WHO'S COUNTING?

The Systematic Underreporting of Toxic Air Emissions

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A joint study by the Environmental Integrity Project and the Galveston-Houston Association for Smog Prevention

Photos courtesy of Kenneth Ford, St. Bernard Citizens for Environmental Quality

THE ENVIRIONMENTAL INTEGRITY PROJECT (EIP) is a non-profit, non-partisan organization dedicated to more effective enforcement of existing federal and state environmental laws and to the prevention of political interference with those laws. EIP's research and reports shed light on how enforcement and rulemaking affect public health. EIP also works closely with local communities seeking the enforcement of environmental laws.

THE GALVESTION-HOUSTON ASSOCIATION FOR SMOG PREVENTION (GHASP) is a community-based environmental organization dedicated to improving the quality of the Houston-Galveston region's hazardous air through public education, participation in the state and federal planning process, and active advocacy in appropriate venues.

Comments and questions regarding this report can be directed to:

Kelly Haragan
Counsel, Equal Justice Works Fellow
Environmental Integrity Project
919 18th St. NW Ste. 975
Washington, DC 20006
(202) 263-4449
kharagan@environmentalintegrity.org

John Wilson
Executive Director
Galveston-Houston Assoc. for Smog Prevention
3015 Richmond, Suite 201
Houston, TX 77098
(713) 528-3779
wilson@ghasp.org

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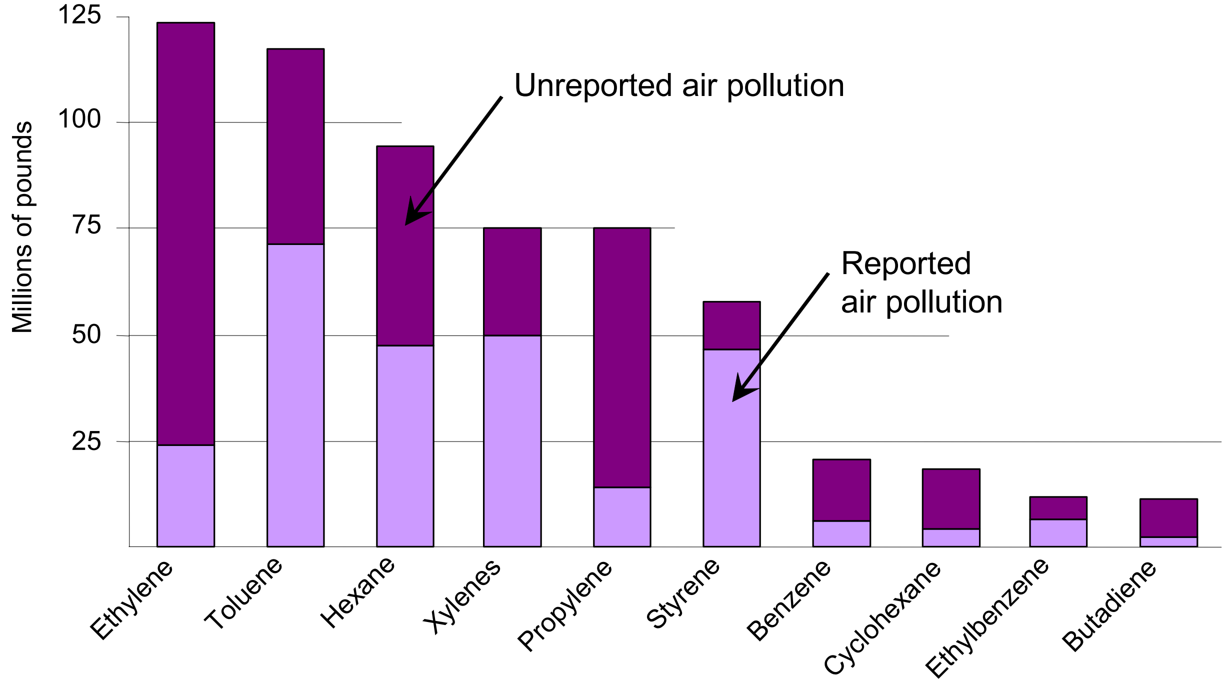
The U.S. Environmental Protection Agency (EPA) releases the results of the annual Toxic Release Inventory (TRI) each summer. The TRI has proved to be a powerful tool for raising consciousness about sources of toxic pollution and encouraging companies to act voluntarily to reduce their emissions. The official TRI, however, tells only part of the story because it dramatically underestimates the amount of toxic pollution from the petrochemical industry. The Texas Commission on Environmental Quality (TCEQ) has conducted studies which demonstrate the extent to which emissions of toxic chemicals from petrochemical facilities in Texas are underreported. This report applies the TCEQ's findings nationwide and reveals that emissions of toxic chemicals, including known carcinogens such as benzene and butadiene, are four to five times higher than is reflected in the TRI.

Federal and State environmental regulators have known for more than a decade that toxic air emissions are widely underreported. The primary reason for this problem is that most air emissions are not actually monitored. Instead, industrial facilities report their toxic emissions based on calculations that are often outdated and inaccurate. Rather than addressing the problem of systematic underreporting, the EPA has weakened monitoring requirements and continues to provide the public inaccurate data regarding toxic air emissions.

The TRI is obviously not serving its purpose if information it provides the public is inaccurate. Numerous studies across the country have documented the underreporting of industrial emissions. Studies by the TCEQ have actually quantified the extent to which refineries and chemical plants in Texas underreport certain toxic emissions.[1] To gain an idea of how significantly the national TRI may underreport these emissions, we applied Texas' findings to the national inventory for 2001, the most recent year for which data is publicly available. Our study reveals that in 2001, if Texas' results are applied nationwide, refineries and chemical plants failed to report at least 330 million pounds of toxic hydrocarbon emissions. See Table 1.

In 1984, an explosion at a chemical facility in Bhopal, India sent a toxic cloud into the neighboring community, killing thousands of people. This led many Americans to question the safety of industrial facilities in our own backyards and to call for stronger reporting of chemicals released into local communities. As a result, Congress passed a law which made industrial facilities report annually on certain toxic releases. This data is made available to the public in the Toxics Release Inventory (TRI).

Figure 1: Estimated Releases of Selected Toxic Pollutants
Millions of pounds of air releases, 2001



Source: See Appendix D.

While the Texas study looked only at a small subset of the chemicals reported to the TRI, applying the Texas results nationwide provides a glimpse of the startling magnitude of industry underreporting. Figure 1 compares the national reported to unreported emissions for the ten chemicals studied. It shows that releases of carcinogens such as benzene and butadiene may be four to five times higher than what is reported in the national TRI.

These findings are consistent with reports by the U.S. General Accounting Office and the EPA's Office of Inspector General, among others, which show that reported air emissions are often inaccurate and underestimated. It is time for EPA and the states to deal with the problem of inaccurate reporting of toxic releases. EPA should require more industrial sources to actually monitor their emissions. It should also improve emissions estimation methods for sources for which actual monitoring is not possible. The stakes for public health are too high for the government to continue to rely on data it knows to be inaccurate.

STUDY METHODOLOGY AND FINDINGS

Methodology

Numerous studies across the country have concluded that the refining and chemical manufacturing industries release significantly greater emissions than they report.[2] Texas was the first state to estimate the magnitude of the problem and to develop a system for adjusting reported emissions to more accurately reflect actual emissions.

Texas measured ambient quantities of select hydrocarbons in the Houston area and compared ambient quantities to reported emissions of those hydrocarbons. Texas then identified the sources of the emissions and developed "adjustment factors" to account for underreporting.[3] See Appendix D.

Texas officials limited their research to certain hydrocarbons believed to play a major role in causing rapid ozone formation in the Houston area. Ten of those hydrocarbons – ethylene, toluene, n-hexane, xylene, propylene, styrene, benzene, cyclohexane, ethylbenzene and 1-3 butadiene – are chemicals that are reported to the TRI. In this report, we adjusted the 2001 TRI chemical plant and refinery emissions for those ten hydrocarbons based on the Texas methodology. See Appendix D. Emissions were adjusted for only chemical plants and refineries in four Standard Industrial Codes (SICs).

It is likely that industrial sources are also underreporting many other toxic pollutant emissions. Studies similar to Texas', however, have not been conducted for the vast majority of the hundreds of pollutants reported to the TRI. This report, therefore, provides just a glimpse of a much broader problem. See Appendix E.

Study Results

Applying the Texas methodology to TRI emissions for the ten selected hydrocarbons dramatically increases the amounts of those chemicals known to be in the air.
For example, according to company data reported to the 2001 TRI, nearly 6 million pounds of benzene were released into the nation's air. Adjusting the reported benzene emissions based on the Texas methodology shows the actual amount of benzene released to be more than 20 million pounds -- a 248 percent increase. Similarly, butadiene increases by 432 percent, ethylene by 417 percent, and propylene by 440 percent. See Table 1.

Table 1: Air Pollution Releases, by Selected Toxic Pollutants (2001)

Toxic Pollutant	Reported Releases	Adjusted Releases	Increase in Emissions	Percentage Increase
Ethylene	23,918,535	123,641,512	99,722,977	417%
Toluene	71,539,704	117,462,423	45,922,719	64%
n-Hexane	47,644,345	94,415,125	46,770,780	98%
Xylenes	49,749,888	75,269,958	25,520,070	51%
Propylene	13,924,267	75,216,162	61,291,895	440%
Styrene	46,466,141	57,932,698	11,466,557	25%
Benzene	5,894,659	20,530,291	14,635,632	248%
Cyclohexane	4,309,434	18,112,831	13,803,397	320%
Ethylbenzene	6,547,375	11,893,226	5,345,851	82%
1,3-Butadiene	2,145,152	11,419,479	9,274,327	432%
Total	272,139,500	605,893,705	333,754,205	123%

Source: See Appendix D.

Obviously, adjusting the TRI data for only ten pollutants, which are emitted primarily by petrochemical facilities, moves states such as Texas and Louisiana, which contain most of the nation's petrochemical facilities, higher in the TRI state ranking. (County rankings also shift markedly.) Texas moves from number three to number one in terms of overall quantity of air emissions. Louisiana moves from number nine to number two. The adjusted data also indicate at least five million pounds of unreported emissions in Illinois, Iowa, Kentucky, Oklahoma, Mississippi, Pennsylvania and Ohio. See Appendices A and C.

