U.S. Refinery Benzene Emissions Increase in 2008:
Data Quality Concerns Undermine Confidence in Reported Data

Photo Credit: U.S. EPA, http://www.epa.gov/oust/graphics/miscpix2.htm.

The Environmental Integrity Project

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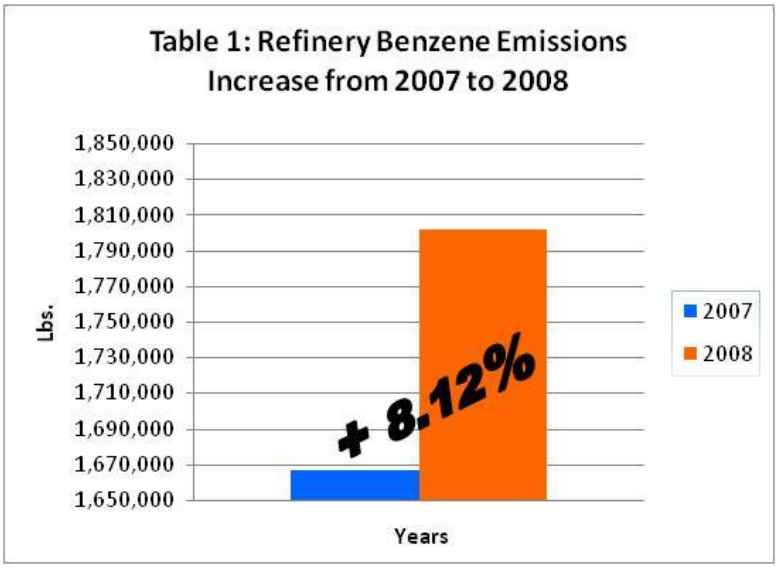
U.S. Refinery Benzene Emissions Increase in 2008: Data Quality Concerns Undermine Confidence in Reported Data

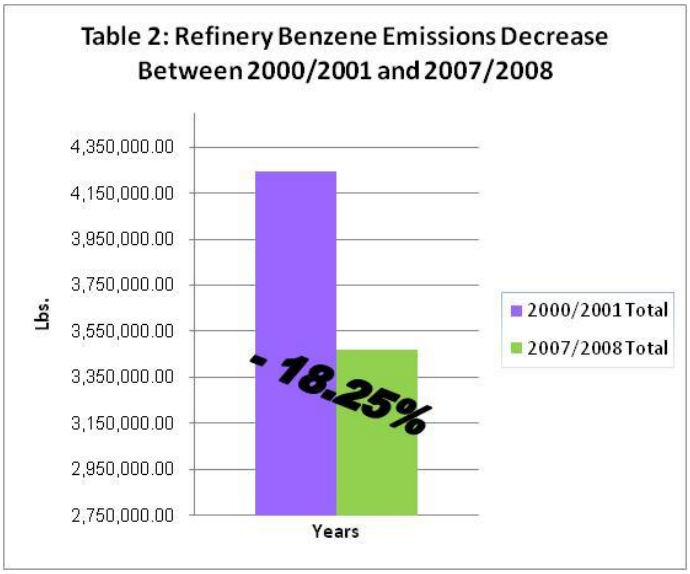
A Report by the Environmental Integrity Project

Trends in Benzene Emissions from U.S. Refineries

Refinery emissions of benzene, a known human carcinogen, increased more than 8% between 2007 and 2008, according to company reports to the Environmental Protection Agency's (EPA) Toxics Release Inventory (TRI). See Table 1. This came despite a decline in the demand for petroleum products in 2008, which led some U.S. refineries to reduce production.[1] Of all U.S. refineries, the four refineries with the largest total emissions increases between 2007 and 2008 were Citgo's Westlake refinery in Louisiana, BP's Texas City refinery in Texas, Sunoco's Philadelphia refinery in Pennsylvania, and Sunoco's Marcus Hook refinery also in Pennsylvania. See Attachment A for complete refinery totals.[2] In addition, concerns over inconsistent emissions reporting and inaccurate emissions factors used to predict actual discharges suggest that these numbers significantly *underreport* actual benzene emissions, creating problems for the agencies relying on this data for permitting and enforcement.[3]



The good news is that long-term emissions of benzene appear to have declined. In fact, benzene emissions from all refineries decreased by more than 18% when comparing emissions from 2000/2001 to 2007/2008. See Table 2. For example, the Conoco Wood River refinery in Illinois decreased its emissions by 400,277 pounds from 2000/2001 to 2007/2008. See Table 3 and Attachment B, "U.S. Refinery Benzene Emissions Changes From 2000/2001 to 2007/2008 in Ranked Order (pounds)." The reductions at Wood River actually account for more than half the total reductions in benzene emissions from all U.S. refineries between

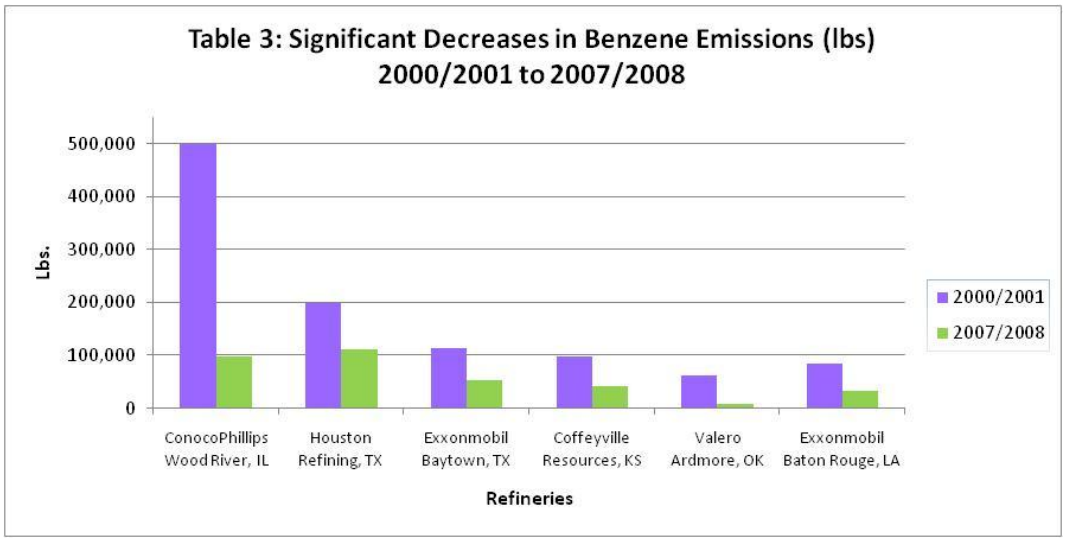


[1] U.S. Department of Energy, Office of Oil and Gas, Energy Information Administration, "Petroleum Marketing Annual 2008" (Aug. 2009).

[2] This research represents all U.S. refineries identified on EPA's TRI website, with the exception of several asphalt plants mislabeled as refineries, terminals and docks with separately reported emissions, plants that reported zero emissions for two years or more, one plant with conflicting TRI reports, and plants for which data was not available.

