

The Increasing Burden of Oil Refineries and Fossil Fuels in Wilmington, California and How to Clean them Up!

- Largest number of refineries in state are concentrated in the Wilmington area
- Wilmington's rising impacts from fossil fuels, (ports, oil drilling, diesel trucking, highway expansions, more) are unaddressed by public policy
- Dirty Crude Oil use by refineries is increasing local, regional, and global pollution
- ⚙ Solutions are available that create jobs:
 - Best Available Control Technology
 - Cap on dirty crude oil
 - Phaseout fossil fuels in favor of alternatives
 - Cumulative Impact policies



The Increasing Burden of Oil Refineries and Fossil Fuels in Wilmington, California

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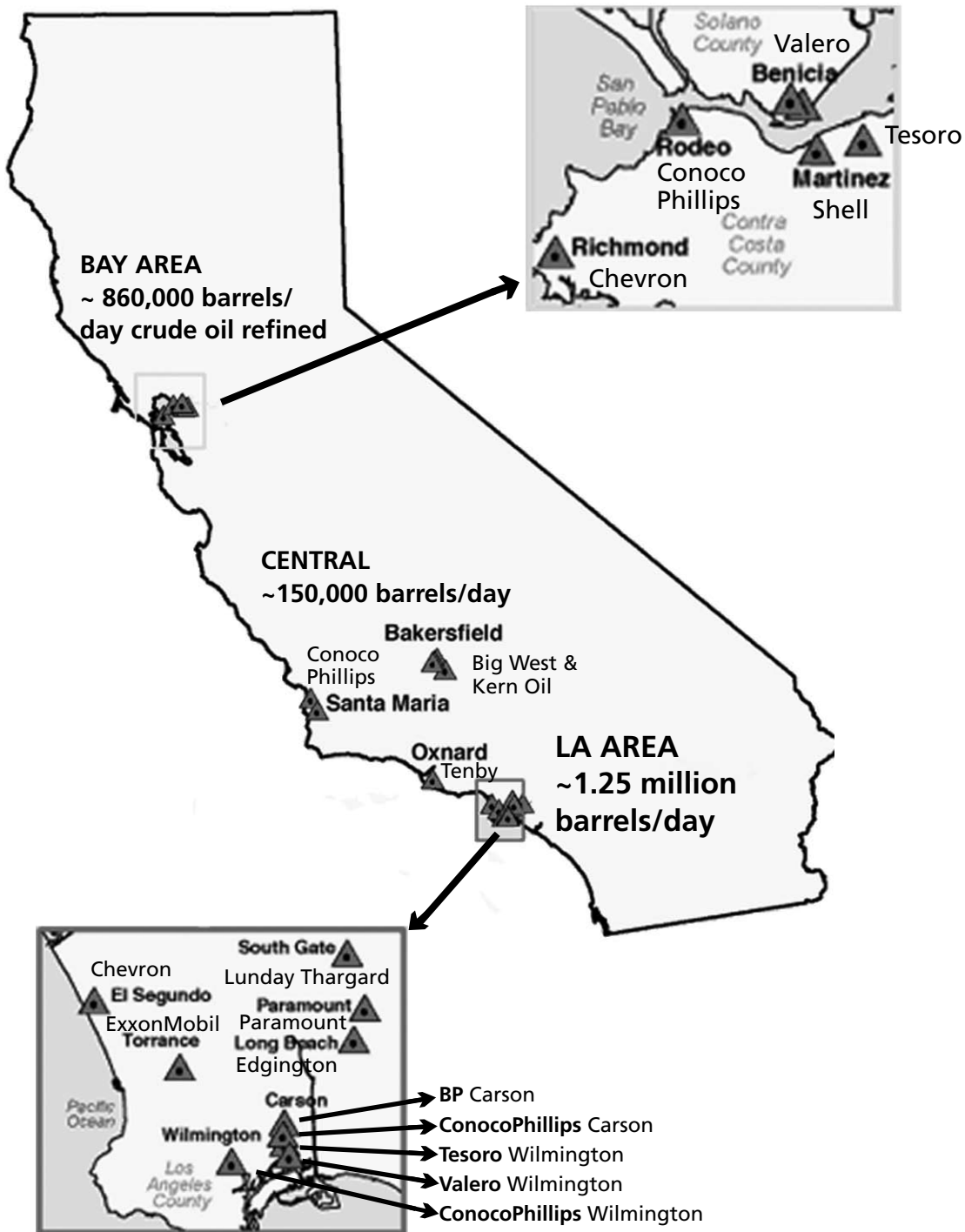
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Many areas of California are heavily impacted by oil refineries¹, but Wilmington/Carson has the highest concentration of refineries statewide.



» Executive Summary

This report looks at the impacts of the refining industry on California health and the environment, and how processing dirtier crude oil seriously exacerbates existing problems, using the case of the heavily-burdened Wilmington/Carson area in Southern California. We compile basic crude oil quality information and associated air emissions. The Wilmington/ Carson area in Southern California emerges with the highest concentration of refineries in California (see map to left), with a surprising 650,000 barrels per day of crude oil processing (about a **third** of the state's production, and half of LA-area refinery VOC's).

To make things worse, the quality of crude oil purchased by refineries statewide (and nationally) is degrading, as refineries switch to cheaper, higher-sulfur crude oil to increase already- record profits. More sulfur in the crude means more acutely hazardous materials in refineries, and increased energy use to remove the contamination from fuels. While refineries are allowed dirtier inputs, electric power plants are required by the state to clean up inputs. Although many new fossil-fuel power plants are still being unnecessarily permitted, the state is requiring phase-in of alternative energy for electric power plants (in California's Renewable Portfolio Standard requiring 33% renewables by 2020). But for refineries, the State is projecting **more refinery fossil fuel capacity** for the future.² Almost zero refinery emissions reductions are required in the State's greenhouse gas plan, despite hopes the plan would clean up refinery greenhouse gases and co-pollutants (smog-forming and toxics resulting from fossil fuel combustion).

Oil refineries are already major pollution sources, from fossil fuel evaporation and burning vast quantities of fossil fuel energy to make gasoline, diesel, and jet fuel. Oil refineries take crude oil, separate it into components, crack and reform it, and treat it to remove contamination (such as sulfur). Refineries are now building high-energy processing units to refine dirtier crude oil (more hydrogen plants, more cracking, coking, etc.). Refiners are currently expanding in a way that will lock us in to higher-pollution infrastructure for the decades to come. While these increases affect us all, the local impacts are concentrated most in communities of color. The population in Wilmington in Southern California is 85% Latino.



Wilmington/Carson not only includes about a third of the entire state's refining capacity, it has many other major pollution sources in or nearby, including the Ports of Los Angeles and Long Beach, the Alameda railway Corridor, many thousands of diesel truck trips per day, sewage treatment, recycling facilities, autobody shops, and heavy oil drilling in residential areas. New permitting policies are greatly needed to address bad decisions allowing unnecessary increases in fossil fuel pollution and Cumulative Impacts. This is especially so when unprecedented alternative energy options are available. Serious action to phase in clean energy alternatives must be taken.

Our report finds:

- California has a large oil refining capacity—over 2 million barrels per day (bpd) of crude oil refined in three regions. **The largest refining capacity in the state is in the Los Angeles region (about 1.25 million bpd of crude oil refining)**, followed by the San Francisco Bay Area with about 860,000 bpd refining capacity, with another 150,000 bpd in the Center of California). Even a single small refinery is a major air pollution source. (See maps on the following pages.)
- **Wilmington/Carson in the LA region has the highest concentration of refineries in the state (about one third the state's capacity).** About half Los Angeles' refining capacity is concentrated in the Wilmington/Carson area (five refineries and about 650,000 bpd).