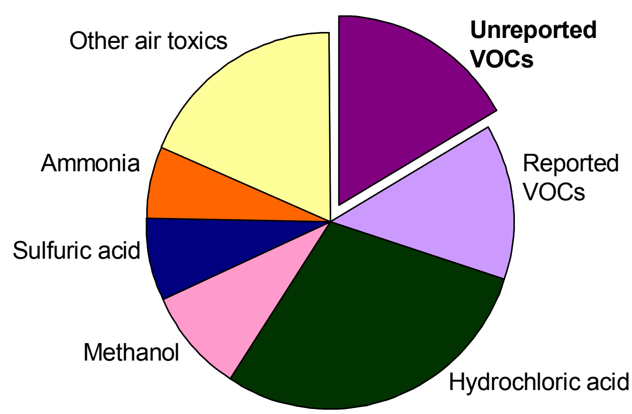
Likewise, our analysis results in individual refineries and chemical plants moving up in the TRI facility rankings. As listed in Appendix B, 14 refineries and chemical plants which do not appear on a list of the 50 plants releasing the most air pollution based on industry-reported TRI data, appear on the top 50 list based on adjusted emissions.[4]

The changes in the state, county and facility rankings demonstrate the magnitude of the underreported toxic air pollution problem. While sources at refineries and chemical plants, such as flares, cooling towers and leaks, have been identified by several studies as sources of underreported emissions, the fundamental problem with reliance on emission calculations, rather than actual monitoring, is far more widespread and could affect many additional air pollutants reported to the TRI.[5]

Adjusting just the ten pollutants included in this report shows that 16% of all toxic air emissions have been kept "off the books." If additional chemicals were adjusted, this percentage would likely grow. See Figure 2.

While numerous studies have made it clear that there is more toxic pollution in the air than is being reported, without sound monitoring and reporting methods, it is not possible to have confidence in <u>any</u> set of air pollution data. The widespread use of inaccurate pollution release estimates means that the public is unknowingly being exposed to far more toxic air pollution than is reported by EPA.

Figure 2: Toxic Air Pollution Releases
Adjusted 2001 Toxics Release Inventory



Source: See Appendix D.

HEALTH EFFECTS OF UNDERREPORTED EMISSIONS

The ten pollutants studied by Texas and adjusted in this report are volatile organic compounds (VOCs). VOCs react in the air to form ozone.[6] A number of the VOCs are also carcinogenic and otherwise toxic to humans. See Table 3. The actual health impacts of toxic air pollution releases depend on the duration and concentration of exposure. The concentration depends on both the amount of pollution released and local conditions, such as topography and weather. In addition, some of the harmful effects from VOCs are caused by secondary pollutants, such as ozone and formaldehyde, formed after the VOCs are released.

Short Term Exposure

VOCs react with other chemicals in the air to form ozone. Ozone can cause acute health reactions such as respiratory distress and eye irritation, often almost immediately upon exposure. Ozone reduces breathing capacity, which is especially serious in persons with respiratory disease. Exposure to ozone also increases a person's susceptibility to allergens (such as pollen), respiratory infections and the effects of other air pollutants. Among asthmatics, exposure to ozone is associated with increased emergency room visits, hospital admissions and deaths.[7]

Acute health effects associated with benzene, styrene and toluene include reproductive, developmental, respiratory, central nervous system and eye problems.[8] In addition, VOC emissions can lead to the secondary formation of formaldehyde, a human carcinogen, and similar chemicals, which themselves cause acute health reactions.[9]

Long Term Exposure

Long-term exposure to the ten pollutants covered in this report is associated with serious health effects. Both benzene and 1,3-butadiene are carcinogens associated with cancers including leukemia. Benzene is ranked by EPA as one of two chemicals posing the greatest national cancer risk. Butadiene is listed by EPA as one of the two most significant probable carcinogens contributing to regional cancer risk.[10]

All ten pollutants are also associated with the risk of one or more non-cancer chronic diseases, especially respiratory and developmental diseases, as described in Table 2.

Table 2: Non-cancer Chronic Disease Reference Concentrations and Endpoints

	Inhalation Reference Concentration (parts per billion)	Source of Inhalation Reference Concentration[11]	Cardiovascular or Blood Toxicity	Developmental Toxicity	Endocrine Toxicity	Gastrointestinal or Liver Toxicity	Immunotoxicity	Kidney Toxicity	Neurotoxicity	Reproductive Toxicity	Respiratory Toxicity	Skin or Sense Organ Toxicity
Benzene	19	OEHHA-CREL	✓	✓	✓	✓	✓		✓		✓	✓
1,3-Butadiene	9.04	OEHHA-CREL	✓	✓		✓				✓	✓	✓
Cyclohexane	780	TRI										
Ethylbenzene	460	OEHHA-CREL	✓	✓	✓	✓		✓		✓	✓	✓
Ethylene	17,000	OEHHA-CREL									✓	
n-Hexane	2,000	OEHHA-CREL		✓						✓	✓	✓
Propylene	1,700	OEHHA-CREL									✓	
Styrene	120	OEHHA-CREL	✓	✓	✓	✓	✓	✓		✓	✓	✓
Toluene	80	OEHHA-CREL	✓	✓		✓	✓	✓		✓	✓	✓
Xylenes	46	OEHHA-CREL	✓	✓		✓	✓				✓	✓

Source: See note 11.

Note: The inhalation reference concentration is an official estimate of the daily exposure to the human population (including sensitive subgroups) that is likely to not cause an appreciable risk of deleterious effects over a lifetime.

The lack of accurate information regarding toxic emissions means that the public may be exposed to unhealthy levels of toxics without their knowledge. It also means that states and local agencies may be developing their state implementation plans – local air pollution clean-up plans - based on incorrect emission estimates. The result may be time and money spent on plans that will not result in compliance with health-based air quality standards.

ENVIRONMENTAL PROTECTION AGENCY INACTION

Documentation of Problem

EPA and states have known for more than a decade that emissions are systematically underreported, but have not taken adequate steps to address the problem. As has been documented in numerous studies and reports, the root problem is the lack of adequate emissions monitoring. Instead of actually monitoring many air emissions, industry uses unreliable calculation methods for estimating emissions.

International studies since the early 1990s have shown that actual hydrocarbon emissions were underestimated in emissions inventories.[12] Likewise, a 1999 report published by the Minority Staff on the U.S. House of Representatives Committee on Government Reform found refineries vastly underreport leaks from valves, adding millions of pounds of harmful pollutants to the atmosphere each year, including over 80 million pounds of VOCs and over 15 million pounds of toxic pollutants.[13]

In 2001, the U.S. General Accounting Office (GAO) called on EPA to improve its oversight of emissions reporting from large facilities. The GAO study documented that only four percent of all emissions "determinations" used direct monitoring or testing. The other 96 percent were based on estimates calculated using emissions factors.[14] Emissions factors were developed by EPA as a means of estimating the long-term average emissions for all facilities in a particular source category. These factors do not reflect the variations within a source category due to different processes, controls or operating systems at individual facilities. The factors, therefore, are often not accurate for calculating a particular facility's emissions.

EPA itself developed a rating system for the accuracy of its emission factors. As of 1999, EPA had rated seventy-five percent of its emission factors. Twenty-nine percent of the emission factors were rated average or above. Forty-six percent were rated below average or poor.[15] Despite this poor rating, these emission factors are still the basis for many facilities' toxic emission estimates.

In 2004, the EPA's Office of Inspector General issued its own report regarding the agency's methods for calculating air toxic emissions. That report confirmed that toxic air emissions data submitted by the states is inconsistent and that EPA's emission factors for toxic emissions are not reliable.[16]

A number of state and local studies have likewise documented the problem of inaccurate air emission reporting. In addition to the Texas studies, the California Bay Area Air Quality Management District (BAAQMD), the University of California at Irvine (UCI), and the Mid-Atlantic Regional Air Management Association (MARAMA) have conducted studies of their own. The BAAQMD studies documented inadequacies in the reporting of emissions from pressure relief devices and from flares at petroleum refineries.[17] The UCI study found ambient levels of alkane hydrocarbons in the Southwest to be higher than reported.[18] The MARAMA study concluded that VOC pollution in Philadelphia area ambient air is greater than the emissions reported by industry. MARAMA found that emissions from refineries, in particular emissions from flares, cooling towers and non-routine operations, are likely underestimated.[19]

EPA's Response

In spite of this evidence, EPA has failed to improve monitoring and reporting of toxic air pollution. In fact, EPA has moved in the opposite direction and has weakened some federal monitoring requirements.

In 2000, EPA proposed regulations that would have standardized the types of toxics data gathered by the states, as well as the methods used to calculate emissions. Despite the fact, however, that seventeen out of the twenty-two state and local governments commenting on the proposed regulations favored toxics reporting requirements, the toxics provisions were dropped from the regulations.[20]

Likewise, EPA established an Emission Inventory Improvement Program (EIIP), which was designed to develop standard procedures for collecting and reporting emissions data. The EIIP workgroup officials, however, decided to eliminate toxics emissions estimation from their scope of work. The EIIP is no longer active due to lack of funding.[21]

Recently, the EPA's Emissions Factors and Policy Applications Group (EFPAG) held a workshop to discuss the use of emission factors. Its survey of various stakeholders suggested that:

- EPA appears to have disinvested from the emissions factors program;
- Emissions factors are being misused;
- Emissions factors and the associated information are sometimes difficult to find; and
- There are many sources with few, old, poor or no emissions factors, as well as many sources with factors of unknown quality.

The EFPAG is expected to produce a "decision on options for further development" by April 2005, but does not have any specific goals for requiring improvements to emissions monitoring or reporting.[22]

Finally, in 2004 EPA adopted new rules that actually weakened air emission reporting requirements.[23] Pursuant to Title V of the Clean Air Act, EPA's old rules required that major air pollution sources conduct monitoring sufficient to reveal whether or not the source was complying with federal pollution limits. This provision was used by states and EPA to add monitoring to Title V permits whenever additional monitoring was necessary to track facilities' compliance. In 2004, EPA revised these rules to only require monitoring that occurs more than once every five years. Such infrequent monitoring is clearly inadequate for tracking compliance and means that more sources will be using emission calculations and estimations, rather than actual monitoring, to report emissions. This is obviously a step in the wrong direction.