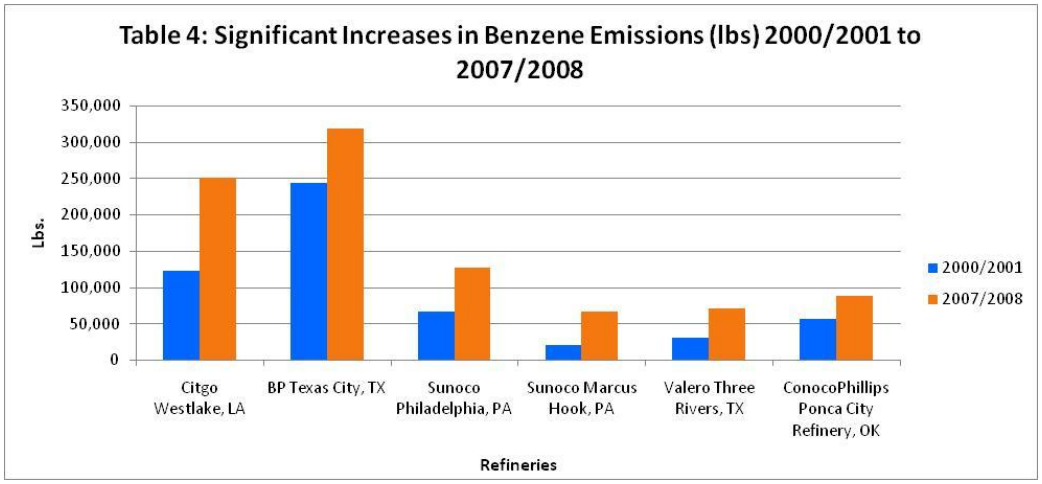
[3] See discussion below, entitled "Data Quality Concerns Regarding Benzene Emissions Monitoring and Reporting."

2001/2002 and 2007/2008.[4] In addition, Houston Refining LP's refinery reduced its emissions by 88,227 pounds from 2000/2001 to 2007/2008. These reductions have been driven in part by Clean Air Act rules that limit emissions of smog-forming chemicals like benzene, as well as enforcement actions that require new controls for flares, process units, and wastewater treatment systems.



See Attachment B, "U.S. Refinery Benzene Emissions Changes From 2000/2001 to 2007/2008 in Ranked Order (pounds)."

Nevertheless, while overall emissions have declined, reported benzene emissions at some refineries continue to increase. See Table 4. For example, combined fugitive and stack emissions at Citgo's Westlake refinery in Louisiana increased by 129,112 pounds from 2000/2001 to 2007/2008. At BP's Texas City refinery, emissions increased by 76,200 pounds from 2000/2001 to 2007/2008. In addition, Sunoco's Philadelphia refinery increased emissions by 60,434 pounds from 2000/2001 to 2007/2008. The increase at Citgo's Westlake refinery appears to be the result of an accident that leaked 92,578 pounds of benzene in December 2008.[5] The leak occurred over a period of less than four hours, and nearly all of the benzene volatilized into the air.



See Attachment B, "U.S. Refinery Benzene Emissions Changes From 2000/2001 to 2007/2008 in Ranked Order (pounds)."

[4] Excluding Wood River, which accounted for 52% of emissions reductions, emissions from all other refineries declined only 10% since the beginning of the decade.

[5] The Westlake refinery is also known as the Lake Charles refinery. Citgo filed a notification report for the unauthorized discharge on January 6, 2009 with Louisiana environmental authorities, Case No. 08-07877.

Data Quality Concerns Regarding Benzene Emissions Monitoring and Reporting

Continued uncertainty over the quality and accuracy of reporting makes it difficult to know how much real progress has been made in the effort to decrease benzene emissions. Some companies that report relatively high emissions may actually be doing a more careful job measuring their releases than others. However, there is also evidence that benzene emissions on the whole are being underreported due to outdated and inaccurate emission factors and conflicting reports submitted by industry.

Inconsistent Emissions Reports Submitted by Refineries

Some refineries have submitted conflicting reports on their emissions that undermine confidence in the quality of their data. See Table 5. For example, the Delek refinery in Tyler, Texas reported releasing 40,920 pounds of benzene to the state's emissions inventory (EI) in 2007, but reported only 5,977 pounds to EPA's Toxics Release Inventory (TRI) for the same year. Also, Valero Refining's Corpus Christi East refinery reported 27,366 pounds to EI and 38,561 pounds to TRI. These inconsistencies cast doubt on industry reports and may compromise the efforts of regulators who rely on that data for permitting and enforcement efforts.

Table 5: Inconsistent Emissions Reports Submitted by Refineries

COMPANY	EI (Lbs.)	TRI (Lbs.)
Delek	40,920	5,977
Valero Corpus Christi East	27,366.20	38,561

Actual Emissions Much Higher Than Reported Emissions

Remote sensing measurements have recorded much higher emissions of benzene and other pollutants than are typically reported by industry. For example, a 2006 report prepared by the Alberta Research Council monitored emissions at a Canadian refinery from fugitive sources such as leaking valves and fittings, vents, cooling towers, tanks, and the coker area.[6] The highest fugitive benzene emissions were recorded from the coker area (including the vacuum unit and water pond), final product tanks, and crude feed tanks. The report was conducted using remote sensing technology called DIAL (Differential Absorption Light Detection and Ranging), which measures quantities of fugitive emissions over a short period of time and then extrapolates the data to estimate annual emissions.

The Alberta study concluded that emissions can be significantly affected by variables such as tank size, design, type of liquid, level of fill, and wind speed, among other factors.

Measurements taken at the Alberta refinery depicted a four-fold increase in benzene emissions from facility tanks when wind speed increased from 10 km/hr (6.2 mph) to 30 km/hr (18.6 mph).

However, Canada's NPRI (National Pollutant Release Inventory) emissions factors do not account well for these variables. For example, the NPRI estimated benzene releases from storage or handling to be 0.265 tons (530 pounds) per year, while the DIAL method predicted annual emissions of 25.4

[6] Allan Chambers, P. Eng., & Mel Strosher, Alberta Research Council, Inc., Refinery Demonstration of Optical Technologies for Measurement of Fugitive Emissions and for Leak Detection (revised Nov. 1, 2006).

tons (50,800 pounds) – nearly 100 times that of the NPRI estimates. These results are particularly significant to Americans because Canada's NPRI emission factors are based on factors developed more than 25 years ago by the U.S. EPA that are still used to estimate emissions at U.S. refineries.

Because of DIAL's greater accuracy, the City of Houston has petitioned EPA use DIAL and other remote sensing technologies to obtain more accurate data on refinery emissions, and to use the information to revise or replace the outmoded emission factors upon which EPA and the refinery industry have relied for decades.

Refineries also frequently underestimate emissions from flares, using EPA approved methodologies that assume that 98% of the volatile organic compounds (which include benzene) that are released to a flare are destroyed in the combustion process. But a DIAL remote sensing study performed by the UK's National Physical Laboratory and conducted at BP's Texas City refinery identified a flare with combustion efficiencies closer to 50%.[7] In other words, half the pollutants were being released directly to the environment instead of being consumed by the flare. That same study found that one flare released emissions of volatile organic compounds at a rate 25 times higher than the standard methods used to estimate emissions from this source.