- Refineries are the largest stationary sources of smog precursors. In the Los Angeles region, refineries dominate the top **15 VOC (Volatile Organic Compound) emitters**, out of many hundreds of Stationary Sources listed by the South Coast Air Quality Management District (SCAQMD) in the 2007 Air Quality Management Plan. **The Wilmington Area emits about half the refinery VOCs emissions³** (about 1,600 out of 3,200 tons per year) in the LA region.
- **In addition to impacts from intensive oil refining, the Wilmington area is burdened by Cumulative Impacts from many other fossil fuel pollution sources**, including the Ports of Los Angeles and Long Beach, the Alameda railway Corridor, the I-110 and 710 freeways, sewage treatment, thousands of diesel truck trips/day, recycling facilities, auto body shops, and many other sources. Greatly expanded drilling of a large oil field in the middle of a Wilmington residential neighborhood also badly exacerbates Cumulative Impacts.
- **Refinery emissions of greenhouse gases in California are very large (about 40% of industrial emissions, and almost 10% of the state's greenhouse gases), and getting much worse.**
- Among many other impacts, **climate change will severely impact air quality due to higher temperatures causing more smog formation**, which is already at severe levels, especially in Southern California.
- Climate change also increases runaway wildfires.⁴ Air quality severely degrades during wildfires, which can cause extreme levels of particulate matter and health impacts.
- **Oil Refinery Fossil Fuel Combustion emits many pollutants—the same flame emits local toxics, regional smog-forming pollutants, and global pollutants (greenhouse gases).** The solution for all these problems is the same: phasing out fossil fuels.
- Sulfur content in crude oil (a contaminant that turns into hazardous hydrogen sulfide and sulfur oxides during refining), is increasing. This potentially means increased emissions associated with asthma impacts. Processing dirtier crude oil also means much higher energy use. **While California power plants are required to switch to at least 20% renewable energy (with plans up to 33%), oil refineries are switching to dirtier crude oil and expanding.**
- **We have unprecedented opportunities to phaseout fossil fuels from refineries and other sources for good, due to real alternatives available in large quantities, instead of investing in expansions of dirtier crude oil and expanded refining.**
- **We should clean up refineries by requiring Best Available Control Technology standards for existing sources, and limits on dirty crude oil inputs.** Refineries can also switch from fossil fueled electricity to clean sources, and reduce refinery production. We are paying the price for fossil fuels, better spent on clean energy.



Although heavily-industrialized, Wilmington is residential, with many schools

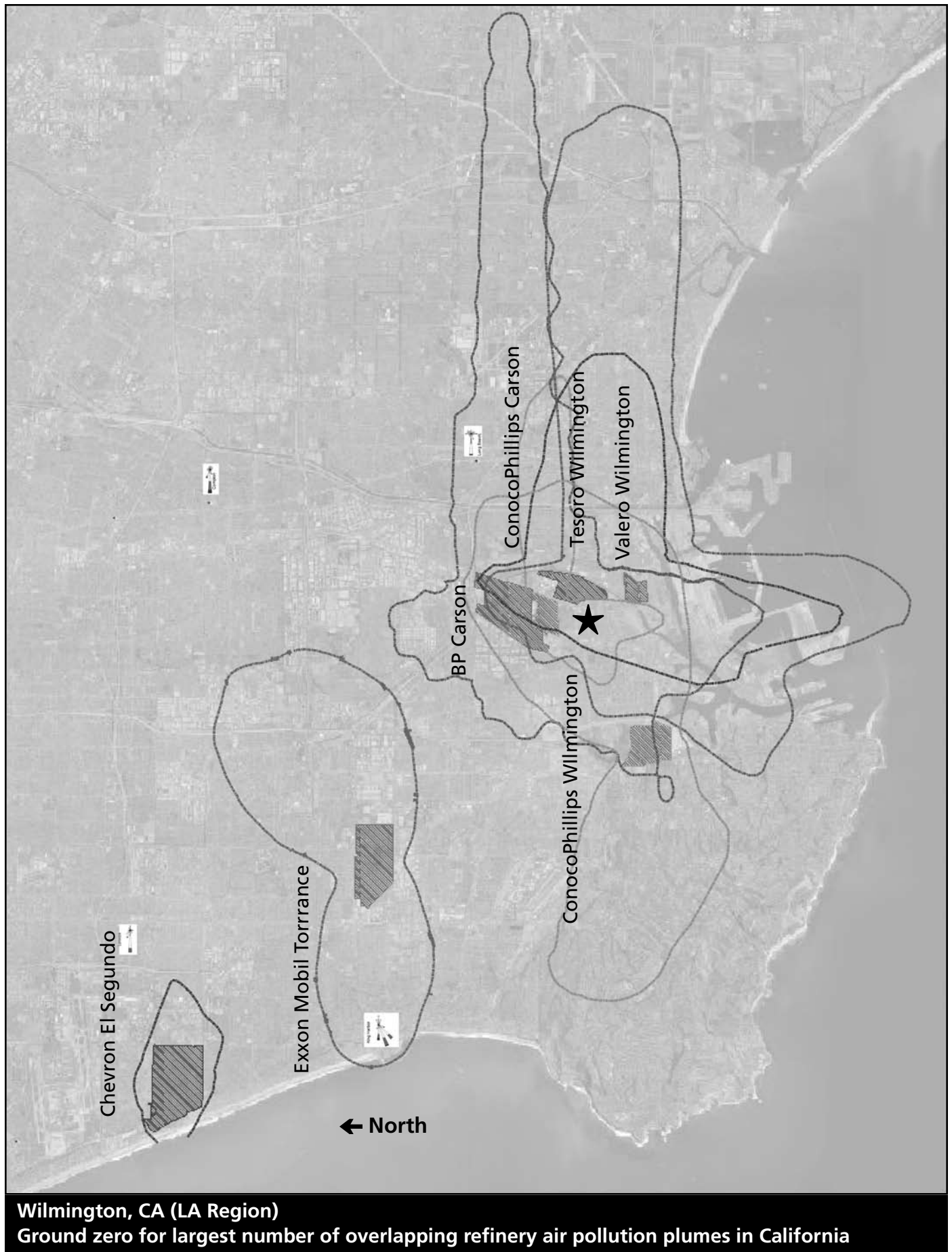
Industry may be the defining characteristic of Wilmington, but it is also home to 53,000 residents, over 45,000 identifying as Latino. Wilmington is low income, with around 24% of families living below the national poverty level. The City represents a clear example of environmental injustice, where a community of color in a lower socio-economic bracket is disproportionately impacted by multiple polluting facilities. CBE has worked since the '90s in Wilmington to empower residents demanding a better quality of life, and has been successful in winning enforcement of regulations and tough new policies. However, Wilmington remains a highly-impacted hub of our fossil-fueled society.

In addition to Wilmington's large residential population, the City contains many schools:

- 6 Primary Schools (Grades 1-5): Island Avenue Elementary; Broad Avenue Elementary School; Fries Avenue Elementary School; Gulf Avenue Elementary School; Hawaiian Avenue Elementary School; and Wilmington Park Elementary School.
- 3 Secondary Schools (Grades 6-12): Wilmington Middle School; Phineas Banning High School; and Harbor Teacher Preparation Academy.
- 4 Private Schools: Holy Family Parish School; St. Peter & St. Paul; Wilmington Christian School; Pacific Harbor Christian School.
- 3 Continuation Schools: Banning-Marine Ave Adult Center; Harbor Occupational-Skill Center; Avalon High School.
- Two Colleges and Universities: Los Angeles Harbor College and National Polytechnic College of Engineering and Oceaneering.

Students at both Harbor Teacher Preparation Academy and Los Angeles Harbor College complain frequently about fumes emanating from ConocoPhillips. ConocoPhillips is less than a mile from both campuses. **Student athletes on the campuses reported refraining from practicing sports on days when air quality is especially bad.**





» CUMULATIVE IMPACTS –

Refinery air pollution plumes converge in Wilmington, CA

Cumulative Impacts — The health and environmental impacts of pollution from many different sources added together. Wilmington is a prime example, with multiple refineries, freeways, ports, and many smaller pollution sources which can create pollution hotspots. Frequently, permitting decisions don't take into account these added impacts, but treat them separately. Communities of color are usually impacted the most. There is a grassroots movement to win good permitting policies to prevent Cumulative Impacts that hurt people's health. The map to the left shows Cumulative Impacts from the air pollution of many different oil refineries that add together in Wilmington/Carson.

Mapping can easily show us things we can't directly see on the ground. For instance, the map at the left provided by the South Coast Air Quality Management District at a public workshop,⁵ shows where air pollutants from refineries blow over the course of the year, as winds change.

Within the different colored outlines on the map are the areas receiving at least a certain baseline level of pollution from the local refinery, averaged over the year. Areas outside the outline can still receive refinery pollution, but receive lower levels than inside the outlines. Some areas inside receive even higher levels. The map only includes pollution from the refineries, and not from all the other pollution sources in the region.

The outlines are made by a computer model, and indicate areas within, with a cancer risk of greater than 1 in a million from each local refinery's emissions. Even though the Air District modeled cancer-causing pollutants, the model shows in general where wind blows other pollutants during the year (because these other pollutants emitted at the same time disperse in the same direction). To get these outlines, the computer starts by calculating air pollution concentration at different points on the map after the pollutants are released by the refinery, by taking into account the wind speed, direction, and weather conditions; then the computer recalculates the air pollution concentrations at each point again as conditions change

daily. The final plumes come from averaging pollution concentration over the year. Of course, knowing how much pollution comes out is essential, and we know that this is frequently underestimated.