EPA has shirked its responsibility to provide the public with accurate information regarding toxic emissions. Overwhelming evidence indicates that EPA's emission factors are inaccurate for developing emission estimates. Additional real monitoring of air emissions sources is clearly needed. Yet, instead of improving monitoring requirements, EPA appears to be moving in the opposite direction by weakening residual monitoring requirements. Unfortunately, most states have done little to pick up the slack.[24]

RECOMMENDATIONS

The primary purpose of the Toxics Release Inventory is to provide members of the public with information regarding toxic releases in their communities. This information is intended to "empower citizens, through information, to hold companies and local governments accountable in terms of how toxic chemicals are managed."[25] Instead, because EPA continues to knowingly allow industrial facilities to underreport toxic emissions, the public remains in the dark about the true extent of their exposure.

In order to fulfill its mandate to protect public health and the environment and to make the TRI the useful tool it is intended to be, EPA should take the following steps:

- EPA should amend its Title V regulations to clearly require that all major sources conduct monitoring sufficient to demonstrate whether or not they are in compliance their federal emission limits.
- EPA should prioritize review of state-issued Title V permits to ensure that adequate monitoring is required.
- EPA should set a schedule to re-examine its emission factors within two years. Priority should be placed on emissions factors for toxic chemicals and on those that are known to be unreliable. These include flares, fugitives and cooling towers at refineries and chemical plants.
- EPA should clarify that its emission factors should not be used in the permitting process (for determining permit applicability or emission limits) or for permit fee calculations. Instead, actual emissions estimates based on plant-specific data should be used.

Likewise, states should take independent action to ensure that state-issued Title V permits require adequate monitoring, and that emission factors are not the sole basis for emissions estimates used in other circumstances such as fee calculations.

Industry and the government have known for years that the calculation methods used to report most emissions are inaccurate. It is time to significantly increase the number of air pollution sources that are actually monitored and to improve emission calculation methods for those that are not. The public deserves to know the true extent of toxic pollution in the air.

APPENDIX A: Toxic Air Pollution by State (pounds released in 2001)

State	Rank by TRI		Air Releases		Adjustment		Facilities	
	Unadjusted	Adjusted	Unadjusted	Adjusted			Total	Adjusted
Total			1,679,373,058	2,013,127,265	333,754,209	(20%)	17,579	817
Texas	3	1	102,748,862	262,349,318	159,600,455	(155%)	1,164	169
Louisiana	9	2	75,960,815	132,039,732	56,078,917	(74%)	303	72
Ohio	1	3	121,295,468	126,526,777	5,231,309	(4%)	1,243	39
North Carolina	2	4	115,130,332	116,514,604	1,384,272	(1%)	625	19
Pennsylvania	5	5	89,034,059	94,684,007	5,649,948	(6%)	960	39
Georgia	4	6	91,834,154	94,289,528	2,455,374	(3%)	537	21
Florida	6	7	83,429,911	86,224,989	2,795,079	(3%)	485	12
Tennessee	7	8	79,573,558	83,868,544	4,294,986	(5%)	516	18
Indiana	8	9	77,828,675	80,763,882	2,935,208	(4%)	823	13
Alabama	10	10	75,567,809	79,601,088	4,033,278	(5%)	428	20
Illinois	12	11	59,411,352	76,969,827	17,558,475	(30%)	984	38
Kentucky	13	12	58,703,794	66,932,976	8,229,183	(14%)	365	21
West Virginia	11	13	59,430,131	62,491,478	3,061,347	(5%)	154	19
Virginia	14	14	57,216,768	59,650,979	2,434,211	(4%)	371	16
Michigan	15	15	56,656,492	59,521,413	2,864,921	(5%)	670	17
South Carolina	16	16	54,977,393	57,815,803	2,838,410	(5%)	414	24
Mississippi	17	17	37,063,726	42,760,494	5,696,768	(15%)	260	11
Maryland	18	18	36,076,213	36,472,618	396,405	(1%)	139	6
Missouri	19	19	34,177,643	34,474,563	296,921	(1%)	443	13
Iowa	22	20	24,332,303	33,098,843	8,766,540	(36%)	301	6
New York	20	21	29,629,649	32,061,690	2,432,041	(8%)	534	10
Wisconsin	21	22	25,139,472	25,368,060	228,588	(1%)	659	13
Oklahoma	26	23	17,377,943	24,556,376	7,178,433	(41%)	231	9
California	24	24	20,020,008	23,197,253	3,177,245	(16%)	1,096	48
Arkansas	23	25	20,036,562	22,814,006	2,777,445	(14%)	294	10
Utah	25	26	19,220,667	20,227,815	1,007,148	(5%)	138	7
Kansas	27	27	14,768,804	18,402,787	3,633,983	(25%)	219	6
New Jersey	31	28	13,809,784	17,160,850	3,351,066	(24%)	447	31
Washington	29	29	14,295,076	16,901,772	2,606,696	(18%)	236	7
Puerto Rico	28	30	14,556,276	15,511,015	954,739	(7%)	115	7
Minnesota	30	31	14,252,131	15,436,857	1,184,726	(8%)	334	4
Oregon	32	32	12,914,088	13,272,687	358,598	(3%)	214	5
Nebraska	33	33	7,875,435	7,923,714	48,279	(1%)	136	3
Massachusetts	34	34	7,447,906	7,626,692	178,786	(2%)	351	14
Delaware	35	35	6,651,525	7,163,816	512,291	(8%)	59	5
Connecticut	37	36	4,821,957	5,771,210	949,253	(20%)	247	9
North Dakota	41	37	4,328,230	5,620,782	1,292,551	(30%)	34	2
Idaho	36	38	5,000,464	5,446,812	446,348	(9%)	69	1
Montana	42	39	4,292,997	4,988,637	695,640	(16%)	40	4
Maine	38	40	4,657,404	4,657,404	-		85	-
New Hampshire	40	41	4,496,284	4,653,904	157,620	(4%)	93	2
Arizona	39	42	4,600,105	4,606,964	6,859	(0%)	205	2
Colorado	43	43	3,629,554	3,916,102	286,548	(8%)	149	5
Alaska	44	44	3,201,013	3,550,343	349,330	(11%)	27	4
Hawaii	46	45	2,379,957	3,073,986	694,029	(29%)	33	2
Nevada	45	46	2,728,933	2,755,236	26,304	(1%)	75	1
Wyoming	47	47	1,817,602	2,350,726	533,124	(29%)	37	5
New Mexico	49	48	1,072,357	2,139,926	1,067,569	(100%)	53	3
South Dakota	48	49	1,799,135	1,801,350	2,215	(0%)	52	2
Virgin Islands (US)	50	50	892,660	1,757,536	864,876	(97%)	5	1
Rhode Island	51	51	824,582	974,454	149,872	(18%)	92	2
Guam	52	52	192,898	192,898	-		6	-
Vermont	53	53	136,536	136,536	-		22	-
District of Columbia	54	54	40,733	40,733	-		3	-
N. Mariana Islands	55	55	7,953	7,953	-		3	-
American Samoa	56	56	6,920	6,920	-		1	-

Source: US Environmental Protection Agency, 2001 Toxics Release Inventory. Adjustments calculated by Grassroots Connection.

APPENDIX B: Toxic Air Pollution by Facility (pounds released in 2001)

Facility	Rank by TRI		Air Releases		Adjustment	
	Unadjusted	Adjusted	Unadjusted	Adjusted		
Total			1,679,373,058	2,013,127,265	333,754,209	(20%)
Eastman Chemical Co. Texas Ops., Longview (Harrison County, TX)	63	3	3,865,663	17,330,694	13,465,031	(348%)
Dow Chemical Co. Freeport, Freeport (Brazoria County, TX)	107	8	2,691,681	11,937,863	9,246,182	(344%)
Union Carbide Corp. Seadrift Plant, Seadrift (Calhoun County, TX)	156	13	2,047,172	10,143,579	8,096,407	(395%)
Equistar Chemicals L.P. Clinton Plant, Clinton (Clinton County, IA)	171	16	1,873,540	9,343,097	7,469,557	(399%)
Equistar Chemicals L.P., Channelview (Harris County, TX)	175	21	1,861,190	9,095,805	7,234,615	(389%)
BASF Fina Petrochemicals L.P., Port Arthur (Jefferson County, TX)	216	25	1,565,300	8,607,380	7,042,080	(450%)
Goodyear Tire & Rubber Co., Cheek (Jefferson County, TX)	205	28	1,686,454	8,078,541	6,392,087	(379%)
Firestone Polymers, Sulphur (Calcasieu County, LA)	213	30	1,580,803	7,591,480	6,010,677	(380%)
BP Texas City Business Unit, Texas City (Galveston County, TX)	72	34	3,558,674	7,050,606	3,491,932	(98%)
Eastman Tennessee Ops., Kingsport (Sullivan County, TN)	46	35	4,735,421	6,988,574	2,253,153	(48%)
Equistar Chemicals L.P., Morris (Grundy County, IL)	296	39	1,195,972	6,557,992	5,362,020	(448%)
Chevron Phillips Chemical Co. L.P. Clemens Terminal, Brazoria (Brazoria County, TX)	323	42	1,116,588	6,242,718	5,126,130	(459%)
Equistar Chemicals L.P. La Porte Plant, LA Porte (Harris County, TX)	274	43	1,254,735	6,154,750	4,900,014	(391%)
Exxonmobil Chemical Baton Rouge Chemical Plant, Baton Rouge (East Baton Rouge County, LA)	199	44	1,723,162	6,104,374	4,381,212	(254%)
Huntsman Polymers Corp., Odessa (Ector County, TX)	295	45	1,205,203	6,058,512	4,853,309	(403%)
BPAmoco Chemical Co. Chocolate Bayou Plant, ALvin (Brazoria County, TX)	347	53	1,037,579	5,511,285	4,473,706	(431%)
Du Pont Sabine River Works, Orange (Orange County, TX)	229	54	1,464,468	5,459,405	3,994,937	(273%)
Honeywell Intl. Inc. Hopewell Plant, Hopewell (Hopewell City County, VA)	48	57	4,684,302	5,248,602	564,300	(12%)
ExxonMobil Oil Beaumont Refy., Beaumont (Jefferson County, TX)	151	61	2,098,038	5,076,118	2,978,080	(142%)
Tosco Wood River Refy., Roxana (Madison County, IL)	157	62	2,031,946	5,059,342	3,027,396	(149%)
Dow Chemical Co. Louisiana Div., Plaquemine (Iberville County, LA)	261	66	1,296,372	4,774,915	3,478,543	(268%)
Chevron Prods. Co. Pascagoula Refy., Pascagoula (Jackson County, MS)	220	68	1,521,151	4,688,051	3,166,901	(208%)
American Synthetic Rubber Co. L.L.C., Louisville (Jefferson County, KY)	375	69	970,174	4,682,129	3,711,955	(383%)
Baker Petrolite Corp., Barnsdall (Osage County, OK)	404	73	897,500	4,497,080	3,599,580	(401%)
Citgo Petroleum Corp., LAke Charles (Calcasieu County, LA)	249	74	1,405,294	4,453,126	3,047,832	(217%)
Chevron Phillips Chemical Co. L.P. Sweeny Complex, Old Ocean (Brazoria County, TX)	428	75	820,340	4,451,897	3,631,557	(443%)
ExxonMobil Chemical Co. Baytown Chemical Plant, Baytown (Harris County, TX)	209	79	1,652,574	4,241,465	2,588,891	(157%)