In 2006, a study by Houston-based Industrial Professionals for Clean Air (IPCA) further corroborated the underestimation of fugitive emissions from flares. The IPCA study concluded that large amounts of unrecognized emissions were being emitted from facility flare stacks due to a poor understanding of the effect that variables such as wind speed have on flare combustion benzene reduction. As a result, regulators and facilities were underestimating the release of benzene and other pollutants coming from flare stacks.[8]

According to IPCA, refineries in Texas report flare emissions based on 1983 estimation methods developed by EPA and the Texas Commission on Environmental Quality that assume flares operate under ideal weather conditions with maximum wind speeds of 5 miles per hour. But in the real world, the winds can blow much harder, and combustion inefficiency increases exponentially with crosswinds at just 10 miles per hour. Chemical compounds must be burned within a flare flame for a certain period of time in order to break down. The IPCA report points out that crosswinds can cause a flare to separate from the tip, leading to major increases in emissions during emergency flaring events. Furthermore, operation variables such as steam input used to balance the flare combustion can be affected by crosswinds that separate the flare from the burner. Inadequate estimates that do not factor in these types of variables lead to a significant underreporting of benzene emissions.

Alternative technologies do exist, however. The IPCA's report recommends replacement of traditional flares with fuel gas recovery systems that recapture and recycle gases from anticipated facility emissions. Also, in lieu of the traditional elevated flare, enclosed ground flares, incinerators, and thermal oxidizers are more combustion efficient and less susceptible to wind.

Other major sources of benzene are not just poorly measured – often they are not measured at all. For example, refinery coker ponds represent a huge source of unregulated fugitive toxic pollutant emissions, including benzene, toluene, ethyl benzene, and xylene (BTEX). Coker units used in oil

[7] National Physical Laboratory (UK), Measurements of VOC Emissions from Petrochemical Industry Sites in the Houston Area Using Differential Absorption Lidar (DIAL) for Summer 2007 (unpublished report for Texas CEQ) (Feb. 2008).
[8] Robert E. Levy, Lucy Randel, Meg Healy, & Don Weaver, Industrial Professionals for Clean Air, Reducing Emissions from Plant Flares (revised Apr. 24, 2006).

refining are cleaned out with water that is sometimes routed to wastewater settling ponds. Once discharged into the pond, toxic pollutants can volatilize into the air. A 1991 EPA study identified the coker pond area as the largest source of unregulated benzene emissions at Amoco's refinery in Yorktown, Virginia.[9] Despite these shockingly high toxic emissions, EPA has yet to set standards of performance to control emissions from the coker pond area.

Table 6: Causes of Uncertainty in Benzene Emissions Data

Problems	Research Conclusions
Inaccurate Fugitive Emission Estimates	While Canada's NPRI methodology estimated a facility's storage handling benzene emissions to be 530 pounds a year, Alberta Research Council's DIAL system determined that 50,800 pounds are actually emitted – a 9,485% difference. (Alberta Research Council's 2006 Report: "Refinery Demonstration of Optical Technologies for Measurement of Fugitive Emissions and for Leak Detection.")
Inaccurate Flare Emissions Estimates	EPA relies upon decades old data to predict benzene emissions from flares, which presumes that flares operate under ideal weather conditions with no more than five mph crosswinds. However, the benzene reduction efficiency of flares reduces exponentially when winds reach just 10 mph, a common occurrence for elevated flare stacks. (Industrial Professionals for Clean Air's 2006 Paper: "Reducing Emissions from Plant Flares.")
No Emissions Measurement or Standards for Coker Ponds	EPA determined that coker settling ponds at an Amoco refinery released 97,400 ug/min/m^2 of toxic pollutants such as benzene, toluene, ethyl benzene, and xylene. Although EPA performed that study in 1991, it has yet to promulgate standards of performance to regulate emissions from coker ponds, meaning that coker pond benzene emissions are not factored into overall emissions. (EPA's 1991 study: Amoco-EPA, Pollution Prevention Project, Yorktown, Virginia: Measurements of Hydrocarbon Emissions and Ambient Air Concentrations at the Amoco Yorktown Refinery.")
Conflicting Emission Reports	In 2007, the Delek refinery in Texas reported 40,920 pounds of benzene emissions to EPA's Emissions Inventory (EI), but only 5,977 pounds to EPA's Toxics Release Inventory (TRI). Also in 2007, Valero Refining's Corpus Christi East refinery reported 27,366 pounds to EI and 38,561 pounds to TRI. (EPA databases: http://www.epa.gov/ttn/chief/eiinformation.html, http://www.epa.gov/tri/)

Virtually every U.S. refinery now operates under a consent decree with U.S. EPA that requires significant reductions of benzene and other pollutants.[10] These enforcement actions, combined with tighter standards and voluntary action by some refineries have no doubt made a difference – the question is just how much. See Table 6. EPA should take the following actions to improve monitoring, and build greater public confidence in the industry's emission reports.

[9] Amoco-EPA, Pollution Prevention Project, Yorktown, Virginia: Measurements of Hydrocarbon Emissions and Ambient Air Concentrations at the Amoco Yorktown Refinery: Air Quality Data, vol. 1 (Sept. 30, 1991).
[10] See EPA, Petroleum Refinery National Priority Case Results, available at http://www.epa.gov/compliance/resources/cases/civil/caa/oil/index.html.

Recommendations:

- Refineries should be required to use remote sensing technology such as DIAL to check and recalibrate emissions factors.
- Regulators should recalibrate emissions estimates to factor in variables such as wind speed. This should take place when EPA revisits emissions factors as promised in a recent Federal Register notice.[11]
- Emissions from cokers and coker ponds need to be better measured, and EPA should develop standards to limit benzene releases from these sources.
- Toxic emissions reporting to EPA's EI and TRI databases needs to be consistent and represent an accurate picture of refinery emissions.

[11] "Emissions Factors Program Improvements," 74 Fed. Reg. 52,723 (Oct. 14, 2009).

ATTACHMENT A

U.S. Refinery Benzene Emissions

Attachment A: U.S. Refinery Benzene Emissions (pounds/year)