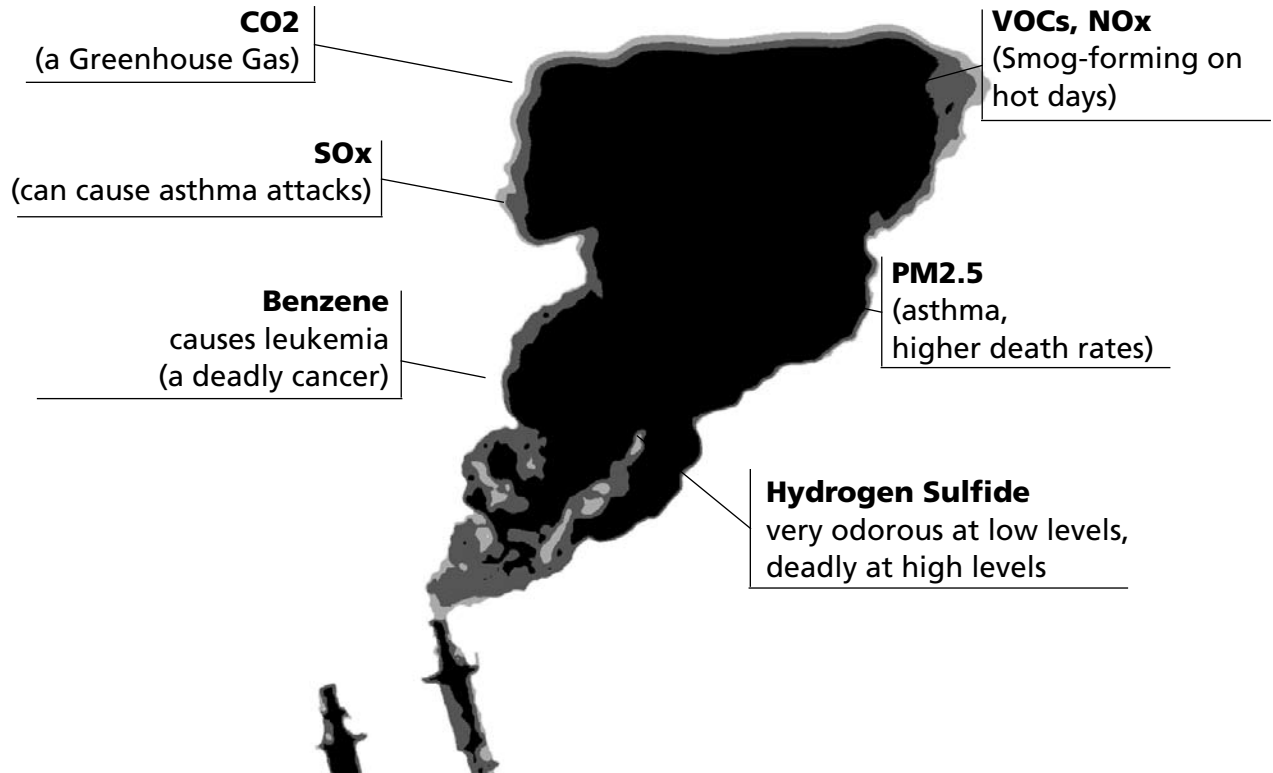
The results show that the Wilmington/Carson area has emissions from five different oil refineries plumes, adding together to create Cumulative Impacts from all five on a yearly average. No other area in the state has five refineries' emissions in one place over the year. Actual health impacts from these sources together is really not known.

The map only shows continuous emissions sources, not accidental releases that can occur in a short time. Of course, other areas outside the map's air pollution plumes are impacted as well, and even having one relatively "small" refinery nearby can cause major air pollution. Each refinery by itself can have a large impact (because oil refineries emit large volumes of gases that cause smog and emit toxic chemicals). But living next to or working in an area with multiple oil refineries (plus other pollution sources) results in Cumulative Impacts, not addressed directly by public policy protections.

The map at left shows that the Wilmington/Carson area of the LA air basin has the largest number of refinery plumes affecting any region in the state. CBE will be publishing a report on Cumulative Impacts in the region in the future including many other pollution sources.

»» What air pollutants come out of oil refineries?

Burning fossil fuels at oil refineries (and by cars, trucks, ports and oil drilling) emits local toxic air pollution, regional smog-forming pollutants, and global greenhouse gases, at the same time.



►» Phasing out fossil fuels will solve all of these pollution problems at once

We have ample opportunities for phasing out fossil fuels.

1. Clean up oil refineries through a limit on dirty crude oil inputs, require energy-efficiency at refineries by replacing old boilers, heaters, and other inefficient equipment require Best Available Control Technology to reduce all pollutants, require refineries to use clean alternative energy instead of grid electricity.

2. Ramp up alternative energy (Plug in hybrid vehicles can get 100 miles to the gallon, drastically reducing the need for refineries; wind energy and solar panel use is increasing dramatically but needs public policy support; many other alternatives are already available).

3. Energy conservation gets the biggest pollution reductions. (See end of report for more detail.)

» Refineries are the largest stationary sources of smog

In the entire LA Region, which is made up of hundreds of stationary (non-mobile) air pollution sources, refineries dominate the top 15 Volatile Organic Compound (VOC) polluters.⁶ Refineries make up about 73% of the top 15 polluters' emissions below. VOCs chemically react on hot days to form ground-level ozone, the main component of smog, causing asthma attacks and hurting normal adults' breathing. Many VOCs are toxic without

chemically reacting in the air (such as benzene, which causes leukemia). In addition to directly emitting pollution, oil refineries produce fuels used in cars and trucks that cause even larger volumes of pollution.

The Wilmington/Carson Area by itself emits about half of the LA Region's total refinery emissions listed below (about 1,600 of 3,200 tons per year).

	Company	City	Tons per year of Volatile Organic Compounds
1	CHEVRON	El Segundo	837
2	EXXON MOBIL	Torrance	676
3	TESORO (previously Shell)	WILMINGTON	506
4	BP	CARSON	429
5	Laco Bathware	Anaheim	278
6	TABC, Inc.	Long Beach	278
7	CONOCO PHILLIPS	WILMINGTON	238
8	Dart Container Corporation of CA	Corona	195
9	VALERO (prev. Ultramar)	WILMINGTON	174
10	Kinder Morgan Liquids Terminals, LLC	Orange	172
11	Anheuser-Busch, Inc.	Van Nuys	164
12	Inland Paperboard and Packaging, Inc.	Ontario	150
13	CONOCO PHILLIPS	CARSON	138
14	TESORO	CARSON	128
15	PARAMOUNT	Paramount	119
Total for Refineries above			3,245 tons per year
Total all of above			4,482 tpy

Note: CBE believes refinery emissions are greatly underestimated (such as emissions from startup/ shutdown, emergencies, leaking gases, storage tanks, and many others), but the numbers above give a feel for relative ranking of refineries according to SCAQMD.

» Refinery crude oil inputs are getting dirtier

Two hazardous Sulfur Compounds are present in refineries at increased levels because refineries are switching to higher-sulfur crude oil:

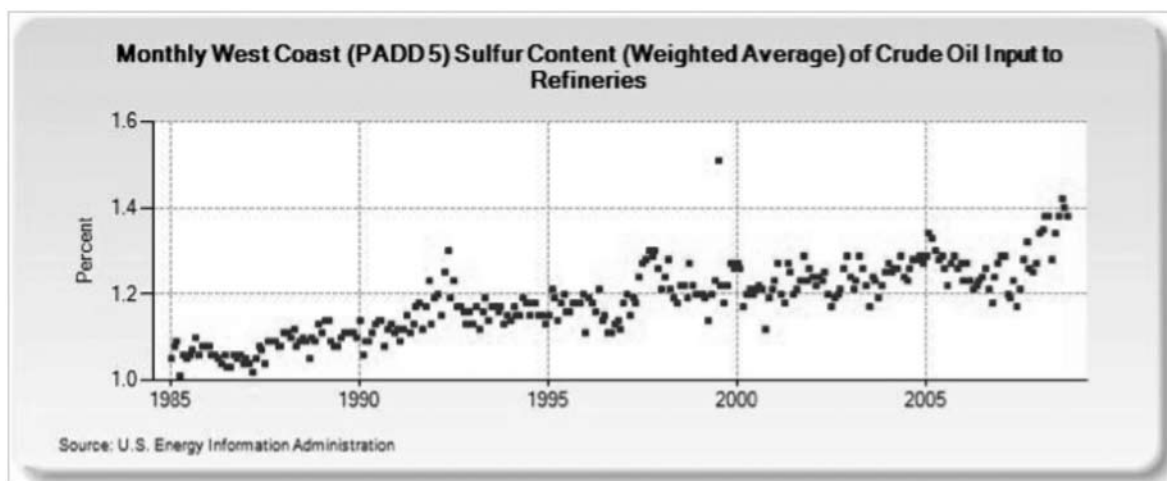
1. Sulfur Dioxide (SO₂) can cause:

