emissions within the project emission boundary, and only lists estimated product emissions with the caveat that they do so for “informational purposes only.”

Table 2. Paredon: comparing CMS & FEIR estimates of annual “drilling & operations” emissions

Segment	CMS estimate tons CO ₂ e/yr	FEIR estimate tons CO ₂ e/yr
Natural gas combustion, on-site	20,507	19,180
Fugitive methane	8,679	1,071
Diesel fuel, direct & indirect	133	276
Gasoline, commuting	20	not incl.
Electricity, indirect	17,518	15,045
Total annual drilling & operations	46,856	35,573

CMS does include product emissions as inherently attributable to new sources of marketed oil and gas, irrespective of possible displacement of existing sources of fuels for refineries and gas distribution companies. The results are compared in Table 3 and Figure 4. CMS also revises estimates of electricity-related emissions and fugitive methane emissions.

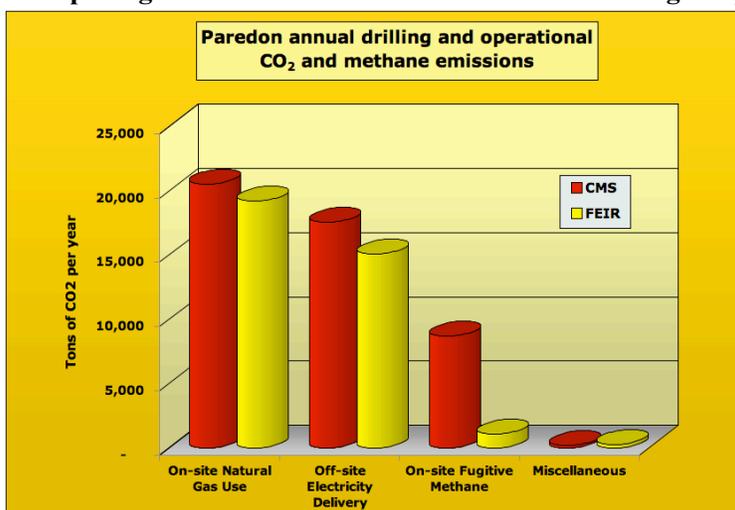
⁵ “Presumed” because the FEIR is not clear on project duration. Also, the FEIR calculates — albeit incorrectly — emissions from combustion of marketed natural gas and crude oil, but then ignores product emissions from its summary of emissions. Also, the FEIR does not sum drilling and operational emissions. See discussion below.

Table 3. Paredon: comparing CMS & FEIR estimates of annual GHG emissions (15-year average)

Segment	CMS estimate tons CO ₂ e/yr	FEIR estimate tons CO ₂ e/yr
Drilling & operations (except methane)	38,177	34,502
Fugitive methane	8,679	1,071
Natural gas end use	172,536	526,000
Crude oil refining etc (“wells to wheels”)	139,301	not estimated
<u>Crude oil end use combustion</u>	<u>674,248</u>	<u>~3,000,000</u>
Total supply chain	1,032,941	3,561,573

CMS includes the FEIR estimated emissions from product end use, even though the FEIR estimates product emissions “for informational purposes only.” The FEIR estimate does not include refinery emissions, alluded to as adding 13 to 17 percent (if 15 percent, then 450,000 tons CO₂/yr). Note that the CMS estimates differ substantially.

Figure 4. Paredon: comparing CMS & FEIR estimates of annual drilling & operations emissions



CMS annual emissions from drilling and operations are compared to the FEIR estimates.

Total project emissions. CMS estimates total project emissions by assuming the 15-year time horizon suggested by FEIR Figure 2-9 (reproduced as Fig. 2 above), roughly interpolates production of “sales gas” and crude oil — necessitated by such data being absent in the FEIR — then estimating fugitive methane emissions on the basis of gas production as discussed above, followed by calculating product emissions from marketed natural gas and crude oil (deducting for non-fuel uses), and finally adding annual emissions derived from the previous calculations of on-site natural gas consumption, electricity demand from SCE, combustion of diesel fuel both on-site and off-site, and a few other minor sources.

Note: The FEIR makes no attempt to estimate variable demand for electricity or on-site requirements for natural gas to run compressors, drilling equipment, or processing of natural gas prior to distribution to the Gas Company. While projected on-site energy demand is sure to vary year by year, perhaps even to decrease substantially as power and process demands vary over time, CMS assumes — for lack of quantitative data — that the FEIR “annual” gas and electricity demand will be constant for each of the 15 years. The CMS estimates of total project CO₂ and methane emissions are shown in Table 4 and Fig. 5 along with the comparable FEIR estimates, including the FEIR erroneous (and excluded) product emissions.

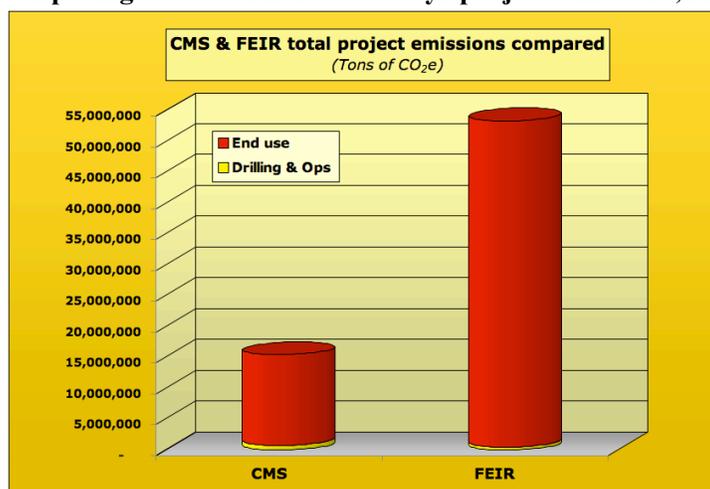
Table 4a. Paredon: comparing CMS & FEIR estimates of total direct project (15-yr) emissions