Facility, City, State	2000		2001		2007		2008	
	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack
Age Refining Inc., San Antonio, TX	250	250	250	250	750	250	1,360	2,900
Alon Refining Krotz Springs Inc., Krotz Springs, LA	4,163	1,297	2,392	1,644	2,819	2,989	2,659	3,909
Alon USA - Big Spring Refinery, Big Spring, TX	18,037	12,780	9,370	21,334	811	16,462	2,837	15,391
American Refining Group Inc., Bradford, PA	554	140	250	250	67	272	77	282
Big West Of California Refinery, Bakersfield, CA	250	250	250	750	250	750	210	828
Big West Oil LLC, North Salt Lake, UT	4,796	0	4,762	0	5,686	0	5,642	0
BP Cherry Point Refinery, Blaine, WA	41,000	2,200	17,000	3,000	3,100	3,900	2,940	3,680
BP Products North America Inc. Texas City Refinery, Texas City, TX	57,000	110,000	4,800	71,000	40,000	110,000	19,000	150,000
BP Products North America Inc. Toledo Refinery, Oregon, OH	4,800	8,300	4,900	6,400	6,900	2,700	5,600	3,800
BP Products North America Whiting, Whiting, IN	12,000	42,000	9,500	4,300	1,253	9,500	19,000	6,500
BP West Coast Products LLC Carson, Carson, CA	908	1,238	684	1,172	846	946	731	786
Calcasieu Refining Co., Lake Charles, LA	2,379	250	1,544	157	496	17,174	553	8,864
Catlettsburg Refining LLC, Catlettsburg, KY	25,068	12,460	25,341	5,365	7,671	11,944	7,588	9,849
Chalmette Refining LLC, Chalmette, LA	46,000	6,000	48,000	8,000	19,400	19,200	12,600	16,500
Chevron Products Co. - Hawaii Refinery, Kapolei, HI	5,970	2,840	1,343	3,393	3,500	1,000	3,700	1,100
Chevron Products Co. - Salt Lake Refinery, Salt Lake City, UT	250	1,200	750	2,200	250	2,000	250	2,500
Chevron Products Co. Div Of Chevron USA Inc., El Segundo, CA	305	1,345	256	1,765	236	975	310	2,200
Chevron Products Co. Pascagoula Refinery, Pascagoula, MS	20,000	26,000	28,000	24,000	33,000	19,000	35,000	17,000
Chevron Products Co. Richmond Refinery, Richmond, CA	3,900	6,700	3,800	2,500	1,500	2,800	2,000	2,300
CHS Inc. Laurel Refinery, Laurel, MT	2,200	1,500	2,600	1,400	2,200	1,700	2,200	2,000
Citgo Petroleum Corp., Westlake, LA	27,673	28,404	33,182	32,521	28,172	53,172	27,391	142,157
Citgo Refining & Chemicals Co. LP - West Plant, Corpus Christi, TX	776	22	1,210	23	229	6	601	19
Citgo Refining & Chemicals Co. LP East Plant, Corpus Christi, TX	19,266	15,064	19,949	15,234	8,418	8,618	16,608	7,610
Coffeyville Resources Refining & Marketing, Coffeyville, KS	1,400	46,720	1,400	48,320	31,806	804	9,140	1,145
ConocoPhillips Co. - Bayway Refinery, Linden, NJ	23,000	9,000	3,100	5,900	2,200	4,600	3,700	4,000

Attachment A: U.S. Refinery Benzene Emissions (pounds/year)

Facility, City, State	2000		2001		2007		2008	
	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack
ConocoPhillips Co. - Trainer Refinery, Trainer, PA	1,730	1,192	1,477	1,382	1,452	2,030	1,769	1,998
ConocoPhillips Co. Billings Refinery, Billings, MT	3,100	2,100	2,300	2,400	6,700	2,200	6,300	2,100
ConocoPhillips Co. Sweeny Refinery Complex, Old Ocean, TX	5,510	39,693	6,633	27,872	12,000	9,300	26,000	9,200
ConocoPhillips Ferndale Refinery, Ferndale, WA	610	1,400	571	1,438	4,900	2,200	5,388	2,387
ConocoPhillips La Refinery Wilmington Plant, Wilmington, CA	61	412	73	378	290	600	320	570
ConocoPhillips Lake Charles Refinery, Westlake, LA	4,810	6,362	4,774	9,085	8,673	5,979	10,117	7,308
ConocoPhillips Los Angeles Refinery Carson Plant, Carson, CA	63	387	68	165	90	490	110	480
ConocoPhillips Ponca City Refinery, Ponca City, OK	17,892	8,935	3,072	25,840	29,250	5,451	34,250	18,998
ConocoPhillips San Francisco Refinery, Rodeo, CA	750	1,000	1,800	1,000	2,000	700	1,900	660
ConocoPhillips Santa Maria Facility-Refinery, Arroyo Grande, CA	160	225	180	230	190	270	200	250
ConocoPhillips Wood River Refinery, Roxana, IL*	280,000	16,000	190,000	12,000	27,590	21,518	24,580	24,035
ConocoPhilllips Co. Borger Refinery, Borger, TX**	36,696	24,405	35,758	9,395	22,000	13,000	34,000	12,000
Convent Refinery, Convent, LA	1,500	1,400	1,300	1,700	682	2,923	771	2,354
Countrymark Refinery, Mount Vernon, IN	3,572	771	1,930	465	392	269	398	241
Delek Refining Ltd., Tyler, TX	19,000	1,900	21,000	2,300	1,367	4,610	4,440	4,440
Ergon West Virginia Inc., Newell, WV	1,150	974	950	796	383	1,553	53	1,023
ExxonMobil Billings Refinery, Billings, MT	3,100	6,500	1,300	6,200	970	3,000	1,800	2,200
ExxonMobil Oil Beaumont Refinery, Beaumont, TX	12,000	6,200	12,000	11,000	3,700	5,700	3,700	7,202
ExxonMobil Oil Corp. - Torrance Refinery, Torrance, CA	740	3,000	670	3,200	530	5,400	560	5,600
ExxonMobil Oil Corp. Joliet Refinery, Channahon, IL	1,357	1,203	2,215	1,641	1,928	3,101	1,826	1,713
ExxonMobil Refining & Supply Baton Rouge Refinery, Baton Rouge, LA	24,334	13,190	19,423	28,173	11,000	7,800	8,800	5,000
ExxonMobil Refining & Supply Baytown Refinery, Baytown, TX	7,642	54,239	9,809	42,385	4,300	21,700	4,300	23,900
Flint Hills Resources Alaska LLC, North Pole, AK	2,900	3,300	2,900	3,200	3,200	2,400	3,200	1,570
Flint Hills Resources LP - East Plant, Corpus Christi, TX	12,010	5,053	3,765	3,487	3,986	3,926	3,840	2,914

Attachment A: U.S. Refinery Benzene Emissions (pounds/year)