Facility	Rank by TRI		Air Releases		Adjustment	
	Unadjusted	Adjusted	Unadjusted	Adjusted		
Calumet Lubricants Co. Shreveport Refy., Shreveport (Caddo County, LA)	374	84	971,567	3,975,557	3,003,990	(309%)
Shell Chemical Co. Deer Park, Deer Park (Harris County, TX)	376	93	968,943	3,715,946	2,747,003	(284%)
International Paper Co. Savannah Complex, Savannah (Chatham County, Ga)	118	98	2,557,027	3,589,487	1,032,460	(40%)
Shell Norco Chemical Plant East Site, Norco (St Charles County, LA)	485	99	680,609	3,580,461	2,899,852	(426%)
Union Carbide Corp. Texas City Plant, Texas City (Galveston County, TX)	305	102	1,172,001	3,466,909	2,294,908	(196%)
Lyondell-Citgo Refining L.P., Houston (Harris County, TX)	468	103	712,210	3,449,994	2,737,784	(384%)
Chevron Phillips Chemical Co. L.P., Baytown (Harris County, TX)	515	105	624,977	3,361,867	2,736,890	(438%)
Port Arthur A&O Plant Huntsman Corp., Port Arthur (Jefferson County, TX)	508	107	631,247	3,304,435	2,673,188	(423%)
Ciba Specialty Chemical Corp., McIntosh (Washington County, AL)	356	115	1,008,255	3,206,380	2,198,125	(218%)
Tesoro Petroleum - Mandan Refy., Mandan (Morton County, ND)	169	116	1,901,355	3,191,056	1,289,701	(68%)
Chalmette Refining L.L.C., Chalmette (St Bernard County, LA)	466	117	715,262	3,163,745	2,448,483	(342%)
Phillips 66 Co., Borger (Hutchinson County, TX)	464	119	717,659	3,107,656	2,389,997	(333%)
Crompton Mfg. Co. Inc., Geismar (Ascension County, LA)	458	122	729,601	3,088,127	2,358,526	(323%)
Union Carbide Corp. Taft/Star Mfg. Plant, Taft (St Charles County, LA)	492	125	668,712	2,998,733	2,330,021	(348%)
Baton Rouge Plastics Plant, Baton Rouge (East Baton Rouge County, LA)	413	126	861,053	2,997,527	2,136,474	(248%)
Lion Oil Co., El Dorado (Union County, AR)	430	127	818,559	2,991,403	2,172,844	(265%)
GE Co., Ottawa (La Salle County, IL)	436	129	797,181	2,930,301	2,133,120	(268%)
DSM Copolymer Inc., Addis (West Baton Rouge County, LA)	528	130	605,985	2,926,720	2,320,735	(383%)
ExxonMobil Refining & Supply Baton Rouge Refy., Baton Rouge (East Baton Rouge County, LA)	255	131	1,338,339	2,916,713	1,578,374	(118%)
ExxonMobil Refining & Supply Baytown Refy., Baytown (Harris County, TX)	294	133	1,206,646	2,871,359	1,664,713	(138%)
BP Prods. N.A. Whiting Business Unit, Whiting (Lake County, IN)	440	136	786,182	2,819,086	2,032,904	(259%)
Valero Refining Co. Texas, Corpus Christi (Nueces County, TX)	505	139	637,709	2,801,616	2,163,906	(339%)
Chevron Phillips Chemical Co. Houston Chemical Complex, Pasadena (Harris County, TX)	637	157	491,543	2,626,737	2,135,194	(434%)
Tesoro Refining & Marketing Co., Anacortes (Skagit County, Wa)	238	161	1,439,176	2,571,997	1,132,820	(79%)
BP Amoco Polymers Deer Park Facility, Deer Park (Harris County, TX)	659	164	471,822	2,561,347	2,089,525	(443%)
Firestone Polymers L.L.C., Orange (Orange County, TX)	603	168	524,800	2,527,200	2,002,400	(382%)
Deer Park Refining Limited Partnership, Deer Park (Harris County, TX)	259	169	1,307,873	2,480,479	1,172,606	(90%)
ADM Corn Processing, Clinton (Clinton County, IA)	291	174	1,211,266	2,426,563	1,215,297	(100%)
Premcor Refining Group Inc., Hartford (Madison County, IL)	656	179	473,648	2,397,245	1,923,597	(406%)
Mobil Chemical Polyethylene Plant, Beaumont (Jefferson County, TX)	709	183	434,883	2,352,590	1,917,707	(441%)
Bayer Corp., Orange (Orange County, TX)	636	187	493,851	2,310,981	1,817,130	(368%)

Facility	Rank by TRI		Air Releases		Adjustment	
	Unadjusted	Adjusted	Unadjusted	Adjusted		
Kraton Polymers U.S. L.L.C., Belpre (Washington County, OH)	567	193	558,186	2,286,337	1,728,151	(310%)
Shell Chemical L.P., Geismar (Ascension County, LA)	576	196	549,295	2,256,093	1,706,798	(311%)
Westlake Vinyls Inc., Calvert City (Marshall County, KY)	584	201	545,064	2,205,877	1,660,813	(305%)
Lyondell Chemical Co., Channelview (Harris County, TX)	552	203	574,395	2,180,537	1,606,142	(280%)
Syngenta Crop Protection Inc. St. Gabriel Facility, Saint Gabriel (Iberville County, LA)	624	204	509,803	2,172,299	1,662,496	(326%)
Koch Petroleum Group L.P. West Plant, Corpus Christi (Nueces County, TX)	519	208	617,975	2,126,542	1,508,567	(244%)
Solutia Inc., Cantonment (Escambia County, FL)	655	214	475,665	2,064,517	1,588,852	(334%)
Hercules Inc., Hattiesburg (Forrest County, MS)	700	215	439,858	2,058,499	1,618,640	(368%)
Ethyl Petroleum Additives Inc., Sauget (St Clair County, IL)	511	216	628,936	2,037,053	1,408,117	(224%)
Conoco Inc. Ponca City Refy., Ponca City (Kay County, OK)	563	218	564,586	2,010,680	1,446,094	(256%)
Chevron Phillips Chemical Co. L.P. Port Arthur Facility, Port Arthur (Jefferson County, TX)	798	222	378,282	1,991,312	1,613,030	(426%)
Equistar Chemicals L.P., ALvin (Brazoria County, TX)	814	231	370,451	1,914,237	1,543,786	(417%)
Farmland Inds. Inc., Coffeyville (Montgomery County, KS)	728	232	421,851	1,913,144	1,491,293	(354%)
Huntsman Corp. C4/O&O Facilities, Port Neches (Jefferson County, TX)	585	247	543,540	1,814,048	1,270,508	(234%)
Borden Chemicals & Plastics Operating L.P., Geismar (Ascension County, LA)	776	255	391,929	1,770,524	1,378,595	(352%)
Phillips 66 Co. Sweeny Complex, Old Ocean (Brazoria County, TX)	570	258	555,815	1,755,967	1,200,152	(216%)
National Coop. Refy. Assoc., Mc Pherson (Mcpherson County, KS)	725	262	422,862	1,733,372	1,310,510	(310%)
BASF Corp., Geismar (Ascension County, LA)	489	268	671,509	1,708,192	1,036,683	(154%)
Williams Olefins L.L.C. Geismar Ethylene Plant, Geismar (Ascension County, LA)	968	280	290,977	1,576,061	1,285,084	(442%)
Marathon Ashland Petroleum L.L.C. Illinois Refining Div., Robinson (Crawford County, IL)	619	283	513,596	1,557,739	1,044,142	(203%)
Valero Refining Texas L.P., Texas City (Galveston County, TX)	599	286	527,149	1,527,592	1,000,443	(190%)
Phillips 66 Co., Linden (Union County, NJ)	756	289	403,835	1,504,613	1,100,778	(273%)
BP Solvay Polyethylene N.A., Deer Park (Harris County, TX)	1,046	297	261,575	1,464,815	1,203,240	(460%)
Schenectady Intl. Inc., Rotterdam Junction (Schenectady County, NY)	878	306	336,705	1,441,384	1,104,679	(328%)
Orion Refining Corp., New Sarpy (St Charles County, LA)	876	309	337,127	1,432,474	1,095,347	(325%)
Equistar Chemicals L.P. Victoria Facility, Victoria (Victoria County, TX)	1,007	315	275,953	1,422,610	1,146,657	(416%)
Sasol N.A. Inc. Lake Charles Chemical Complex, Westlake (Calcasieu County, LA)	935	328	305,837	1,368,131	1,062,295	(347%)
ExxonMobil Oil Corp. (Dba Mobil Chemical Co.), Beaumont (Jefferson County, TX)	1,089	329	249,909	1,357,441	1,107,532	(443%)
Ameripol Synpol Corp., Port Neches (Jefferson County, TX)	1,030	336	268,746	1,310,796	1,042,050	(388%)

Source: US Environmental Protection Agency, 2001 Toxics Release Inventory. Adjustments calculated by Grassroots Connection.