Segment	CMS estimate tons CO ₂ e/yr	FEIR estimate tons CO ₂ e/yr
Construction	276	360
Drilling & operations (except methane)	572,653	517,527
Fugitive methane	130,181	16,064
Total supply chain	703,110	533,951

Table 4b. Paredon: comparing CMS & FEIR estimates of total indirect project (15-yr) emissions

Segment	CMS estimate tons CO ₂ e/yr	FEIR estimate tons CO ₂ e/yr
Natural gas end use	2,588,047	7,890,000
Crude oil refining etc (“wells to wheels”)	2,089,511	not estimated
Crude oil end use combustion	10,113,718	~45,000,000
Total supply chain	14,791,276	52,890,000

Figure 5. Paredon: comparing CMS & FEIR total 15-yr project emissions, incl. product emissions



CMS total project emissions from “drilling and operations” are compared to the FEIR estimates.

CONCLUSIONS

CMS has reviewed the FEIR’s estimated emissions of greenhouse gases with re-calculations of construction emissions, annual drilling and operational emissions, and total emissions over the anticipated 15-year project duration. CMS has re-estimated several emission sources, adjusted estimated emissions from electricity demand and on-site natural gas consumption, and included emissions from combustion by end-users of Paredon’s marketed products.

The FEIR estimates are poorly detailed, their methodology is unclear, and the results are of dubious value to local and state decision-makers who must review the environmental impacts and their proposed mitigation plans. Indeed, the FEIR makes no serious attempt to describe the mitigation options, and provides no detail on how the project aims to reduce emissions by mitigation. The mitigation savings are simply stated in their Table 4.2.17: “Proposed Project and Mitigated Project Greenhouse Gases Emissions Summary.”

CMS estimates aggregate GHG emissions over the presumed 15-year project duration in Figure 6. Details are shown in Tables 1 through 4 above and in the attached worksheets.

Figure 6. Paredon 15-yr production schedule and estimated total emissions

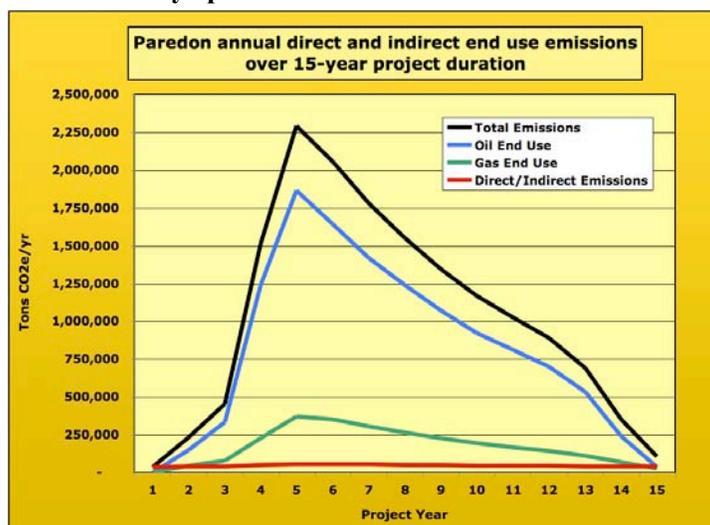
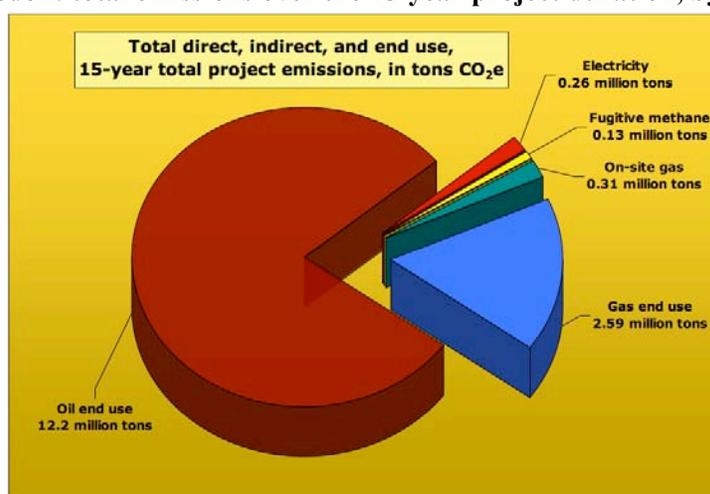


Figure 7. Paredon: total emissions over the 15-year project duration, by major source.



Total project emissions from direct, indirect, and product use is illustrated in Figure 7, also showing the estimated total contribution of each emissions source. The emissions sources estimated by both CMS and the FEIR — electricity, on-site natural gas consumption, and fugitive methane — add up to 4.5 percent of CMS’s total 15-year project emissions estimate.

In sum, the FEIR is poorly documented, contains several erroneous emissions estimates, excludes product emissions, and is an inadequate guide to decision-makers. The report should be revised to provide a complete, accurate assessment.

Respectfully,

Richard Heede,

Principal, Climate Mitigation Services

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Report commissioned by Environmental Defense Center

Richard Heede

Climate Mitigation Services

28 April 2008

Folio of worksheets

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Images from the FEIR, pages 3-9 and 4.2-31.

Notes



FEIR Figure 2-10: Simplified process flow diagram of proposed CPF operations.