Facility, City, State	2000		2001		2007		2008	
	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack
Flint Hills Resources LP - West Plant, Corpus Christi, TX	28,813	20,634	31,621	14,863	38,479	22,503	33,189	18,798
Flint Hills Resources LP, Rosemount, Clark Rd, MN	2,500	8,000	5,400	9,000	340	5,700	380	5,600
Frontier El Dorado Refining Co., El Dorado, KS	16,000	15,000	11,000	14,000	7,182	19,347	11,637	11,259
Frontier Refining Inc., Cheyenne, WY	3,885	2,020	3,703	1,787	1,075	5,413	1,085	5,454
Hess Corp. - Port Reading Refinery, Port Reading, NJ	162	2,378	177	2,531	1,120	3,652	509	1,693
Holly Refining & Marketing Co. Woods Cross Refinery, Woods Cross, UT	6,400	1,700	6,500	2,100	12,100	3,900	8,700	1,300
Houston Refining LP, Houston, TX	51,113	53,428	57,527	37,614	63,827	14,158	24,187	9,283
Hovensa LLC, Christiansted, VI	5,684	18,480	4,192	19,364	4,647	19,220	4,816	19,538
Hunt Refining Co. A Corp., Tuscaloosa, AL	7,569	1,220	7,637	1,064	4,710	692	4,268	788
Hunt Southland Refining Co. - Sandersville, Heidelberg, MS	500	7,400	500	7,400	92	581	111	497
Kern Oil & Refining Co., Bakersfield, CA	750	250	750	250	250	250	250	250
Lima Refining Co., Lima, OH	8,821	13,359	25,799	13,412	4,700	18,047	4,679	13,005
Lion Oil Co., El Dorado, AR	16,718	9,697	16,632	11,736	6,032	11,926	6,850	7,596
Marathon Ashland Petroleum LLC Illinois Refining Div, Robinson, IL	20,393	5,096	21,477	8,086	6,876	10,987	7,546	8,643
Marathon Petroleum Co. LLC - Michigan Refining Div, Detroit, MI	2,200	4,200	2,800	3,600	3,244	1,709	5,231	2,742
Marathon Petroleum Co. LLC Ohio Refining Div, Canton, OH	5,535	5,149	7,261	4,235	9,490	4,297	6,323	3,855
Marathon Petroleum Co. LLC Saint Paul Park Refiner, Saint Paul Park, MN	6,291	1,358	11,085	1,288	8,413	12,004	5,061	4,419
Marathon Petroleum Co. LLC, Texas City, TX	19,610	17,600	23,241	10,883	4,166	22,016	2,627	23,065
Marathon Petroleum Corp. Garyville, Garyville, LA	4,492	4,154	2,434	4,455	15,000	1,600	12,394	2,065
Montana Refining Co. Inc., Great Falls, MT	250	250	1,400	250	2	7,959	20	9,355
Motiva Enterprises LLC Norco Refinery, Norco, LA	8,700	5,200	8,626	9,129	4,167	11,680	5,855	7,186
Motiva Enterprises LLC, Port Arthur, TX	1,440	1,420	702	1,502	13,651	1,059	13,597	1,296
Murphy Oil USA Inc. Meraux Refinery, Meraux, LA	6,643	1,917	6,789	3,581	3,352	3,765	4,955	4,509
Murphy Oil USA Inc., Superior, WI	709	279	651	652	3,927	2,213	3,918	2,015
National Co-Op Refinery Assoc, McPherson, KS	16,600	8,400	13,540	10,220	6,466	2,803	4,352	2,654

Attachment A: U.S. Refinery Benzene Emissions (pounds/year)

Facility, City, State	2000		2001		2007		2008	
	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack
Navajo Refining Co., Artesia, NM	15,508	3,020	6,995	3,020	11,723	983	18,634	1,052
Pasadena Refining System,Inc., Pasadena, TX	10,574	4,798	10,574	4,630	17,000	2,500	7,590	4,539
Placid Refining Co. LLC, Port Allen, LA	3,274	1,330	3,274	1,330	1,089	5,453	484	4,023
Premcor Refining Group Inc., Delaware City, DE	8,500	1,000	18,000	1,200	1,723	3,403	2,399	4,228
Shell Chemical Yabucoa Inc., Yabucoa, PR	2,856	528	1,109	205	10,868	811	9,107	1,192
Shell Oil Co. Deer Park Refining LP, Deer Park, TX	5,800	17,000	6,600	21,000	279	15,314	4,176	18,242
Shell Oil Products US - Martinez Refinery, Martinez, CA	560	1,400	590	2,600	580	1,400	400	1,100
Shell Oil Products US - Puget Sound Refinery, Anacortes, WA	1,010	1,920	1,700	2,200	820	910	590	1,200
Silver Eagle Refining Woods Cross, Woods Cross, UT	957	417	2,749	466	1,197	820	885	484
Sinclair Casper Refining Co., Casper, WY	3,343	973	6,300	1,100	3,270	4,065	594	1,463
Sinclair Tulsa Refining Co., Tulsa, OK	250	1,989	5,300	1,700	7,400	5,400	10,000	3,300
Sinclair Wyoming Refining Co., Sinclair, WY	8,694	3,546	10,000	7,000	25,000	3,500	25,000	2,900
Suncor Energy Commerce City Refinery, Commerce City, CO	1,401	1,457	1,635	1,357	157	926	88	694
Sunoco Inc. (R&M) Eagle Point Facility, Westville, NJ	11,563	11,966	11,514	13,614	10,187	6,505	2,349	5,037
Sunoco Inc., Oregon, OH	3,000	3,510	3,900	2,724	2,011	2,508	2,050	2,530
Sunoco, Inc. (R&M) - Marcus Hook Refinery, Marcus Hook, PA	1,700	7,300	1,600	10,218	7,754	13,253	26,932	19,024
Sunoco, Inc. (R&M) Philadelphia Refinery, Philadelphia, PA	34,576	4,975	21,613	4,974	20,625	8,187	65,600	32,160
Tesoro Alaska - Kenai Refinery, Kenai, AK	4,883	4,199	7,520	2,836	6,400	4,100	4,500	2,600
Tesoro Hawaii Refinery, Kapolei, HI	290	6,347	917	2,910	1,965	2,859	3,231	2,283
Tesoro Refining & Marketing Co. - Mandan Refinery, Mandan, ND	16,000	1,500	16,000	1,300	6,000	750	3,300	850
Tesoro Refining & Marketing Co., Anacortes, WA	5,100	11,240	5,125	10,971	3,814	6,188	6,917	2,265
Tesoro Refining & Marketing Co., Martinez, CA	1,100	6,200	1,600	6,700	980	4,800	1,300	4,700
Tesoro Refining & Marketing Co., Salt Lake City, UT	750	3,000	1,100	3,000	4,800	3,100	12,000	3,300
Total Petrochemicals USA Inc. - Port Arthur Refinery, Port Arthur, TX	15,801	17,885	11,325	19,032	10,040	5,151	11,181	4,871
Ultramar Inc. Wilmington Refinery, Wilmington, CA	240	440	170	470	217	470	316	424

Attachment A: U.S. Refinery Benzene Emissions (pounds/year)

Facility, City, State	2000		2001		2007		2008	
	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack
United Refining Co., Warren, PA	2,200	3,400	2,030	1,500	2,470	3,679	2,680	3,671
US Oil & Refining Co., Tacoma, WA	1,667	454	1,165	1,201	991	700	1,220	1,070
Valero McKee, Sunray, TX***	1,260	6,420	340	6,088	3,002	1,344	2,611	4,728
Valero Refining - New Orleans LLC, New Sarpy, LA	265	6,598	10,783	6,553	1,300	4,000	1,200	3,200
Valero Refining - Texas LP Corpus Christi West Plant, Corpus Christi, TX	2,357	7,167	2,393	7,052	2,658	8,816	2,688	12,886
Valero Refining - Texas LP Houston Refinery, Houston, TX	1,170	11,697	1,165	12,414	6,296	6,824	4,271	3,944
Valero Refining - Texas LP, Texas City, TX	2,962	16,875	2,962	14,089	475	8,559	580	15,245
Valero Refining Co. - California Benicia Refinery, Benicia, CA	4,400	5,400	4,800	5,300	12,180	5,686	4,246	2,673
Valero Refining Co. - New Jersey, Paulsboro, NJ	5,921	2,919	6,561	2,865	3,336	7,516	2,699	11,341
Valero Refining Co. -Oklahoma Valero Ardmore Refinery, Ardmore, OK	6,460	27,280	27,772	18	1,460	2,939	1,558	2,718
Valero Refining Co. Tennessee LLC, Memphis, TN	3,147	3,244	3,575	2,771	3,120	3,744	2,524	4,362
Valero Refining Texas LP Corpus Christi East Plant, Corpus Christi, TX	40,021	11,028	34,945	11,102	19,331	19,230	8,916	19,053
Valero Three Rivers Refinery, Three Rivers, TX	7,327	8,162	7,331	7,097	12,360	20,606	23,502	14,397
Valero, Port Arthur, TX****	3,800	4,500	4,045	4,428	2,655	9,290	1,482	9,431
Western Refining Bloomfield Refinery, Bloomfield, NM	458	3,232	458	3,207	1,566	3,440	1,839	7,023
Western Refining Co. El Paso Refinery, El Paso, TX	6,300	2,250	2,150	3,450	4,733	4,555	5,700	3,100
Western Refining Southwest Inc. - Gallup Refinery, Jamestown, NM	2,544	7,451	2,629	7,435	3,798	7,652	5,540	12,737
Wynnewood Refining Co., Wynnewood, OK	4,600	8,200	2,100	8,400	3,500	3,700	2,600	3,300
Wyoming Refining Co., Newcastle, WY	250	750	750	750	39	342	129	803
Yorktown Refinery, Grafton, VA	560	2,600	1,882	1,702	909	1,535	1,021	1,722
TOTAL	**1,259,809**	**1,001,957**	**1,097,091**	**883,591**	**814,520**	**851,875**	**829,486**	**972,192**