APPENDIX C: Toxic Air Pollution by County (pounds released in 2001)

State	Rank by TRI		Air Releases		Adjustment		Facilities	
	Unadjusted	Adjusted	Unadjusted	Adjusted			Total	Adjusted
Total			1,679,373,058	2,013,127,265	333,754,209	(20%)	17,579	817
Harris, TX	2	1	21,159,401	65,395,327	44,235,926	(209%)	262	69
Jefferson, TX	24	2	9,683,304	38,688,357	29,005,053	(300%)	43	20
Brazoria, TX	34	3	7,591,325	34,228,593	26,637,268	(351%)	33	15
Person, NC	1	4	28,078,514	28,078,514		(0%)	9	0
Ascension, LA	13	5	12,995,295	20,929,425	7,934,130	(61%)	18	8
Armstrong, PA	3	6	19,778,000	19,778,000		(0%)	4	0
Harrison, TX	79	7	4,662,372	18,905,000	14,242,628	(305%)	14	3
Calcasieu, LA	66	8	5,367,873	18,763,945	13,396,072	(250%)	32	12
Baltimore City, MD	4	9	18,311,656	18,636,663	325,006	(2%)	41	3
Bartow, GA	5	10	16,613,789	16,613,789		(0%)	11	0
Escambia, FL	6	11	14,536,817	16,328,259	1,791,442	(12%)	13	3
East Baton Rouge, LA	49	12	6,641,481	15,557,456	8,915,975	(134%)	20	12
Jefferson, KY	23	13	9,941,608	14,817,395	4,875,787	(49%)	70	6
Marshall, WV	7	14	14,423,912	14,667,918	244,006	(2%)	6	1
Tooele, UT	8	15	14,379,882	14,379,882		(0%)	9	0
Jefferson, OH	9	16	14,238,546	14,238,546		(0%)	7	0
Galveston, TX	52	17	6,472,230	14,058,923	7,586,693	(117%)	18	10
Monroe, MI	10	18	13,879,612	13,879,612		(0%)	14	0
Catawba, NC	11	19	13,772,912	13,780,755	7,843	(0%)	34	1
Orange, TX	93	20	4,188,386	13,464,617	9,276,231	(221%)	11	6
Hillsborough, FL	12	21	13,120,121	13,122,990	2,869	(0%)	51	1
Humphreys, TN	15	22	12,332,303	12,721,039	388,736	(3%)	7	1
Stokes, NC	14	23	12,347,259	12,347,259		(0%)	2	0
Washington, OH	20	24	10,437,735	12,316,548	1,878,813	(18%)	16	3
Clinton, IA	118	25	3,294,817	11,979,672	8,684,854	(264%)	9	2
Adams, OH	16	26	11,960,696	11,960,696		(0%)	4	0
St Charles, LA	106	27	3,569,209	11,772,661	8,203,451	(230%)	20	10
Citrus, FL	17	28	11,413,532	11,413,532		(0%)	2	0
Calhoun, TX	185	29	2,415,358	11,375,417	8,960,059	(371%)	5	3
Mobile, AL	21	30	10,392,692	10,869,960	477,268	(5%)	42	8
Putnam, WV	18	31	10,504,929	10,636,942	132,013	(1%)	9	4
Shelby, TN	25	32	9,650,639	10,461,905	811,266	(8%)	64	4
Gallia, OH	19	33	10,441,907	10,441,907		(0%)	4	0
Colbert, AL	22	34	10,381,248	10,381,248		(0%)	11	0
Wayne, MI	28	35	8,898,889	9,623,282	724,393	(8%)	110	4
Greene, AL	26	36	9,227,090	9,227,090		(0%)	1	0
Lafourche, LA	27	37	9,143,310	9,143,310		(0%)	4	0
Madison, IL	95	38	4,102,762	9,053,755	4,950,993	(121%)	22	2
Greene, PA	29	39	8,756,659	8,756,659		(0%)	5	0
Jackson, MS	69	40	5,312,888	8,500,318	3,187,430	(60%)	12	3
Iberville, LA	176	41	2,460,377	8,488,961	6,028,584	(245%)	16	5
Gaston, NC	32	42	8,372,682	8,465,711	93,029	(1%)	20	3
Grimes, TX	30	43	8,454,776	8,454,776		(0%)	4	0
Nueces, TX	164	44	2,614,341	8,427,152	5,812,811	(222%)	15	8
Monroe, GA	31	45	8,389,937	8,389,937		(0%)	1	0
Allegheny, PA	50	46	6,634,364	8,224,622	1,590,258	(24%)	68	7
Hopewell City, VA	36	47	7,389,462	8,102,764	713,302	(10%)	9	3
Mason, WV	33	48	8,051,263	8,051,346	83	(0%)	4	1
Berkeley, SC	40	49	7,263,603	7,613,218	349,615	(5%)	17	2
Los Angeles, CA	51	50	6,484,210	7,526,995	1,042,786	(16%)	357	24
Duval, FL	35	51	7,463,729	7,526,763	63,034	(1%)	39	1
Sullivan, TN	71	52	5,254,044	7,507,197	2,253,153	(43%)	13	1
Hamilton, OH	43	53	7,074,059	7,389,630	315,570	(4%)	87	3
Heard, GA	37	54	7,365,689	7,365,689		(0%)	1	0
Richland, SC	39	55	7,313,768	7,350,382	36,614	(1%)	14	1
Cameron, LA	38	56	7,316,791	7,316,791		(0%)	2	0
Gibson, IN	41	57	7,262,138	7,262,138		(0%)	9	0
Grundy, IL	257	58	1,623,686	7,152,573	5,528,887	(341%)	9	3

State	Rank by TRI		Air Releases		Adjustment		Facilities	
	Unadjusted	Adjusted	Unadjusted	Adjusted			Total	Adjusted
Vermilion, IL	42	59	7,096,175	7,096,175		(0%)	10	0
Ottawa, MI	44	60	6,949,589	7,095,522	145,934	(2%)	31	1
Cook, IL	45	61	6,933,450	7,045,311	111,862	(2%)	371	7
Putnam, GA	46	62	6,895,014	6,895,014		(0%)	4	0
Charles, MD	47	63	6,807,092	6,807,092		(0%)	3	0
Muhlenberg, KY	48	64	6,693,748	6,693,748		(0%)	4	0
Ector, TX	292	65	1,428,825	6,456,256	5,027,431	(352%)	14	3
New Hanover, NC	63	66	5,657,803	6,356,262	698,459	(12%)	15	1
Ashtabula, OH	53	67	6,124,302	6,133,536	9,234	(0%)	31	1
Roane, TN	54	68	6,007,597	6,007,597		(0%)	7	0
Warrick, IN	55	69	5,949,656	5,949,656		(0%)	6	0
Clermont, OH	56	70	5,917,880	5,917,880		(0%)	12	0
Monroe, NY	57	71	5,889,546	5,889,546		(0%)	31	0
Georgetown, SC	59	72	5,829,443	5,857,681	28,238	(0%)	7	1
Floyd, GA	58	73	5,848,395	5,848,395		(0%)	13	0
Monongalia, WV	60	74	5,787,451	5,787,451		(0%)	7	0
Harrison, MS	61	75	5,669,347	5,669,347		(0%)	6	0
Coshocton, OH	62	76	5,660,919	5,660,919		(0%)	12	0
Macon, IL	64	77	5,635,070	5,639,300	4,229	(0%)	17	1
York, PA	65	78	5,553,426	5,553,426		(0%)	48	0
Marshall, KY	109	79	3,488,949	5,452,954	1,964,005	(56%)	16	5
Chesterfield, VA	67	80	5,360,281	5,360,281		(0%)	8	0
Lawrence, KY	68	81	5,319,518	5,319,518		(0%)	1	0
Montour, PA	70	82	5,269,259	5,269,259		(0%)	1	0
Chatham, GA	92	83	4,200,274	5,261,694	1,061,420	(25%)	21	2
Richmond, GA	85	84	4,385,137	5,147,474	762,337	(17%)	23	3
Morgan, AL	76	85	4,959,043	5,093,385	134,342	(3%)	21	3
Washington, AL	197	86	2,239,695	5,084,956	2,845,261	(127%)	6	3
Erie, NY	72	87	5,048,981	5,049,118	137	(0%)	59	1
Jackson, AL	73	88	4,978,618	4,978,618		(0%)	6	0
Putnam, FL	74	89	4,978,581	4,978,581		(0%)	9	0
Shelby, AL	75	90	4,963,608	4,963,608		(0%)	13	0
Carroll, KY	80	91	4,650,116	4,878,760	228,644	(5%)	6	2
Jefferson, IN	77	92	4,782,544	4,782,544		(0%)	7	0
Covington City, VA	78	93	4,685,811	4,685,811		(0%)	3	0
Osage, OK	414	94	930,437	4,646,385	3,715,948	(399%)	3	2
Richmond City, VA	84	95	4,417,453	4,644,195	226,742	(5%)	33	3
Anderson, TN	81	96	4,640,048	4,640,048		(0%)	8	0
Wood, WI	82	97	4,587,364	4,587,364		(0%)	16	0
New Castle, DE	94	98	4,185,942	4,581,089	395,147	(9%)	34	3
Lake, IN	175	99	2,478,198	4,557,368	2,079,169	(84%)	45	4
Allen, OH	103	100	3,576,747	4,463,869	887,122	(25%)	19	2
Caddo, LA	296	101	1,417,186	4,421,176	3,003,990	(212%)	14	1
De Soto, LA	83	102	4,417,912	4,417,912		(0%)	4	0
Polk, FL	88	103	4,320,939	4,393,743	72,804	(2%)	37	3
Elkhart, IN	89	104	4,316,373	4,361,464	45,091	(1%)	79	1
Montgomery, IL	86	105	4,352,041	4,352,041		(0%)	4	0
Grant, WV	87	106	4,339,702	4,339,702		(0%)	4	0
Union, AR	222	107	1,952,359	4,304,922	2,352,563	(120%)	16	4
St Bernard, LA	383	108	1,065,768	4,292,790	3,227,022	(303%)	2	2
Peoria, IL	90	109	4,283,458	4,283,458		(0%)	18	0
Vermillion, IN	91	110	4,273,885	4,273,885		(0%)	3	0
Contra Costa, CA	146	111	2,838,081	4,193,267	1,355,186	(48%)	41	7
Mc Curtain, OK	96	112	4,100,423	4,100,423		(0%)	4	0
Hutchinson, TX	351	113	1,175,729	3,967,352	2,791,623	(237%)	6	2
Kanawha, WV	119	114	3,280,912	3,918,905	637,993	(19%)	17	7
Bay, FL	128	115	3,082,277	3,897,944	815,666	(26%)	12	1
Rutherford, NC	97	116	3,874,428	3,874,428		(0%)	9	0
Giles, VA	124	117	3,161,689	3,866,955	705,266	(22%)	4	1
Hampton, SC	98	118	3,844,599	3,844,599		(0%)	3	0
Nassau, FL	99	119	3,790,534	3,790,534		(0%)	3	0
Saint Louis City, MO	102	120	3,643,416	3,762,132	118,716	(3%)	77	4