- Breathing and eye irritation and asthma attacks
- Respiratory illness and heart disease aggravation

2. Hydrogen Sulfide (H₂S) can cause:

- Eye, nose, and throat irritation at low levels; headache, dizziness, nausea, vomiting, cough, breathing difficulty at moderate levels
- Shock, convulsions, coma, and death at high levels (H₂S has killed many workers)

Crude Oil Sulfur Contamination in West Coast Refineries (inching up since 1985), increased more drastically in recent years.⁷



The US Energy Information Administration (EIA) also found this increase on a national basis:

“The average sulfur content of U.S. crude oil imports increased from 0.9 percent in 1985 to 1.4 percent in 2005 [26], and the slate of imports is expected to continue “souring” in coming years. Crude oils are also becoming heavier and more corrosive . . .”⁸

California refineries dominate the data in the chart for the West Coast region shown above called PADD5.⁹ (California makes about 67% or 2.2 million

barrels per day (bpd) in 2006 out of 3.2 million PADD5 total). EIA does not provide such data separately for California in total. Also, only imported crude data is provided by EIA for individual refineries, so domestic crude from California and Alaska are missing. See table on pages 14–15 for more on crude oils used by California refineries. PADD5 also includes Alaska, Washington, Hawaii, a tiny Nevada refinery,¹⁰ and Arizona and Oregon (with no refineries). **EIA reported average October 2008 PADD5 sulfur at 1.38% (which is “sour” or high-sulfur crude oil).¹¹**

» Refinery greenhouse gases are also big and getting worse because of dirty crude

“Refineries are the largest energy using industry in California and the most energy intensive industry in the United States...After Texas and Louisiana, California has the largest petroleum refining industry in the country.” (Lawrence Berkeley Labs¹²) The California Public Utilities Commission found that industrial facilities in California emit about 23% of California’s total greenhouse gases, and refineries emit about 40% of industrial emissions.

Oil refineries directly emit about 10% of the state’s total Greenhouse gases. Oil refineries also make transportation fuels, so they are responsible for the additional 40% of California’s greenhouse gases emitted by transportation. Refineries are adding and expanding energy-

intensive equipment in order to process higher-sulfur crude oil, including hydrogen plants and hydrotreaters (for stripping sulfur contamination), cracking and coking, for processing heavier crude oil, etc. This is drastically increasing Greenhouse Gas (GHG) emissions.

One new refinery hydrogen plant can emit over one million tons of CO₂ every year, and many refineries are adding new hydrogen plants.¹³ (Hydrogen is used by refineries to strip sulfur contamination from fuels, and for other fossil fuel processing. This is not to be confused with hydrogen used as an alternative energy source, because refineries use very large amounts of fossil fuels to make this hydrogen.)

CLIMATE CHANGE WILL SEVERELY DEGRADE OUR AIR

Photo: istockphoto.com/Daniel Stein



MORE SMOG—

75% more “bad air” days due to higher temperatures from climate change in the Los Angeles region and other areas by the end of the century.¹⁴

Photo: Getty Images



MORE PARTICULATE MATTER FROM WILDFIRES—

Severe air quality occurred during the 2008 wildfires for many months through large regions of California, where thousands of fires raged out of control. This was the worst wildfire season ever. Many people suffered severe respiratory impacts. Frequency of run-away wildfires is projected to increase due to hotter, drier conditions.¹⁵

Instead of reducing fossil fuel use, oil refineries are expanding, using dirtier crude oil, & making record profits.

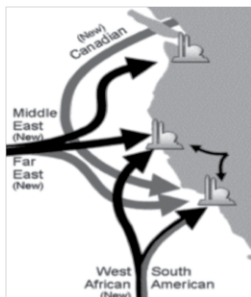
While California electric power plants are being required to use at least 20% renewable energy by 2020 . . .

. . . Some oil refiners are bragging about making permanent changes to refineries to use cheaper, dirtier crude oil and make more money
(Higher sulfur (called "sour crude"), heavier (higher carbon), and potentially higher heavy metal crude oil)

In the words of the oil industry:

"Valero also spent heavily to upgrade many of those refineries to process lesser and cheaper grades of crude oil. That reduces Valero's operating costs and widens its profit margins. "We figured we would have the advantage of using a cheaper feedstock . . ."¹⁶
(*LA Times*, 7/ 24/01 (emphasis added))

"Valero's strategy of basing its feedstock largely on sour crude oil, which was selling at a large discount to sweet crude oil. . . Valero then nearly tripled its profits one year later, making \$1.8 billion on revenues of \$54.62 billion."¹⁷ [*Sour crude oil means high-sulfur contamination; sweet crude oil is low sulfur (which is less polluting).*]



"Tesoro will integrate with the supply of heavy, sour crudes for Golden Eagle which opens up new sources of economic supply for both refineries."

The Tesoro report to the SEC also includes this map, showing heaviest Canadian tar sands crude shipped to LA. (Report to Securities Exchange Commission)

OTHER TESORO REFINERIES¹⁸

"In 2002, we completed a heavy-oil conversion project, which allows the refinery to process a larger proportion of lower-cost heavy crude oils, while producing a larger proportion of higher-value products. A distillate treater also was installed allowing the refinery to increase production of low-sulfur diesel and jet fuels." (Anacortes Washington)

CHEVRON EL SEGUNDO CA

"The objectives of the proposed project at the El Segundo Refinery are to: . . . Allow the Refinery to efficiently and reliably process a wider range of crude oils, including higher sulfur-containing crude oils;"¹⁹ (Environmental Impact Report 2008 ("EIR"))

"Chevron is currently proposing modifications to the existing No. 4 Crude Unit and Delayed Coke Unit to enable the refinery to increase heavy crude oil refining capacity with the potential for minor increases in product production volume, " SCAQMD, <http://www.aqmd.gov/CEQA/igr/2006/april/413-05.pdf>



CHEVRON RICHMOND CA

Design and engineering for a project to increase the flexibility to process lower API-gravity crude oils at the company's Richmond, California, refinery continued in 2007.²⁰ Chevron 10K Report to the SEC (Note: API gravity is a reverse scale; lower API means heavier crude oil.)

CONOCOPHILLIPS RODEO CA

The Refinery would use heavy gas oil (HGO) that is produced at the Refinery, but is currently being sold into the heavy gas oil and fuel oil markets, to produce cleaner-burning gasoline and ultra-low-sulfur diesel (ULSD) fuels targeted for the California market. Overall, Refinery production following implementation of the Proposed Project would increase by up to approximately 1,000,000 gallons/day or 30 percent over current Refinery production levels. (Draft EIR²¹)

OTHER U.S. CONOCOPHILLIPS REFINERIES

ConocoPhillips is spending \$1.3 billion on its East Coast refineries and \$1.8 billion in the Midwest and Rocky Mountain regions, Nokes said. . . . **The investments will increase the company's total high-sulfur crude processing to 41% from 28%. High-sulfur or "sour" crude is costlier to refine but is significantly cheaper than the U.S. benchmark light sweet crude. The upgrades will allow ConocoPhillips to refine more high-sulfur oil from Canada.** (LA Times²²) (Note that the Wilmington plant is already using high-sulfur.)

» California refineries: How big are they? How dirty is the crude oil to make gasoline, diesel & jet fuel?

The table below shows crude oil used by each California refinery, split into three big regions. Crude oil is processed through heating, cracking, and chemical reactions to make gasoline, diesel, jet fuel, etc. The first column shows the maximum capacity of the refinery to process crude oil (a volume in barrels per day or bpd), the next shows the volume of crude oil imported to each refinery from outside the US, and the last shows the domestic

(US) crude oil used at the refinery. The US Energy Information Administration (EIA) provides public data online on imported crude oil, but not domestic crude. Domestic crude information had to be searched through various sources and was not always available. See notes at end of this report. The Wilmington/Carson area makes up almost a third of the state's total refining capacity.