Source: EPA, TRI Database. (Note: This list represents all U.S. refineries identified on EPA's TRI website, with the exception of several asphalt plants mislabeled as refineries, terminals and docks with separately reported emissions, plants that reported zero emissions for two years or more, one plant with conflicting TRI reports, and plants for which data was not available).

* Listed in TRI as "Wood River Refinery."

** Listed in TRI as "Borger Refinery."

*** Listed in TRI as "Diamond Shamrock Refining Co. LP."

**** Listed in TRI as "Premcor Refining Group."

ATTACHMENT B

U.S. Refinery Benzene Emissions Changes
From 2000/2001 to 2007/2008 in Ranked Order
(pounds)

Attachment B: U.S. Refinery Benzene Emissions Changes From 2000/2001 to 2007/2008 in Ranked Order (pounds)

Facility, City, State	2000		2001		2007		2008		Change from 2000/2001 to 2007/2008 (pounds)
	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	
ConocoPhillips Wood River Refinery, Roxana, IL*	280,000	16,000	190,000	12,000	27,590	21,518	24,580	24,035	-400,277
Houston Refining LP, Houston, TX	51,113	53,428	57,527	37,614	63,827	14,158	24,187	9,283	-88,227
ExxonMobil Refining & Supply Baytown Refinery, Baytown, TX	7,642	54,239	9,809	42,385	4,300	21,700	4,300	23,900	-59,875
Coffeyville Resources Refining & Marketing, Coffeyville, KS	1,400	46,720	1,400	48,320	31,806	804	9,140	1,145	-54,945
Valero Refining Co. -Oklahoma Valero Ardmore Refinery, Ardmore, OK	6,460	27,280	27,772	18	1,460	2,939	1,558	2,718	-52,855
ExxonMobil Refining & Supply Baton Rouge Refinery, Baton Rouge, LA	24,334	13,190	19,423	28,173	11,000	7,800	8,800	5,000	-52,520
BP Cherry Point Refinery, Blaine, WA	41,000	2,200	17,000	3,000	3,100	3,900	2,940	3,680	-49,580
Chalmette Refining LLC, Chalmette, LA	46,000	6,000	48,000	8,000	19,400	19,200	12,600	16,500	-40,300
Total Petrochemicals USA Inc. - Port Arthur Refinery, Port Arthur, TX	15,801	17,885	11,325	19,032	10,040	5,151	11,181	4,871	-32,800
National Co-Op Refinery Assoc, McPherson, KS	16,600	8,400	13,540	10,220	6,466	2,803	4,352	2,654	-32,485
BP Products North America Whiting, Whiting, IN	12,000	42,000	9,500	4,300	1,253	9,500	19,000	6,500	-31,547
Catlettsburg Refining LLC, Catlettsburg, KY	25,068	12,460	25,341	5,365	7,671	11,944	7,588	9,849	-31,182
Valero Refining Texas LP Corpus Christi East Plant, Corpus Christi, TX	40,021	11,028	34,945	11,102	19,331	19,230	8,916	19,053	-30,566
Delek Refining Ltd., Tyler, TX	19,000	1,900	21,000	2,300	1,367	4,610	4,440	4,440	-29,343
Citgo Refining & Chemicals Co. LP East Plant, Corpus Christi, TX	19,266	15,064	19,949	15,234	8,418	8,618	16,608	7,610	-28,259
ConocoPhillips Co. - Bayway Refinery, Linden, NJ	23,000	9,000	3,100	5,900	2,200	4,600	3,700	4,000	-26,500
Alon USA - Big Spring Refinery, Big Spring, TX	18,037	12,780	9,370	21,334	811	16,462	2,837	15,391	-26,019
ConocoPhilllips Co. Borger Refinery, Borger, TX**	36,696	24,405	35,758	9,395	22,000	13,000	34,000	12,000	-25,254
Sunoco Inc. (R&M) Eagle Point Facility, Westville, NJ	11,563	11,966	11,514	13,614	10,187	6,505	2,349	5,037	-24,579
Tesoro Refining & Marketing Co. - Mandan Refinery, Mandan, ND	16,000	1,500	16,000	1,300	6,000	750	3,300	850	-23,900
ConocoPhillips Co. Sweeny Refinery Complex, Old Ocean, TX	5,510	39,693	6,633	27,872	12,000	9,300	26,000	9,200	-23,208
Lion Oil Co., El Dorado, AR	16,718	9,697	16,632	11,736	6,032	11,926	6,850	7,596	-22,379

Attachment B: U.S. Refinery Benzene Emissions Changes From 2000/2001 to 2007/2008 in Ranked Order (pounds)