State	Rank by TRI		Air Releases		Adjustment		Facilities	
	Unadjusted	Adjusted	Unadjusted	Adjusted			Total	Adjusted
Prince Georges, MD	100	121	3,757,724	3,757,724		(0%)	8	0
Cobb, GA	101	122	3,749,238	3,749,238		(0%)	16	0
York, SC	129	123	3,028,513	3,739,387	710,873	(23%)	22	4
Lake, OH	104	124	3,576,583	3,628,692	52,109	(1%)	38	2
Beaver, PA	110	125	3,447,900	3,587,690	139,790	(4%)	26	2
Mason, KY	105	126	3,572,819	3,572,819		(0%)	6	0
La Salle, IL	307	127	1,363,981	3,570,885	2,206,905	(162%)	15	2
Erie, PA	107	128	3,553,842	3,558,953	5,111	(0%)	48	1
Morton, ND	199	129	2,227,063	3,516,764	1,289,701	(58%)	2	1
Chatham, NC	108	130	3,506,679	3,506,679		(0%)	9	0
Lucas, OH	151	131	2,745,713	3,473,491	727,778	(27%)	46	4
Ingham, MI	111	132	3,432,404	3,438,104	5,700	(0%)	19	1
Hudson, NJ	112	133	3,415,914	3,416,336	422	(0%)	25	1
Warren, MS	113	134	3,409,871	3,409,871		(0%)	8	0
Jefferson, AL	115	135	3,349,575	3,399,359	49,784	(1%)	65	2
Lexington, SC	167	136	2,588,479	3,396,359	807,880	(31%)	15	1
Hamblen, TN	114	137	3,381,572	3,381,572		(0%)	16	0
Cowlitz, WA	134	138	2,964,847	3,381,031	416,184	(14%)	9	1
Rogers, OK	116	139	3,340,208	3,340,208		(0%)	19	0
St Charles, MO	117	140	3,336,261	3,336,261		(0%)	17	0
West Baton Rouge, LA	446	141	860,611	3,290,856	2,430,245	(282%)	14	3
Skagit, WA	233	142	1,833,325	3,280,230	1,446,905	(79%)	7	3
Dearborn, IN	120	143	3,278,255	3,278,255		(0%)	5	0
Walker, AL	121	144	3,258,728	3,258,728		(0%)	4	0
Will, IL	181	145	2,424,179	3,256,324	832,145	(34%)	43	8
St Clair, MI	159	146	2,665,987	3,240,936	574,950	(22%)	19	1
Licking, OH	122	147	3,235,664	3,235,664		(0%)	28	0
Lee, IA	123	148	3,168,596	3,193,265	24,670	(1%)	11	1
Posey, IN	170	149	2,498,033	3,168,209	670,176	(27%)	5	2
Pleasants, WV	135	150	2,964,242	3,123,082	158,840	(5%)	4	1
Pike, IN	125	151	3,118,287	3,118,287		(0%)	5	0
Loudon, TN	126	152	3,093,982	3,093,982		(0%)	8	0
Clay, MO	131	153	3,016,211	3,091,975	75,764	(3%)	15	1
Chautauqua, NY	127	154	3,084,613	3,084,613		(0%)	14	0
Columbus, NC	130	155	3,019,836	3,021,375	1,539	(0%)	7	1
Floyd, IN	132	156	2,990,671	2,990,671		(0%)	7	0
Franklin City, VA	133	157	2,979,617	2,979,617		(0%)	4	0
Coweta, GA	136	158	2,958,768	2,958,768		(0%)	6	0
Forrest, MS	513	159	672,794	2,954,242	2,281,448	(339%)	7	3
Chesapeake City, VA	139	160	2,906,918	2,942,163	35,245	(1%)	13	1
Merrimack, NH	137	161	2,935,137	2,935,137		(0%)	10	0
Clearfield, PA	138	162	2,931,978	2,931,978		(0%)	8	0
St Clair, IL	325	163	1,283,572	2,921,520	1,637,948	(128%)	22	3
Hardin, TN	140	164	2,902,027	2,902,027		(0%)	2	0
Lorain, OH	141	165	2,890,994	2,899,308	8,314	(0%)	29	1
Wayne, NC	142	166	2,882,593	2,882,593		(0%)	9	0
Ouachita, LA	147	167	2,823,697	2,880,962	57,265	(2%)	5	1
Northampton, PA	143	168	2,865,745	2,865,745		(0%)	29	0
Bay, MI	144	169	2,859,900	2,859,900		(0%)	6	0
Hancock, KY	145	170	2,857,019	2,857,019		(0%)	7	0
Plaquemines, LA	212	171	2,077,872	2,832,006	754,133	(36%)	7	2
Decatur, GA	148	172	2,821,609	2,821,609		(0%)	4	0
Haywood, NC	149	173	2,821,063	2,821,063		(0%)	2	0
Victoria, TX	465	174	802,798	2,807,746	2,004,948	(250%)	5	2
Buncombe, NC	150	175	2,777,453	2,777,453		(0%)	11	0
Orange, NY	152	176	2,737,866	2,763,444	25,578	(1%)	22	1
Oakland, MI	154	177	2,718,292	2,748,989	30,696	(1%)	43	1
Daviess, KY	173	178	2,481,482	2,735,161	253,679	(10%)	12	2
Manatee, FL	153	179	2,718,663	2,718,663		(0%)	16	0
Carter, MO	155	180	2,714,976	2,714,976		(0%)	1	0
Charleston, SC	156	181	2,710,789	2,710,789		(0%)	17	0
Middlesex, NJ	240	182	1,747,236	2,708,114	960,878	(55%)	79	7

State	Rank by TRI		Air Releases		Adjustment		Facilities	
	Unadjusted	Adjusted	Unadjusted	Adjusted			Total	Adjusted
Indiana, PA	157	183	2,703,234	2,703,234		(0%)	4	0
York, VA	186	184	2,412,374	2,693,822	281,448	(12%)	2	1
Allen, IN	158	185	2,678,295	2,683,995	5,700	(0%)	41	1
Florence, SC	160	186	2,650,795	2,650,795		(0%)	14	0
Alexandria City, VA	161	187	2,647,979	2,647,979		(0%)	1	0
Early, GA	162	188	2,645,398	2,645,398		(0%)	2	0
Jefferson, AR	163	189	2,628,572	2,628,572		(0%)	14	0
Mercer, KY	165	190	2,612,146	2,612,146		(0%)	4	0
Tippecanoe, IN	166	191	2,590,092	2,590,092		(0%)	16	0
Dickson, TN	168	192	2,561,946	2,561,946		(0%)	8	0
Union, NJ	301	193	1,404,967	2,554,335	1,149,368	(82%)	38	4
Woodbury, IA	169	194	2,532,066	2,532,066		(0%)	17	0
Bristol, MA	171	195	2,491,451	2,496,360	4,910	(0%)	49	1
Williamson, TN	172	196	2,485,312	2,485,312		(0%)	4	0
Delaware, PA	336	197	1,222,264	2,479,489	1,257,225	(103%)	24	6
Lawrence, MS	174	198	2,478,757	2,478,757		(0%)	1	0
Glynn, GA	177	199	2,453,285	2,454,045	760	(0%)	6	1
Northumberland, PA	219	200	1,984,491	2,451,378	466,887	(24%)	12	1
Miami-Dade, FL	178	201	2,450,646	2,450,646		(0%)	33	0
Sumner, TN	179	202	2,447,378	2,447,378		(0%)	8	0
Wyandotte, KS	180	203	2,435,593	2,437,945	2,352	(0%)	29	1
Lowndes, MS	182	204	2,422,808	2,422,808		(0%)	8	0
Guayanilla, PR	183	205	2,421,397	2,421,397		(0%)	1	0
Russell, AL	184	206	2,420,976	2,420,976		(0%)	7	0
Milwaukee, WI	193	207	2,299,790	2,413,023	113,232	(5%)	106	4
Honolulu, HI	247	208	1,696,487	2,390,516	694,029	(41%)	18	2
Mercer, NJ	187	209	2,380,780	2,380,780		(0%)	11	0
Mississippi, AR	188	210	2,380,670	2,380,670		(0%)	14	0
Union, OH	189	211	2,369,422	2,369,422		(0%)	6	0
Toa Baja, PR	190	212	2,368,394	2,368,394		(0%)	1	0
Hamilton, TN	192	213	2,304,605	2,344,992	40,387	(2%)	40	5
Shannon, MO	191	214	2,324,448	2,324,448		(0%)	1	0
Texas, MO	191	214	2,324,448	2,324,448		(0%)	1	0
Marion, IN	198	215	2,232,335	2,317,588	85,253	(4%)	68	2
Lawrence, PA	194	216	2,290,601	2,290,601		(0%)	11	0
Garfield, OK	195	217	2,288,219	2,288,219		(0%)	4	0
Davidson, TN	239	218	1,757,635	2,257,569	499,933	(28%)	29	1
Sussex, DE	196	219	2,245,321	2,246,648	1,326	(0%)	14	1
New Haven, CT	317	220	1,328,074	2,238,709	910,636	(69%)	73	4
Montgomery, KS	488	221	740,767	2,232,060	1,491,293	(201%)	11	1
Lane, OR	200	223	2,224,746	2,226,646	1,900	(0%)	25	1
Mcpherson, KS	425	224	914,713	2,225,223	1,310,510	(143%)	4	1
Orangeburg, SC	265	232	1,585,949	2,173,673	587,724	(37%)	11	1
Kay, OK	517	235	663,330	2,109,424	1,446,094	(218%)	9	1
Mc Kean, PA	235	240	1,793,798	2,041,748	247,950	(14%)	9	1
Brunswick, NC	256	242	1,628,897	2,029,375	400,478	(25%)	9	2
St James, LA	255	245	1,632,509	1,992,945	360,436	(22%)	9	2
Beauregard, LA	229	248	1,865,833	1,953,119	87,286	(5%)	3	1
St John the Baptist, LA	480	249	761,070	1,950,333	1,189,263	(156%)	10	4
Spartanburg, SC	234	253	1,824,670	1,895,375	70,706	(4%)	37	4
Pulaski, KY	237	255	1,785,366	1,879,264	93,898	(5%)	5	1
Jones, MS	242	257	1,741,159	1,866,939	125,780	(7%)	10	1
Guayama, PR	300	258	1,410,469	1,866,348	455,878	(32%)	7	1
Gloucester, NJ	427	263	907,824	1,808,135	900,311	(99%)	28	4
Schenectady, NY	630	264	457,806	1,795,919	1,338,113	(292%)	5	2
Kenai Peninsula, AK	272	266	1,550,443	1,786,685	236,242	(15%)	3	1
St Croix, VI	430	268	890,136	1,755,012	864,876	(97%)	2	1
Midland, MI	505	269	700,674	1,751,250	1,050,576	(150%)	3	2
Crawford, IL	504	271	700,992	1,745,134	1,044,142	(149%)	5	1
Wood, WV	406	277	967,735	1,689,457	721,722	(75%)	6	2
Summit, OH	275	286	1,514,454	1,620,959	106,505	(7%)	60	5
Venango, PA	508	288	686,980	1,606,424	919,444	(134%)	10	2