<i>(In order of largest to smallest in each region)</i>	MAXIMUM CRUDE OIL CAPACITY 2009 Barrels/day (bpd)	IMPORTED CRUDE USED 2006²³ Capacity (bpd) Average Sulfur % Density (API °)	DOMESTIC CRUDE USED 2006 estimated²⁴ (bpd) *Less data available — On average— about 80% sour ²⁵
LOS ANGELES REGION 1,250,500 bpd, WILMINGTON/CARSON total: 649,000 bpd			
BP Carson	275,000	134,000 bpd – 51% Sulfur: 1.38% SOUR 29.88° Intermediate.	91,980*
CONOCOPHILLIPS Wilmington & Carson <i>(two integrated sites)</i>	139,000	68,452 bpd – 49.2% Sulfur: 2.89% SOUR 30.44° Intermediate	51,500*
VALERO Wilmington <i>(previously Ultramar)</i>	135,000	61,742 bpd Sulfur: 1.55% SOUR 22.35° Heavy	13,976 SOUR Heavy
TESORO Wilmington <i>(previously Shell)</i>	100,000 Sulfur: 2.7% ²⁶ SOUR 21.9° ²⁷ Heavy	23,645 bpd – 24%	54,644 San Joaquin pipeline & LA basin (SEC)
CHEVRON El Segundo	270,000	245,097 bpd – 94.3% Sulfur: 1.61% – SOUR 27.79° Intermediate	10,879*
EXXON MOBIL Torrance	149,000	0	109,135*
PARAMOUNT Paramount	53,000	0	36,500*
EDGINGTON Long Beach	35,000	5,903 bpd - 22.7% Sulfur: 1.55% – SOUR 23.50° Heavy	14,671*
LUNDAY THAGARD South Gate	8,500	0	6,205*

<i>Continued from previous page)</i>	MAX CRUDE OIL CAPACITY	IMPORTED CRUDE USED	DOMESTIC CRUDE USED
BAY AREA 861,000 bpd			
CHEVRON Richmond	240,000	145,323 bpd – 59.8% Sulfur: 1.26% SOUR 34.04° Interm / Light	71,232*
VALERO Benicia	170,000	33,871 bpd – 23.5% Sulfur: 0.42% – Sweet 20.71° Heavy	80,394 SOUR
TESORO Avon / Martinez	166,000	58,710 bpd – 35.4% Sulfur: 0.73% Moderate 29.45° Intermediate	78,322*
SHELL Martinez	165,000	26,806 (17.3% Sulfur: 2.09% SOUR 21.08° Heavy	93,581*
CONOCOPHILLIPS Rodeo	120,000	21,839 bpd – 28.7% Sulfur: 0.26% Sweet 35.80° Interm/ Light	39,538*
OTHER CALIFORNIA REFINERIES about 150,000 bpd			
BIG WEST (Flying J) Bakersfield	70,000	0	48,180*
KERN OIL Bakersfield	26,000	0	18,980*
CONOCOPHILLIPS Santa Maria	41,800	not available	32,266 *
GREKA Santa Maria	9,500	not available	not available
TENBY Oxnard	2,800	0	2,044*

- VOLUME OF CRUDE OIL processed in the refinery is in barrels per day (1 barrel = 42 gallons)
- SOUR CRUDE = HIGH SULFUR — greater than 1% sulfur contamination (though definitions vary)
- SOUR CRUDE CREATES MORE HAZARDOUS SULFUR GASES DURING REFINING
- SWEET CRUDE = LOW SULFUR
- API GRAVITY is a measure of how heavy (or dense) the crude oil is. This is a reverse scale so that lower API numbers mean heavier crude oil. Heavy crude takes more energy to process, and more pollution is generated. Heavy or “high carbon” crude is frequently high sulfur, with higher heavy metals.

» Environmental racism: Cumulative impacts of fossil fuels in Wilmington go well beyond refineries

Although this report focuses on the oil industry, it is important to note Wilmington's severe Cumulative Impact burden by identifying the many other major pollution sources in or very nearby Wilmington. There is a need for effective Cumulative Impact policies by government agencies involved in planning and permitting, to reverse these impacts. CBE will be publishing a fuller report on Cumulative Impacts in the region in the future.

Environmental injustice or environmental racism is a well-documented and severe problem across the country, where communities of color and low-income communities bear a higher concentration of pollution compared to white communities. Unfortunately, Wilmington is a prime example. Although having five oil refineries puts Wilmington into a class by itself due to that fact alone, the pollution burden does not stop there.

Pollution sources in or near Wilmington add up!

Five Oil Refineries	Oil Drilling
Ports of LA & Long Beach	Alameda Corridor (railway)
I-110 & 710 Freeways	Diesel Trucking
Auto Body Shops	Recycling Facilities
Sewage Treatment (& much more)	Regional Smog

Communities of color & the low income in Wilmington bear the cumulative impact burden of fossil fuel.²⁸

	Wilmington	LA
Hispanic or Latino of any race	85%	45%
Median household income	\$30,260	\$42,190
Individuals below the poverty level	27%	18%

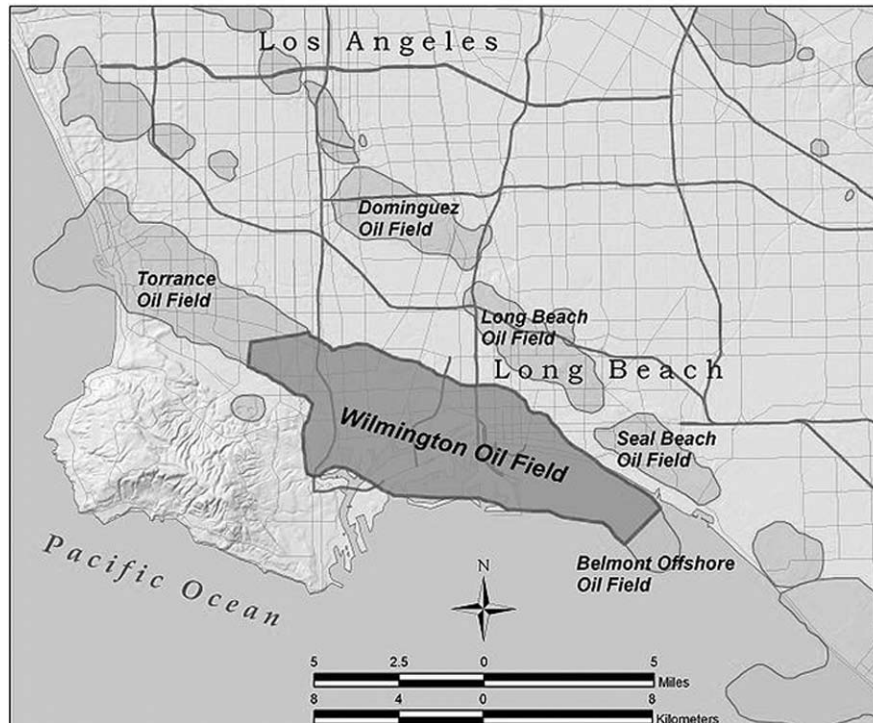


Wilmington:
Refineries, Ports, Oil Drilling, Railways, Freeways, Diesel Trucking & more



- Cumulative Impacts means communities receive pollution from many different sources together
- New policies requiring stricter permits are greatly needed!

» In addition to oil refining, oil drilling is causing more fossil fuel cumulative impacts right in Wilmington



As if ports, freeways, and refineries weren't enough, **Wilmington contains the third largest oil field in the U.S.**

The oil field was previously considered depleted, but in recent years with new methods and the incentive of high oil prices, drilling has ramped up. CBE's Wilmington oil drilling campaign began in 2006. **People living around the Warren E&P drilling operations contacted CBE to report severe noise, sickening smells, air and water pollution, and breathing problems after the company purchased the site.** Neighbors reported constant diesel truck traffic through the residential streets, dust and oily residue covering and invading homes, constant flaring (from a stack burning oil field gas), and heavy vibrations at all hours of the day and night, seven days a week.

Although drilling operations occurred at this site in the past (at a much reduced level), when Warren E&P purchased the facility, production drastically increased, as did impacts on the community where it sits. Recent technological advances now allow oil companies to drill laterally, reaching out underground to large areas, that

previously would have been drilled from other locations. That means much larger volumes of oil and gas can come out of one drilling site, in a very intensive operation. Warren E&P has concentrated its drilling operations in this way at the "Wilmington Town Lot," in a residential neighborhood. Even though it borders an industrial area, it is hard to understand why such a neighborhood site would be chosen.

After neighbors called us, CBE worked together with the community to devise strategies to stop the impacts of the drilling. These included evaluating Warren's compliance with air, water, toxics and land use regulations, identifying methods and equipment to reduce flaring and air pollution, pushing for enforcement of existing bans for large diesel truck traffic through the neighborhood, getting paving and street-sweeping requirements implemented to stop the heavy construction dust blowing offsite, and pushing for better government agency monitoring.