Facility, City, State	2000		2001		2007		2008		Change from 2000/2001 to 2007/2008 (pounds)
	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	
Marathon Ashland Petroleum LLC Illinois Refining Div, Robinson, IL	20,393	5,096	21,477	8,086	6,876	10,987	7,546	8,643	-21,000
Lima Refining Co., Lima, OH	8,821	13,359	25,799	13,412	4,700	18,047	4,679	13,005	-20,960
ExxonMobil Oil Beaumont Refinery, Beaumont, TX	12,000	6,200	12,000	11,000	3,700	5,700	3,700	7,202	-20,898
Marathon Petroleum Co. LLC, Texas City, TX	19,610	17,600	23,241	10,883	4,166	22,016	2,627	23,065	-19,460
Premcor Refining Group Inc., Delaware City, DE	8,500	1,000	18,000	1,200	1,723	3,403	2,399	4,228	-16,947
Hunt Southland Refining Co. - Sandersville, Heidelberg, MS	500	7,400	500	7,400	92	581	111	497	-14,519
Valero Refining - New Orleans LLC, New Sarpy, LA	265	6,598	10,783	6,553	1,300	4,000	1,200	3,200	-14,499
Tesoro Refining & Marketing Co., Anacortes, WA	5,100	11,240	5,125	10,971	3,814	6,188	6,917	2,265	-13,252
Flint Hills Resources LP, Clark Rd, Rosemount, MN	2,500	8,000	5,400	9,000	340	5,700	380	5,600	-12,880
Shell Oil Co. Deer Park Refining LP, Deer Park, TX	5,800	17,000	6,600	21,000	279	15,314	4,176	18,242	-12,389
Valero Refining - Texas LP, Texas City, TX	2,962	16,875	2,962	14,089	475	8,559	580	15,245	-12,029
Wynnewood Refining Co., Wynnewood, OK	4,600	8,200	2,100	8,400	3,500	3,700	2,600	3,300	-10,200
Flint Hills Resources LP - East Plant, Corpus Christi, TX	12,010	5,053	3,765	3,487	3,986	3,926	3,840	2,914	-9,649
ExxonMobil Billings Refinery, Billings, MT	3,100	6,500	1,300	6,200	970	3,000	1,800	2,200	-9,130
Chevron Products Co. Richmond Refinery, Richmond, CA	3,900	6,700	3,800	2,500	1,500	2,800	2,000	2,300	-8,300
Hunt Refining Co. A Corp., Tuscaloosa, AL	7,569	1,220	7,637	1,064	4,710	692	4,268	788	-7,032
Frontier El Dorado Refining Co., El Dorado, KS	16,000	15,000	11,000	14,000	7,182	19,347	11,637	11,259	-6,575
Countrymark Refinery, Mount Vernon, IN	3,572	771	1,930	465	392	269	398	241	-5,438
BP Products North America Inc. Toledo Refinery, Oregon, OH	4,800	8,300	4,900	6,400	6,900	2,700	5,600	3,800	-5,400
Valero Refining - Texas LP Houston Refinery, Houston, TX	1,170	11,697	1,165	12,414	6,296	6,824	4,271	3,944	-5,111
Chevron Products Co. - Hawaii Refinery, Kapolei, HI	5,970	2,840	1,343	3,393	3,500	1,000	3,700	1,100	-4,246
Sunoco Inc., Oregon, OH	3,000	3,510	3,900	2,724	2,011	2,508	2,050	2,530	-4,035
Suncor Energy Commerce City Refinery, Commerce City, CO	1,401	1,457	1,635	1,357	157	926	88	694	-3,985
Tesoro Refining & Marketing Co., Martinez, CA	1,100	6,200	1,600	6,700	980	4,800	1,300	4,700	-3,820

Attachment B: U.S. Refinery Benzene Emissions Changes From 2000/2001 to 2007/2008 in Ranked Order (pounds)

Facility, City, State	2000		2001		2007		2008		Change from 2000/2001 to 2007/2008 (pounds)
	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	
Shell Oil Products US - Puget Sound Refinery, Anacortes, WA	1,010	1,920	1,700	2,200	820	910	590	1,200	-3,310
Motiva Enterprises LLC Norco Refinery, Norco, LA	8,700	5,200	8,626	9,129	4,167	11,680	5,855	7,186	-2,767
Valero McKee, Sunray, TX***	1,260	6,420	340	6,088	3,002	1,344	2,611	4,728	-2,423
Murphy Oil USA Inc. Meraux Refinery, Meraux, LA	6,643	1,917	6,789	3,581	3,352	3,765	4,955	4,509	-2,349
Sinclair Casper Refining Co., Casper, WY	3,343	973	6,300	1,100	3,270	4,065	594	1,463	-2,324
Flint Hills Resources Alaska LLC, North Pole, AK	2,900	3,300	2,900	3,200	3,200	2,400	3,200	1,570	-1,930
Tesoro Alaska - Kenai Refinery, Kenai, AK	4,883	4,199	7,520	2,836	6,400	4,100	4,500	2,600	-1,838
Shell Oil Products US - Martinez Refinery, Martinez, CA	560	1,400	590	2,600	580	1,400	400	1,100	-1,670
Yorktown Refinery, Grafton, VA	560	2,600	1,882	1,702	909	1,535	1,021	1,722	-1,557
Silver Eagle Refining Woods Cross, Woods Cross, UT	957	417	2,749	466	1,197	820	885	484	-1,204
Wyoming Refining Co., Newcastle, WY	250	750	750	750	39	342	129	803	-1,187
Citgo Refining & Chemicals Co. LP - West Plant, Corpus Christi, TX	776	22	1,210	23	229	6	601	19	-1,176
Kern Oil & Refining Co., Bakersfield, CA	750	250	750	250	250	250	250	250	-1,000
Ergon West Virginia Inc., Newell, WV	1,150	974	950	796	383	1,553	53	1,023	-858
BP West Coast Products LLC Carson, Carson, CA	908	1,238	684	1,172	846	946	731	786	-693
US Oil & Refining Co., Tacoma, WA	1,667	454	1,165	1,201	991	700	1,220	1,070	-506
American Refining Group Inc., Bradford, PA	554	140	250	250	67	272	77	282	-497
Tesoro Hawaii Refinery, Kapolei, HI	290	6,347	917	2,910	1,965	2,859	3,231	2,283	-126
Chevron Products Co. Div Of Chevron USA Inc., El Segundo, CA	305	1,345	256	1,765	236	975	310	2,200	50
Ultramar Inc. Wilmington Refinery, Wilmington, CA	240	440	170	470	217	470	316	424	107
ConocoPhillips Santa Maria Facility- Refinery, Arroyo Grande, CA	160	225	180	230	190	270	200	250	115
Marathon Petroleum Co. LLC - Michigan Refining Div, Detroit, MI	2,200	4,200	2,800	3,600	3,244	1,709	5,231	2,742	126
Chs Inc. Laurel Refinery, Laurel, MT	2,200	1,500	2,600	1,400	2,200	1,700	2,200	2,000	400
ConocoPhillips Los Angeles Refinery Carson Plant, Carson, CA	63	387	68	165	90	490	110	480	487

Attachment B: U.S. Refinery Benzene Emissions Changes From 2000/2001 to 2007/2008 in Ranked Order (pounds)