State	Rank by TRI		Air Releases		Adjustment		Facilities	
	Unadjusted	Adjusted	Unadjusted	Adjusted			Total	Adjusted
Salt Lake, UT	409	290	957,054	1,599,657	642,603	(67%)	48	3
Chester, PA	303	302	1,399,327	1,533,847	134,520	(10%)	33	1
Hampden, MA	291	307	1,429,679	1,485,699	56,020	(4%)	32	3
Pierce, WA	302	308	1,401,953	1,484,877	82,924	(6%)	32	1
Whatcom, WA	462	312	807,703	1,468,387	660,684	(82%)	14	2
Dakota, MN	484	328	754,294	1,383,318	629,024	(83%)	19	1
Tyler, WV	559	331	569,824	1,374,882	805,058	(141%)	2	1
Chambers, TX	734	332	343,766	1,371,385	1,027,619	(299%)	8	5
Philadelphia, PA	420	333	922,140	1,370,776	448,636	(49%)	40	5
Butler, KS	595	341	518,751	1,335,808	817,057	(158%)	5	1
Solano, CA	453	353	839,845	1,276,276	436,430	(52%)	13	1
Albany, NY	479	360	765,029	1,243,525	478,496	(63%)	14	1
Carter, OK	712	361	376,032	1,243,092	867,060	(231%)	5	1
Washington, MN	499	363	707,874	1,236,919	529,045	(75%)	8	1
Tulsa, OK	531	364	621,758	1,232,619	610,862	(98%)	50	2
Independence, AR	357	365	1,143,296	1,232,371	89,076	(8%)	6	1
Tuscaloosa, AL	516	375	664,849	1,184,275	519,426	(78%)	20	2
Yellowstone, MT	538	385	613,681	1,160,666	546,985	(89%)	9	3
Boyd, KY	709	386	380,013	1,157,105	777,092	(204%)	6	1
Kent, MI	388	393	1,053,665	1,132,389	78,725	(7%)	67	2
Saratoga, NY	511	399	677,149	1,113,916	436,767	(65%)	8	1
Howard, TX	826	400	270,477	1,108,089	837,612	(310%)	2	1
Adams, CO	460	421	823,756	1,055,443	231,686	(28%)	30	2
Multnomah, OR	437	422	875,779	1,051,350	175,571	(20%)	53	2
Macomb, MI	444	429	861,971	1,016,935	154,964	(18%)	39	1
Salem, NJ	426	430	913,241	1,016,778	103,537	(11%)	14	2
Stark, OH	525	432	647,973	1,014,730	366,757	(57%)	44	2
Matagorda, TX	886	439	231,985	986,844	754,860	(325%)	2	2
Jefferson, LA	448	444	854,306	979,872	125,566	(15%)	20	2
Liberty, GA	587	456	529,896	924,336	394,440	(74%)	7	1
Marshall, IL	648	461	436,884	908,160	471,276	(108%)	3	1
Fairbanks North Star, Al	470	462	790,387	901,575	111,188	(14%)	9	2
Guilford, NC	452	465	843,011	893,490	50,479	(6%)	46	3
Knox, TN	459	468	824,237	882,484	58,246	(7%)	20	1
Douglas, IL	716	478	369,098	863,278	494,180	(134%)	6	1
El Paso, TX	544	486	609,177	836,140	226,963	(37%)	23	2
Warren, PA	565	487	563,673	835,775	272,102	(48%)	12	2
Davis, UT	643	497	440,346	800,552	360,206	(82%)	18	3
Rock Island, IL	518	500	658,982	785,879	126,897	(19%)	15	1
Smith, TX	609	506	500,787	779,807	279,020	(56%)	12	1
Eddy, NM	1027	511	158,496	773,604	615,108	(388%)	3	1
Niagara, NY	541	512	611,487	763,810	152,323	(25%)	35	3
Columbia, AR	562	515	566,710	756,862	190,152	(34%)	8	1
Delaware, OH	918	531	207,581	712,085	504,503	(243%)	7	1
Laramie, WY	629	538	458,552	688,763	230,211	(50%)	3	1
Fort Bend, TX	509	539	682,952	684,168	1,216	(0%)	11	2
Crittenden, AR	576	545	544,189	653,591	109,402	(20%)	10	1
Live Oak, TX	1020	550	161,550	638,915	477,365	(295%)	1	1
Montgomery, TX	550	570	591,065	593,261	2,196	(0%)	13	1
Boise, ID	1126	584	117,460	563,808	446,348	(380%)	1	1
San Juan, NM	649	605	436,841	532,827	95,986	(22%)	6	1
Westmoreland, PA	626	609	465,037	528,026	62,989	(14%)	40	1
Garvin, OK	1156	615	107,863	517,603	409,740	(380%)	1	1
Mc Kinley, NM	1069	630	138,591	495,066	356,475	(257%)	2	1
Moore, TX	970	637	183,666	477,711	294,045	(160%)	5	1
Marinette, WI	672	644	407,586	466,061	58,474	(14%)	13	1
Bayamon, PR	867	645	244,077	465,910	221,833	(91%)	10	2
Essex, NJ	743	647	335,814	464,398	128,584	(38%)	46	4
Hancock, WV	967	669	184,025	433,035	249,010	(135%)	4	1
Kern, CA	768	717	315,008	389,394	74,386	(24%)	27	4
Worcester, MA	798	722	287,700	382,507	94,806	(33%)	62	6
Hillsborough, NH	903	737	217,877	363,147	145,270	(67%)	34	1

State	Rank by TRI		Air Releases		Adjustment		Facilities	
	Unadjusted	Adjusted	Unadjusted	Adjusted			Total	Adjusted
Cherokee, SC	1026	758	159,125	337,258	178,133	(112%)	9	1
Kent, DE	901	761	220,262	336,080	115,818	(53%)	11	1
Yabucoa, PR	1038	764	150,565	330,879	180,314	(120%)	2	1
Mayes, OK	914	765	211,779	330,042	118,264	(56%)	9	1
Darke, OH	1005	800	169,830	304,996	135,166	(80%)	7	1
Frederick, VA	1364	807	62,683	300,768	238,085	(380%)	4	1
Warren, VA	1085	808	130,746	300,226	169,480	(130%)	2	1
Kent, RI	1057	816	141,425	290,940	149,515	(106%)	16	1
St Landry, LA	1294	817	77,294	290,463	213,169	(276%)	3	1
Henderson, NC	870	821	242,626	288,226	45,600	(19%)	7	1
San Luis Obispo, CA	1225	823	90,853	286,536	195,683	(215%)	7	2
Miami, OH	942	866	193,635	260,215	66,580	(34%)	16	1
Harney, OR	1460	918	47,165	226,392	179,227	(380%)	1	1
Natrona, WY	1396	931	58,049	213,206	155,157	(267%)	4	1
Webster, LA	1106	932	122,522	213,095	90,573	(74%)	3	1
Cocke, TN	1229	955	90,096	197,712	107,616	(119%)	4	1
Cascade, MT	1498	971	41,925	190,579	148,654	(355%)	1	1
Ionia, MI	1108	980	122,260	186,860	64,600	(53%)	8	1
Wayne, WV	1352	1001	65,867	178,489	112,622	(171%)	3	1
Rhea, TN	1208	1043	95,013	160,476	65,463	(69%)	6	1
Carbon, WY	1325	1097	70,455	134,998	64,543	(92%)	3	1
Hardin, TX	1176	1152	104,081	115,557	11,476	(11%)	4	1
Walker, GA	1439	1182	50,119	105,792	55,673	(111%)	5	1
Liberty, TX	1213	1224	93,934	93,934		(0%)	4	0
Weston, WY	1698	1270	19,334	84,467	65,132	(337%)	2	1
Lafayette, MO	1608	1285	29,035	82,235	53,200	(183%)	2	1
Penuelas, PR	1707	1321	18,602	73,634	55,032	(296%)	4	1
Waller, TX	1645	1652	23,693	23,693		(0%)	3	0

Source: US Environmental Protection Agency, 2001 Toxics Release Inventory. Adjustments calculated by Grassroots Connection.

APPENDIX D: Study Methods

Adjustments to the US Environmental Protection Agency 2001 Toxics Release Inventory were based on the initial database released by the US EPA in 2001. Revisions made by the US EPA since its initial database release are not included so that the numbers could be compared with the EPA's 2001 TRI Data Release.

The emission adjustment was made for all facilities reporting a primary or secondary SIC code listed in Table D-1. These four SIC codes were selected based on a database analysis of the accounts listed in tables 6.2-1 and 6.2-2, "Complete Attainment Demonstration SIP for the Houston/Galveston Ozone Nonattainment Area" (Texas Commission on Environmental Quality, March 18, 2003). The listed SIC classifications are those for which Texas has identified major or moderate revisions to the highly reactive VOC emissions. No similar data are available from TCEQ for other reactive VOC emissions.

Where facilities or plants are counted in this report, the term "facilities" or "plants" refers to the number of reporting entities with non-zero air emissions. When placed in the context of "adjusted," the terms refer to the number of reporting entities whose data were adjusted.

Table D-1: Toxic Air Pollution by Selected
Standard Industrial Classifications (pounds of VOCs released in 2001)

SIC	Industry	Air Releases		Emissions Increase	Facilities
		Reported	Adjusted		
2821	Plastics materials, synthetic resins, and nonvulcanizable elastomers	32,819,405	174,205,732	141,386,327	336
2822	Synthetic rubber	9,953,168	48,901,583	38,948,415	37
2869	Industrial organic chemicals, not elsewhere classified	44,954,390	237,775,979	192,821,589	365
2911	Petroleum refining	22,154,345	110,511,432	88,357,087	174
	Subtotal	**80,036,498**	**413,790,703**	**333,754,205**	**817**
	Other (excluding all facilities with SIC codes listed above)	192,103,002	192,103,002		
	Total (ten VOCs only)	**272,139,500**	**605,893,705**	**333,754,205**	**817**

Note: Many facilities report more than one SIC. This table includes facilities reporting more than one SIC code under each reported SIC codes. Therefore, the subtotal cannot be reproduced by adding up releases or numbers of facilities from SIC codes 2821, 2822, 2869 and 2911 because that would result in double counting.
Source: US Environmental Protection Agency, 2001 Toxics Release Inventory. Emissions TRI data tables and adjustments were generated by Richard Puchalsky of Grassroots Connection.