CBE contacted the South Coast Air Quality Management District and the City of Los Angeles, and together with community members met with government officials and the company. CBE community organizers and Warren neighbors developed logs of impacts, took photos, videotaped flaring, and evaluated noise levels. Meanwhile CBE lawyers and scientists researched and documented health and environmental impacts, legal requirements, and Warren's permit limits.

It became clear that Warren was not in compliance with permit conditions and limits. After we contacted the Air Quality Management District, the regional agency issued a Notice of Violation to Warren for burning gases in the flare, far above its permit limits. Unfortunately the Air District then began rushing through a permit that would have allowed even more flaring. CBE challenged it and the Air District withdrew it. CBE and neighbors met with the Air District staff and chief to describe the severe conditions. The Air District began to develop a new compliance plan to reduce Warren's air pollution.

(continued next page)



Photo from video by Rember Sosa, neighbor to Warren oil drilling

In a CBE survey, Wilmington neighbors described oil drilling operations as “a living hell.”

CBE organizers carried out a survey of neighbors after bitter complaints about Warren drilling, with the following different responses from neighbors:

- It's been different since the Warren site came to the neighborhood
- A lot of allergies, breathing problem, headaches, chronic problems, lack of sleep
- Get a weird taste in my mouth, difficulty in bad traffic, breathing, there's a breeze of dust, the house is full of dust, must close the windows in the house 24/7
- Mainly health problems—sleeping. House always has dust and oily residue, vibrations. I know my blood pressure is just on edge, I just have to leave. This can't go on much longer.
- Smell, noise, illness. Extreme breathing difficulties, Dr. visits
- Evening noise—more dust, smells, extensive lung illness, constant coughing—less sleep
- Lots of dust. Every morning lots of black film all over the cars
- Problems breathing. More dust in my home, headache
- Affected my health by asthma, community is dirt
- Headache, nausea, and difficulty breathing



Neighbors attend public meeting on Warren Oil Drilling Operations at Los Angeles Councilwoman Hahn's office

After the Notice of Violation, CBE and members intensified work on the land use front. As a result of communications with the City and Wilmington's representative Janice Hahn, the Zoning Administrator instituted a review of Warren's Land Use requirements. CBE and members documented the suite of impacts, and submitted legal and technical briefs.

The morning of the hearing, Warren packed the auditorium by providing free breakfast to busloads of Warren E&P shareholders and royalty recipients from outside the community who didn't have knowledge of local impacts. CBE members from the neighborhood were dismayed and offended by this show, but many still overcame their disillusionment and spoke out eloquently at the hearing. It took months before the Zoning Administrator issued a decision, adding few requirements including restrictions on hours of operation and trucking, but not sufficient to meet neighbors' concerns.

CBE and members continued documenting ongoing impacts from Warren, and pursued the Air District process, where the agency and polluter were collaborating

on a long-term plan to relieve Warren of liability for its air violations. CBE testified and offered evidence at the quasi-trial conducted by the Air District Hearing Board on Warren's permit violations.

Neighbors urged the Board to reject the plan and require compliance with the law. Although the Hearing Board denied our challenge, the community efforts resulted in the Air District issuing a more protective compliance plan to decrease Warren's flaring, improve equipment, ultimately send gases offsite for sale instead of burning onsite, and more. Warren is now required to comply with more enforceable air protections.

Although CBE and neighbors were very dissatisfied with the formal decisions at the hearings, the community pressure meant that much was accomplished behind the scenes to get the City and the Air District to force Warren to clean up operations, while they awaited permit decisions. While neighbors are very happy that conditions have greatly improved, many are concerned that this may be only a temporary improvement.

HEALTH IMPACTS OF OIL DRILLING

- H₂S and other hazardous sulfur compounds such as SO_x (Sulfur Oxides) can hurt breathing, and can be released by oil drilling operations including well heads, pumps, piping, separation devices, storage tanks, and flaring.
- The US Agency for Toxic Substances and Disease Registry found: People can smell H₂S at low levels. Lower level, long-term exposure can cause eye irritation, headache, fatigue, respiratory irritation, and at high levels, death.²⁹
- Studies found people living near oil and gas wells had higher levels of many diseases.³⁰
- Oil drilling operations also cause emissions of VOCs (Volatile Organic Compounds), which include smog-producing and cancer-causing chemicals.

People are concerned that Warren may only be temporarily on its best behavior, prior to the next permit approval needed, and may relapse in the future. The facility is slated to further increase production for years. There is also a major concern that reduced noise and pollution is due to reduced production because crude oil prices are currently down again. Warren may have ramped down production until prices go up again. If production increases greatly, there is concern impacts could increase greatly.

Neighbors are also very frustrated about foundation damage to their homes that was never compensated. Continued watchdogging is needed to protect neighbors from this terribly inappropriate siting. **A serious Cumulative Impact policy could have prevented this bad siting.**

A FEW CAMPAIGN RESULTS

	Positive Result for Now?	Permanent Solution?
Diesel trucking through neighborhood	✓	?
Construction dust from dirt	✓	✓
Continuous flaring	✓	?
Noise	✓	?
Smells	✓	?
Foundation damage	☹	☹

- The frequent, illegal diesel trucking through the neighborhood has stopped; the crude oil is now piped offsite instead of trucked.
- Extreme construction dust is apparently permanently stopped on the main site. Warren has now complied with its original requirement to pave the site (though a nearby area is still in question)
- Constant flaring has stopped for now
- Noise has improve greatly, possibly temporary
- Smells have improved

RECOMMENDATION 1 — CLEAN UP REFINERIES, REDUCE PRODUCTION

A. SET A CAP ON DIRTY CRUDE OIL & STOP EXPANDING REFINERIES

- Set standards for refinery inputs requiring limits on use of heavy, high sulfur crude oil (just like electric power plants which are switching to lower carbon fuels)

B. REQUIRE ENERGY EFFICIENCY & BEST AVAILABLE CONTROL TECHNOLOGY TO REDUCE ALL POLLUTANTS

- **Refineries need energy audits to identify the worst energy users at each refinery.**
The worst energy users emit not only greenhouse gases, but smog forming chemicals and toxics from combustion of fossil fuels, so reducing energy use cleans up most or all pollutants. The biggest growing energy users at refineries include: Hydrogen Plants, Hydrotreaters, Hydrocrackers, Fluid Catalytic Crackers, Cokers, Sulfur Recovery Units, Boilers & Heaters (many which were built as long ago as the 1930's).
- **BACT is a well-tested Clean Air Act method of cleaning up industrial polluters.**
New sources are required to meet the pollution control levels met by the best controls in use in the nation. It's time we applied BACT (or BARCT — Best Available Retrofit Control Technology) to existing refinery sources (not just new sources).
- **Remove Methane Exemptions in smog regulations for refineries and all sources.**
Methane was previously considered not to cause smog formation, and is exempted from emission limits, but Harvard and Princeton studies show that methane is not only a potent greenhouse gas, but a smog precursor.³¹
- **No dumping and burning of "waste" gases through flares and Pressure Relief Devices:**
Require sufficient gas recovery to recycle gases in refineries instead of burning in flares, and require Flare Minimization Plans for all flares. The Shell Martinez CA Refinery has achieved a very low level of flaring, including emergencies. Ban venting of Pressure Relief Devices to atmosphere, recycling gases in the refinery.

C. SWITCH REFINERY USE OF GRID ELECTRICITY TO CLEAN ENERGY

Refineries are current large users of fossil fuel grid electricity & should be required to switch to clean alternative energy electricity, frequently buildable on refinery land.

D. SET A GOAL FOR REDUCTION PRODUCTION & DEMAND

Like requirements for electric power plants renewable

We have unprecedented opportunities to clean up fossil fuels, eliminate their health and environmental impacts for good, & create green jobs!

RECOMMENDATION 2 — RAMP UP AVAILABLE ALTERNATIVES

A. CONSERVATION IS BY FAR THE BIGGEST OPPORTUNITY FOR REDUCTION FOSSIL FUEL USE, for example:

If we had Vehicle Fuel Economy standards we could save over 3 California's worth of gasoline:

If the U.S. increased mpg standards 45% higher using cost-efficient techniques, we'd save over 50 billion gallons of gasoline per year (Nat'l. Academy of Sciences), or over three Californias worth of gas. (California used about 15 billion gals/yr in 2003). Increasing fuel efficiency of cars & trucks by 3 mpg can save about 1 million barrels of oil/day or 5 times the amount the Arctic refuge might produce.

B. MANY CLEAN ALTERNATIVES ARE AVAILABLE



Plug-in Hybrid Electric Vehicles already achieve 60-100 mpg. Non-plug in hybrids are being converted to hybrids, achieving 60-100 mpg, and even 200 mpg under ideal conditions.³² Running a plug-in would reduce average fuel cost by about half. Plug-ins also help wind energy by providing storage in the car batteries.