Facility, City, State	2000		2001		2007		2008		Change from 2000/2001 to 2007/2008 (pounds)
	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	
Hovensa LLC, Christiansted, VI	5,684	18,480	4,192	19,364	4,647	19,220	4,816	19,538	501
Big West Of California Refinery, Bakersfield, CA	250	250	250	750	250	750	210	828	538
Chevron Products Co. - Salt Lake Refinery, Salt Lake City, UT	250	1,200	750	2,200	250	2,000	250	2,500	600
ConocoPhillips San Francisco Refinery, Rodeo, CA	750	1,000	1,800	1,000	2,000	700	1,900	660	710
Convent Refinery, Convent, LA	1,500	1,400	1,300	1,700	682	2,923	771	2,354	830
ConocoPhillips La Refinery Wilmington Plant, Wilmington, CA	61	412	73	378	290	600	320	570	856
Valero Refining Co. Tennessee LLC, Memphis, TN	3,147	3,244	3,575	2,771	3,120	3,744	2,524	4,362	1,013
Pasadena Refining System,Inc., Pasadena, TX	10,574	4,798	10,574	4,630	17,000	2,500	7,590	4,539	1,053
ConocoPhillips Co. - Trainer Refinery, Trainer, PA	1,730	1,192	1,477	1,382	1,452	2,030	1,769	1,998	1,468
Frontier Refining Inc., Cheyenne, WY	3,885	2,020	3,703	1,787	1,075	5,413	1,085	5,454	1,632
Hess Corp. - Port Reading Refinery, Port Reading, NJ	162	2,378	177	2,531	1,120	3,652	509	1,693	1,727
Big West Oil LLC, North Salt Lake, UT	4,796	0	4,762	0	5,686	0	5,642	0	1,770
Marathon Petroleum Co. LLC Ohio Refining Div, Canton, OH	5,535	5,149	7,261	4,235	9,490	4,297	6,323	3,855	1,785
Placid Refining Co. LLC, Port Allen, LA	3,274	1,330	3,274	1,330	1,089	5,453	484	4,023	1,841
ExxonMobil Oil Corp. Joliet Refinery, Channahon, IL	1,357	1,203	2,215	1,641	1,928	3,101	1,826	1,713	2,152
Alon Refining Krotz Springs Inc., Krotz Springs, LA*	4,163	1,297	2,392	1,644	2,819	2,989	2,659	3,909	2,880
United Refining Co., Warren, PA	2,200	3,400	2,030	1,500	2,470	3,679	2,680	3,671	3,370
Navajo Refining Co., Artesia, NM	15,508	3,020	6,995	3,020	11,723	983	18,634	1,052	3,849
Western Refining Co. El Paso Refinery, El Paso, TX	6,300	2,250	2,150	3,450	4,733	4,555	5,700	3,100	3,938
Age Refining Inc., San Antonio, TX	250	250	250	250	750	250	1,360	2,900	4,260
ExxonMobil Oil Corp. - Torrance Refinery, Torrance, CA	740	3,000	670	3,200	530	5,400	560	5,600	4,480
Valero Refining Co. - California Benicia Refinery, Benicia, CA	4,400	5,400	4,800	5,300	12,180	5,686	4,246	2,673	4,885
Chevron Products Co. Pascagoula Refinery, Pascagoula, MS	20,000	26,000	28,000	24,000	33,000	19,000	35,000	17,000	6,000
Valero, Port Arthur, TX****	3,800	4,500	4,045	4,428	2,655	9,290	1,482	9,431	6,085

Attachment B: U.S. Refinery Benzene Emissions Changes From 2000/2001 to 2007/2008 in Ranked Order (pounds)

Facility, City, State	2000		2001		2007		2008		Change from 2000/2001 to 2007/2008 (pounds)
	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	
Western Refining Bloomfield Refinery, Bloomfield, NM	458	3,232	458	3,207	1,566	3,440	1,839	7,023	6,513
Valero Refining Co. - New Jersey, Paulsboro, NJ	5,921	2,919	6,561	2,865	3,336	7,516	2,699	11,341	6,626
ConocoPhillips Lake Charles Refinery, Westlake, LA	4,810	6,362	4,774	9,085	8,673	5,979	10,117	7,308	7,046
ConocoPhillips Co. Billings Refinery, Billings, MT	3,100	2,100	2,300	2,400	6,700	2,200	6,300	2,100	7,400
Valero Refining - Texas LP Corpus Christi West Plant, Corpus Christi, TX	2,357	7,167	2,393	7,052	2,658	8,816	2,688	12,886	8,079
Holly Refining & Marketing Co. Woods Cross Refinery, Woods Cross, UT	6,400	1,700	6,500	2,100	12,100	3,900	8,700	1,300	9,300
Western Refining Southwest Inc. - Gallup Refinery, Jamestown, NM	2,544	7,451	2,629	7,435	3,798	7,652	5,540	12,737	9,668
Murphy Oil USA Inc., Superior, WI	709	279	651	652	3,927	2,213	3,918	2,015	9,782
Marathon Petroleum Co. LLC Saint Paul Park Refiner, Saint Paul Park, MN	6,291	1,358	11,085	1,288	8,413	12,004	5,061	4,419	9,875
ConocoPhillips Ferndale Refinery, Ferndale, WA	610	1,400	571	1,438	4,900	2,200	5,388	2,387	10,856
Montana Refining Co. Inc., Great Falls, MT	250	250	1,400	250	2	7,959	20	9,355	15,186
Tesoro Refining & Marketing Co., Salt Lake City, UT	750	3,000	1,100	3,000	4,800	3,100	12,000	3,300	15,350
Marathon Petroleum Corp. Garyville, Garyville, LA	4,492	4,154	2,434	4,455	15,000	1,600	12,394	2,065	15,524
Sinclair Tulsa Refining Co., Tulsa, OK	250	1,989	5,300	1,700	7,400	5,400	10,000	3,300	16,861
Flint Hills Resources LP - West Plant, Corpus Christi, TX	28,813	20,634	31,621	14,863	38,479	22,503	33,189	18,798	17,038
Shell Chemical Yabucoa Inc., Yabucoa, PR	2,856	528	1,109	205	10,868	811	9,107	1,192	17,280
Calcasieu Refining Co., Lake Charles, LA	2,379	250	1,544	157	496	17,174	553	8,864	22,757
Motiva Enterprises LLC, Port Arthur, TX	1,440	1,420	702	1,502	13,651	1,059	13,597	1,296	24,539
Sinclair Wyoming Refining Co., Sinclair, WY	8,694	3,546	10,000	7,000	25,000	3,500	25,000	2,900	27,160
ConocoPhillips Ponca City Refinery, Ponca City, OK	17,892	8,935	3,072	25,840	29,250	5,451	34,250	18,998	32,209
Valero Three Rivers Refinery, Three Rivers, TX	7,327	8,162	7,331	7,097	12,360	20,606	23,502	14,397	40,948
Sunoco, Inc. (R&M) - Marcus Hook Refinery, Marcus Hook, PA	1,700	7,300	1,600	10,218	7,754	13,253	26,932	19,024	46,145

Attachment B: U.S. Refinery Benzene Emissions Changes From 2000/2001 to 2007/2008 in Ranked Order (pounds)

Facility, City, State	2000		2001		2007		2008		Change from 2000/2001 to 2007/2008 (pounds)
	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	
Sunoco, Inc. (R&M) Philadelphia Refinery, Philadelphia, PA	34,576	4,975	21,613	4,974	20,625	8,187	65,600	32,160	60,434
BP Products North America Inc. Texas City Refinery, Texas City, TX	57,000	110,000	4,800	71,000	40,000	110,000	19,000	150,000	76,200
Citgo Petroleum Corp., Westlake, LA	27,673	28,404	33,182	32,521	28,172	53,172	27,391	142,157	129,112
TOTAL	**1,259,809**	**1,001,957**	**1,097,091**	**883,591**	**814,520**	**851,875**	**829,486**	**972,192**	

Source: EPA, TRI Database. (Note: This list represents all U.S. refineries identified on EPA's TRI website, with the exception of several asphalt plants mislabeled as refineries, terminals and docks with separately reported emissions, plants that reported zero emissions for two years or more, one plant with conflicting TRI reports, and plants for which data was not available).

* Listed in TRI as "Wood River Refinery."

** Listed in TRI as "Borger Refinery."

*** Listed in TRI as "Diamond Shamrock Refining Co. LP."

**** Listed in TRI as "Premcor Refining Group."