Of the hundreds of chemicals reported to the Toxics Release Inventory, only ten were adjusted. The Texas Commission on Environmental Quality has estimated only two adjustment factors. One is used for the "highly reactive" VOCs and the other is for several dozen other VOCs. However, only ten of these VOCs are reported to the Toxics Release Inventory.

Table D-2: Air Pollution Adjustment Factors and Releases, by Selected Toxics Release Inventory Pollutants (pounds released in 2001)

Toxic Pollutant	CAS Number(s)	Adjustment Factor	Reported Releases	Adjusted Releases	Increase in Emissions	Percentage Increase
Ethylene	000074851	5.6	23,918,535	123,641,512	99,722,977	417%
Toluene	000108883	4.8	71,539,704	117,462,423	45,922,719	64%
n-Hexane	000110543	4.8	47,644,345	94,415,125	46,770,780	98%
Xylenes	000108383 000095476 000106423 001330207	4.8	49,749,888	75,269,958	25,520,070	51%
Propylene	000115071	5.6	13,924,267	75,216,162	61,291,895	440%
Styrene	000100425	4.8	46,466,141	57,932,698	11,466,557	25%
Benzene	000071432	4.8	5,894,659	20,530,291	14,635,632	248%
Cyclohexane	000110827	4.8	4,309,434	18,112,831	13,803,397	320%
Ethylbenzene	000100414	4.8	6,547,375	11,893,226	5,345,851	82%
1,3-Butadiene	000106990	5.6	2,145,152	11,419,479	9,274,327	432%
Subtotal			**272,139,500**	**605,893,705**	**333,754,205**	**123%**
Hydrocloric acid	007647010		587,134,079			
Methanol	000067561		175,844,606			
Sulfuric acid	007664939		146,397,844			
Ammonia	007664417		122,057,546			
Other			375,799,482			
Total			**1,679,373,058**	**2,013,127,265**	**333,754,205**	**20%**

Source: US Environmental Protection Agency, 2001 Toxics Release Inventory. Emissions TRI data tables and adjustments were generated by Richard Puchalsky of Grassroots Connection. See note 1 for sources of adjustment factors.

APPENDIX E:
Questions & Answers Regarding Study Methodology

Is it reasonable to adjust emissions from refineries and chemical plants outside Texas?
Studies in various parts of the country have confirmed that hydrocarbon emissions are underreported in other states. While the extent of underreporting may vary, a common problem is that industry reports are based on federal emissions factors that are known to be inaccurate. Until other states conduct studies like those done in Texas to actually quantify underreporting, the Texas data is the best available.

Is it reasonable to adjust emissions for plants in such a limited number of industrial classifications?
While the lack of emissions monitoring is a problem for many other types of facilities, there are not studies available quantifying the accuracy (or inaccuracy) of emissions inventories for other major sources of air toxics. For example, findings from Europe suggest that large storage tank leaks (particularly older tanks) are a major source of unreported emissions, but similar studies have not been conducted in the US that would allow the findings to be applied to bulk storage facilities. The findings in Texas suggest that a somewhat broader group of industrial facilities may be responsible for unreported hydrocarbon emissions, but these findings have not been validated with field studies. Further studies clearly need to be conducted so that the public can know the true extent of toxic air pollution.

Is it reasonable to apply uniform adjustments to individual plants?
On-site monitoring would make this report obsolete by providing useful plant-specific data. Unfortunately, the findings from Texas remain quite general. The findings in this report indicate the potential size and nature of a systematic problem with reporting, but cannot be directly translated into accurate emissions estimates for specific facilities. Some plants may use more actual monitoring and, therefore, have fewer problems with underreporting.

ENDNOTES

[1] The Texas studies include: (1) Estes, Mark, et al, "Analysis of Automated Gas Chromatograph Data from 1996-2001 to Determine VOCs with Largest Ozone Formation Potential" (Texas Commission on Environmental Quality, November 11, 2002); (2) Estes, Mark, et al, "Preliminary Emission Adjustment Factors Using Automated Gas Chromatography Data" (Texas Commission on Environmental Quality, November 5, 2002); (3) Smith, Jim, "HGB Modeling Update" (Texas Commission on Environmental Quality, April 1, 2004) and (4) Texas Commission on Environmental Quality, "Revisions to the State Implementation Plan (SIP) for the Control of Ozone Air Pollution Houston/Galveston/Brazoria Ozone Nonattainment Area" (Draft Appendix D, Tables D.4 and D.26, and Appendix GG, Table 2, May 26, 2004).

[2] See notes 12-19.

[3] See note 1.

[4] The broad-scale, uniform adjustment to reported emissions is the only practical method of illustrating the size of the problem with industry's self-reported data. The errors in reporting are not however uniform across all facilities. In studies examining just four hydrocarbon species (see note 1), Texas environmental officials found that refineries and chemical plants in some areas of the Houston region appeared to be releasing 13-14 times more pollution than they were reporting, while in a few other areas, the emissions reporting error was significantly smaller, on the order of 20-90%.

[5] Reports documenting emissions estimation problems with flares, cooling towers and leaks include: (1) Environ International, "Measurement and Assessment of Equipment Leak Fugitives and Vent Emissions in Industrial Ethylene and Other Chemical Sources" (Texas Environmental Research Consortium, June 2003) and (2)Galveston-Houston Association for Smog Prevention, "Smoke in the Water: Air Pollution Hidden in the Water Vapor from Cooling Towers – Agencies Fail to Enforce Against Polluters" (February 2004). See also reports referenced in notes 17 and 19.

[6] The relative contribution to ozone formation among the ten VOCs varies. Ethylene, propylene and butadiene are considered by Texas to be "highly reactive." For example, ethylene has the potential to form ten times more ozone than benzene.

[7] Brunekreef, B and Holgate, S T, "Air Pollution and Health," *Lancet* (Oct 19, 2002).

[8] California Environmental Protection Agency, "The Determination of Acute Reference Exposure Levels for Airborne Toxicants," March 1999.

[9] See note 8.

[10] EPA "National Air Toxics Assessment" at http://www.epa.gov/ttn/atw/nata/risksum.html. See also, California Environmental Protection Agency, "Toxicity Criteria Database - OEHHA Cancer Potency Values" (Office of Environmental Health Hazard Assessment, December 2002).

[11] "OEHHA-CREL" refers to the California EPA, Office of Environmental Health Hazard Assessment. Air Toxics Hot Spots Program Risk Assessment Guidelines, Part III: Technical Support Document "Determination of Noncancer Chronic Reference Exposure Levels," adopted and draft proposed Chronic Reference Exposure Levels (CRELs), http://www.oehha.ca.gov/air/chronic_rels/index.html, September 2002. "TRI" refers to the US EPA, Office of Pollution Prevention and Toxics. TRI Risk-Screening Environmental Indicators Version 2.0, Technical Appendix A - Available Toxicity Data for TRI Chemicals of the RSEI User's Manual, http://www.epa.gov/opptintr/rsei/, February 2002. These data were used as compiled by Environmental Defense at www.scorecard.org/chemical-profiles/def/rav_edf.html. For endpoints, see Scorecard at http://www.scorecard.org/health-effects/.

[12] Several studies in Europe have also concluded that emissions are under reported by a large factor. For instance, a 1993 study using aircraft measurements around the Rijnmond (The Netherlands) area suggested that emissions of ethane, propane, n-butane, i-butane, n-pentane, i-pentane, 1,1,1-trichloroethene, tetrachloromethane, tetrachloroethene were under reported by industrial sources. The study cited earlier work in support of its findings, going back as early as 1988. Michiel Roemer, "Aircraft Measurements around the Rijnmond Area" (TNO Institute of Environmental Sciences, Delft, The Netherlands, January 1993).

[13] U.S. House of Representatives, Minority Staff, Special Investigations Division, Committee on Government Reform, "Oil Refineries Fail to Report Millions of Pounds of Harmful Emissions" (Prepared for Rep. Henry A. Waxman, November 10, 1999).

[14] United States General Accounting Office, "Air Pollution: EPA Should Improve Oversight of Emissions Reporting by Large Facilities (GAO-01-46, April 2001).

[15] See note 14.

[16] United States Environmental Protection Agency, Office of Inspector General, "EPA's Method for Calculating Air Toxics Emissions for Reporting Results Needs Improvement" (Report No. 2004-P-00012, March 31, 2004).

[17] Bay Area Air Quality Management District, "Technical Assessment Document: Further Study Measure 8, Flares" (Draft Revision 2, December 2002), "Technical Assessment Document: Further Study Measure 8, Pressure Relief Devices" (Draft Revision 2, December 2002), and "Proposed Regulation 12, Rule 11: Flare Monitoring at Petroleum Refineries" (Draft Staff Report, March 2003).

[18] Katzenstein, Doezema, Simpson, Blake and Rowland, "Extensive Regional Atmospheric Hydrocarbon Pollution in the Southwestern United States" (August 2003).

[19] Mid-Atlantic Regional Air Management Association, "Evaluating Petroleum Industry VOC Emissions in Delaware, New Jersey and Southeastern Pennsylvania" (October 2003).

[20] See note 16.

[21] See note 16.

[22] Driscoll, Tom, "Emissions Factors Program Fact Finding Survey" (US Environmental Protection Agency, Emissions Factors and Policy Applications Group (EFPAG), June 2004).

[23] 69 Fed. Reg. 3201 (Jan. 22, 2004).

[24] Most states have not acted to improve monitoring or reporting of toxic air pollution. Texas has adopted regulations requiring increased monitoring of cooling towers for leaks and better monitoring of the gases sent to flares, but only for equipment related to ethylene, propylene, butadiene and butenes. In addition, for the past two years, the Texas Commission on Environmental Quality has used a "top-down" emissions inventory for certain hydrocarbons rather than the unadjusted data submitted by industry. The California Bay Area Air Quality Management District has adopted a rule requiring better monitoring of flares and is considering rules adopting control requirements for flares. Bay Area Air Quality Management District, "Proposed Regulation 12, Rule 11: Flare Monitoring at Petroleum Refineries" (Draft Staff Report, March 2003).

[25] US Environmental Protection Agency website (www.epa.gov/tri/whatis.htm).