Photovoltaics (Solar Panels) could provide about 10% of the grid's electricity by 2030 without grid management problems (equivalent to 275 GW in the US) (*American Solar Energy Society*). PV installation is a fast-growing green jobs provider.



Concentrated Solar Power can economically deploy 80 gigawatts by 2030 in the US Southwest (equivalent to about 160 large fossil fuel plants at 500 megawatts each).



Wind capacity in the US is assessed at 245 gigawatts and higher with storage; over 10,000 megawatts are already in use. Wind power's low cost is expected to cause continued market penetration; the U.S. has large numbers of high quality wind sites. Best resources are Rocky Mountain and Great Plains states; also Sierras and Appalachians.

Most of the information above is from an excellent report on alternative energy, *Tackling Climate Change* from the American Solar Energy Society. See endnotes.³³

These opportunities are unprecedented because of the ground-swell of installations of available alternatives, demonstrating that they work.

» Glossary

Climate Change – a long-term significant change in patterns of average weather of the Earth. Thousands of scientists around the world have concurred that air pollution from human activities is causing climate change. Greenhouse gases, such as Carbon Dioxide (CO₂) emitted when fossil fuels are burned in cars and by industry, as well as methane emissions from agriculture and industry, and other air pollutants in lesser quantities from various sources, trap the sun's heat in our atmosphere. In the past, more of this heat was reflected back to space, but now it is increasing temperatures on earth. CO₂ is also naturally occurring in our atmosphere, but human use of fossil fuels for energy has caused a sharp increase IN CO₂.

Examples of impacts of climate change include melting of polar ice caps, mountain glaciers and snowpack, due to increasing average temperatures (projected to cause 1 billion people to lose their drinking water), extreme weather conditions including droughts and floods, tropical diseases moving northward, sea level rise (which is destroying certain island nations and threatens millions in coastal areas), more wildfires, increased intensity of hurricanes, increased smog due to hotter temperatures, extinction of many plant and animal species, and many other extreme impacts. Extensive documentation of climate change and impacts is available from numerous sources, including the Intergovernmental Panel on Climate Change (IPCC), at <http://www.ipcc.ch/ipccreports/ar4-syr.htm>.

Crude oil – a fossil fuel. Crude oil is made up of a mix of hydrocarbons (such as pentane, octane, benzene, methane, and many others). Crude oil is processed by separating, cracking, reforming molecules, and stripping contamination at oil refineries to make diesel, gasoline, jet fuel, kerosene, lube oil, heating oil, sulfur, and petrochemicals. Different crude oils originate from many parts of the world and vary in how heavy they are, and how much contamination is present (such as sulfur, heavy metals, and selenium).

Fossil fuels – Fossil fuels were formed from decayed prehistoric plants and animals over millions of years (hence the name fossil fuels). These include crude oil, coal, natural gas, other gases, fuels made from crude oil, such as gasoline, diesel, jet fuel, and others. Fossil fuels are hydrocarbon molecules, made up of different numbers of hydrogen and carbon. Using and burning fossil fuels

causes emissions of greenhouse gases that cause global impacts, including carbon dioxide (CO₂) and methane, but they also emit chemicals that cause local impacts such as smog-forming chemicals and toxics (such as benzene). Many people are working toward promoting available alternative energy in order to phase out fossil fuels and eliminate their associated severe respiratory (such as asthma), and other health impacts and global impacts.

Greenhouse gases – CO₂ is the main greenhouse gas emitted, due to burning fossil fuels. Methane is another greenhouse gas, emitted by using fossil fuels, but also emitted by cows in agriculture, landfills, and other sources. Methane is much more potent than CO₂ as a greenhouse gas, but is emitted in lower quantities. These two greenhouse gases are both emitted by oil refineries. Other greenhouse gases include nitrous oxide, sulfur hexafluoride, trifluoromethane, difluoroethane, carbon tetrafluoride, and others.

Renewable energy – Renewable energy is generated from natural resources — sunlight, wind, geothermal, tides — as opposed to fossil fuel, which is not renewable because it was formed over millions of years. See page 23 for a few important examples, plus a reference to a report with extensive information on alternative energy availability in the U.S.

Sweet crude oil / Sour crude oil – Sweet crude oil means lower sulfur crude oil – generally less than 1% sulfur contamination (though definitions vary). Sour crude oil is generally greater than 1% sulfur. Sour crude is cheaper than sweet crude, so if refineries invest in the equipment needed to process sour crude, they increase profits greatly. Unfortunately sour crude takes much more energy to process, which means that more fossil fuels are needed to make the gasoline and diesel from the crude. Thus more air pollution is generated. It also means a large increase in acutely hazardous sulfur compounds present at oil refineries, which can be emitted continuously, or during accidents.

Sulfur, Sulfur Dioxide (SO_x), and Hydrogen Sulfide (H₂S) and other sulfur compounds – Sulfur is solid, pale yellow nonmetallic element occurring widely in nature, but also present as a contaminant in different compounds found within crude oil. Sulfur by itself is a solid

that is not harmful, but at oil refineries it is present as part of acutely hazardous sulfur gases including hydrogen sulfide, sulfur dioxide, carbon disulfide, and many other severely odorous and hazardous gases.

CO₂ – or Carbon Dioxide – see greenhouse gases above.

Ozone – Ground-level ozone (or O₃) is the main pollutant in smog, which causes respiratory harm and asthma attacks. Ground-level ozone is formed by the chemical reaction in the atmosphere of hydrocarbons and nitrogen oxides which are released during the burning of fossil fuels. Ozone on the other hand is naturally occurring in the upper atmosphere of the earth, where it shields us from harmful ultra-violet rays, and where it is called the ozone layer. Destruction of the ozone layer caused by chemicals emitted by human activities is a different problem from climate change caused by fossil fuel combustion.

PM 2.5 – Particulate matter of 2.5 microns or less (extremely small particles that can be inhaled deep into our lungs). Numerous studies have found that when PM_{2.5} increases, hospital death rates increase. It also causes respiratory irritation to normal adults. PM_{2.5} is emitted by the combustion of fossil fuels, and other sources.

VOCs – Volatile Organic Compounds are generally hydrocarbon gases. Different hydrocarbons have varying numbers of hydrogen and carbon atoms. One hydrocarbon (methane) is a strong greenhouse gas, but less toxic. Another hydrocarbon, benzene, is not a greenhouse gas,

but is much more toxic, and is known to cause leukemia (a deadly cancer). Hydrocarbons in general react in the atmosphere to cause ground-level ozone, the main component of smog.

PRDs – Pressure Relief Devices at oil refineries, necessary to ensure that when pressure gets too high, the valve opens to keep equipment from blowing up. Unfortunately, many PRDs at refineries vent to the atmosphere, causing large bursts of harmful air pollution, including H₂S, smog precursors, and greenhouse gases. PRDs can instead be vented to gas recovery systems.

SCAQMD – South Coast Air Quality Management District, which is responsible for cleaning up smog and issuing permits for equipment that can emit air pollution in the Los Angeles region. The SCAQMD implements many aspects of the Clean Air Act and state and local regulations. Community members can take part in public processes at the SCAQMD in order to win clean up of air pollution problems.

Stationary, mobile, and area sources of air pollution – A stationary source of air pollution is a single source that is not mobile. This includes both large and small sources such as oil refineries, power plants, other industries, and also dry cleaners, autobody shops, and many others. Non-stationary sources of air pollution include mobile sources (cars, trucks, trains, planes) and area sources (spray cans, consumer products, lawn mowers, that are small sources that add up over a large area).

» More solutions – other CBE publications

Contact CBE for technical and legal publications identifying specific refinery pollution sources, and methods for minimizing and phasing out their fossil fuel pollution. A few key documents are listed below (soon to come on our website, at www.cbecal.org):

May 2008 Comments to the California Air Resources Board on the AB32 Scoping Plan

December 2008 Comments to the California Air Resources Board on the AB32 Scoping Plan with Addendum on Dirty Crude and Hydrogen use

Comments on the Chevron Richmond “Energy and Hydrogen Renewal Project”

Comments on the ConocoPhillips Rodeo “Clean Fuels Expansion”

» Notes on Table – Sources of Crude, Sulfur, Content, API Gravity

Crude Capacity

BP <http://www.bp.com/sectiongenericarticle.do?categoryId=9005027&contentId=7009099>

Chevron El Segundo <http://www.chevron.com/products/sitelets/elsegundo/about/>

Exxon Mobil Torrance <http://www.eia.doe.gov/neic/rankings/refineries.htm>

ConocoPhillips Wilmington & Carson
http://www.conocophillips.com/about/worldwide_ops/country/north_america/west.htm

Valero Wilmington <http://www.valero.com/AboutUs/Refineries/Wilmington.htm>

Tesoro Wilmington <http://www.tsocorp.com/tsocorp/ProductsandServices/Refining/LosAngelesCaliforniaRefinery/LosAngelesCalifornia>

Paramount Petroleum, Paramount <http://www.eia.doe.gov/neic/rankings/refineries.htm>

Edgington Oil <http://www.eia.doe.gov/neic/rankings/refineries.htm>

Lunday Thagard <http://www.eia.doe.gov/neic/rankings/refineries.htm>

Chevron Richmond <http://www.chevron.com/products/sitelets/richmond/about/>

Valero Benicia <http://www.valero.com/AboutUs/Refineries/Benicia.htm>

Tesoro Avon/Martinez <http://www.tsocorp.com/TSOCorp/ProductsandServices/Refining/MartinezCaliforniaRefinery/MartinezCaliforniaRefinery>

Shell Martinez <http://www.piersystem.com/external/index.cfm?cid=159&fuseaction=EXTERNAL.docview&documentID=52481>

ConocoPhillips Rodeo http://www.conocophillips.com/about/worldwide_ops/country/north_america/west.htm

Big West Bakersfield http://www.bigwestca.com/bigwest/appmanager/bwoc/home?_nfpb=true&_pageLabel=flyingjPortal_portal_page_18

Kern Oil Bakersfield <http://www.kernoil.com/>

ConocoPhillips Santa Maria
http://www.greatvalley.org/sjpartnership/docs/101707/oil%20refineries_10-17-07.pdf

Greka Santa Maria <http://www.eia.doe.gov/neic/rankings/refineries.htm>

Tenby Oxnard <http://www.eia.doe.gov/neic/rankings/refineries.htm>

Valero Domestic Crude Supply

Valero Energy Corp (New York Stock Exchange)

Valero's Benicia Refinery is located northeast of San Francisco on the Carquinez Straits of San Francisco Bay. It **processes** sour crude oils into premium products, primarily CARBOB gasoline. (CARBOB is a reformulated gasoline mixture that meets the specifications of the California Air Resources Board when blended with ethanol.)

Its Wilmington Refinery is located near Los Angeles, California. The refinery processes a blend of heavy and high-sulfur crude oils. The refinery can produce all of its gasoline as CARBOB gasoline and produces both ultra-low-sulfur diesel and CARB diesel. The refinery is connected by pipeline to marine terminals and associated dock facilities that can move and store crude oil and other feedstocks. Refined products are distributed via the Kinder Morgan pipeline system and various third-party terminals in southern California, Nevada, and Arizona. (Reuters, <http://www.reuters.com/finance/stocks/companyProfile?symbol=VLO.N>, Jan. 27, 2009)

» Endnotes

1. Original graphics from: http://www.energy.ca.gov/maps/refinery_locations.html , graphics modified, labels added, data on barrels per day added by CBE
2. California Air Resources Board, Climate Change Proposed Scoping Plan Appendices (later finalized), Volume I: Supporting Documents and Measure Detail page C-155 states: "It is unlikely that refinery production will decrease in California over the next 12 years because of GHG reduction requirements. Due to the State's proximity to existing infrastructure (seaports, pipelines, etc.) and the developing Low Carbon Fuel Standard (LCFS)—which will hold both in-state and out-of-state producers to the same low carbon fuel standard—the demand for fuel products from California's refineries will not significantly change in the short term." <http://www.arb.ca.gov/cc/scopingplan/document/appendix1.pdf>
3. Draft 2007 AQMP Appendix III, Base and Future Year Emissions Inventories, 10/06
4. Presentation, Local Impacts of Global Warming, June 15, 2006, Dr. Margaret Torn, Climate Change and Carbon Management Program Head, Lawrence Berkeley National Laboratory, Earth Sciences Division: "Wildfire Severity Increases in California: -Fires burn hotter and spread faster, -More fires escape initial suppression efforts, - The number of potentially catastrophic fires doubles!"
5. SCAQMD, "Aerial photo with Aerial Photo with one-in-a-million risk isopleths of refineries," http://www.aqmd.gov/prdas/refinery/ref_agen_2005-08-18.html
6. Proposed Modifications to the Draft 2007 AQMP Appendix III, Base and Future Year Emissions Inventories, 10/06, Table D, 175th page (unnumbered), February 2007
7. <http://tonto.eia.doe.gov/dnav/pet/hist/mcrs1p52m.htm>, PADD5 also includes Alaska (373,500 bpd 2006), Washington State (673,850 bpd), and Hawaii (147,500 bpd). Alaska refineries included: North Pole Koch Industries, Inc, Kenai Tesoro Petroleum Corp, Valdez Petro Star Inc, North Pole Petro Star Inc, Kuparuk ConocoPhillips, Prudhoe Bay BP Exploration Alaska Inc; Washington State included: Anacortes Tesoro West Coast, Cherry PT BP W Coast Prods LLC, Ferndale ConocoPhillips Co, Puget Sound Shell Oil Prods US, Tacoma U S Oil & Refg CO, Hawaii included: EWA Beach Tesoro Hawaii Corp, Honolulu Chevron USA Inc. (The Form EIA-810, "Monthly Refinery Report," is used to collect data on refinery input and capacity, sulfur content and API gravity of crude oil)
8. U.S. Energy Information Administration, Changing Trends in the Refining Industry, 2006, http://www.eia.doe.gov/oiaf/aeo/otheranalysis/aeo_2006analysispapers/tri.html
9. Petroleum Administration For Defense Districts (PADD) - Five geographic areas into which the United States was divided by the Petroleum Administration for Defense for purposes of administration during federal price controls or oil allocation. OPIS, Oil Price Information Service, <http://www.opisnet.com/market/glossary.asp#P>
10. Nevada: Eagle Springs Refinery (Foreland Refining), 1,700 bbl/d (270 m³/d), http://en.wikipedia.org/wiki/List_of_oil_refineries#Nevada, Oregon Department of Energy – Conservation Division: "There are no primary oil refineries in Oregon." <http://www.oregon.gov/ENERGY/CONS/Industry/petro.shtml>, EIA: Arizona has no refineries and receives its petroleum product supply via two pipelines, one from southern California and the other from El Paso, Texas. http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=AZ
11. http://tonto.eia.doe.gov/dnav/pet/pet_pnp_crq_dcu_r50_m.htm
12. Profile of the Petroleum Refining Industry in California, California Industries of the Future Program, The Lawrence Berkeley National Laboratory, LBNL-55450, Ernst Worrell and Christina Galitsky, Environmental, Energy Technologies Division, March 2004, page iii. <http://ies.lbl.gov/iespubs/55450.pdf>
13. ConocoPhillips Rodeo Refinery Clean Fuels Expansion Project, Contra Costa County Community Development Department, April 2007, Final Environmental Impact Report, page 2-6, http://www.co.contra-costa.ca.us/depart/cd/current/ConocoPhillipsDEIR_11_27_06/1%20-%20Introduction.pdf
14. Ibid, Torn
15. Ibid
16. <http://articles.latimes.com/2001/jul/24/business/fi-25907>
17. <http://www.answers.com/topic/valero-energy-corp>
18. http://www.tsocorp.com/stellent/groups/public/documents/published/tsi_bus_ref_t3__anacortes.hcsp
19. Final Environmental Impact Report for Chevron Products Company El Segundo Refinery Product Reliability and Optimization Project, <http://www.aqmd.gov/ceqa/documents/2008/nonaqmd/chevron/PRO/chevronFND.html>

20. Form 10-K, Chevron Corp – CVX, February, 28 2008, Annual report [Section 13 and 15(d), not S-K Item 405], page 25
21. ConocoPhillips Rodeo Refinery Clean Fuels Expansion Project, November 2006, page 1-1, ConocoPhillips Rodeo Refinery Clean Fuels Expansion Project
22. <http://articles.latimes.com/2005/nov/17/business/fi-conoco17>
23. BP Alaska Pipeline Shutdown- Impact on West Coast Refiners, http://www.fundamentalpetroleumtrends.com/sample_reports/update/PADD%205%20Crude%20Oil%20Supply%20081106.pdf
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30. Drilling Down, Natural Resources Defense Council, http://catskillpost.files.wordpress.com/2008/04/drillingdown_factsheet.pdf
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32. <http://www.physorg.com/news140271245.html> , PhysOrg.com is a Web-based science and technology news service specializing in content ranging from Physics, Earth Science, Medicine, Nanotechnology, Electronics, Space, Biology, Chemistry, Computer sciences, Engineering, Mathematics and much more.
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