Houston, We Have a Problem

A Roadmap for Reducing Petrochemical Industry Toxic Emissions in the Lone Star State

Galveston-Houston Association for Smog Prevention
Industry Professionals for Clean Air
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GHASP's mission is to persuade government and corporate officials to prevent smog. GHASP seeks to accomplish its mission by being the most credible advocate for clean air in the Houston region; by supporting efforts to educate the public and intensify the political climate; and by directly engaging government officials, community leaders, the media and industry on regional air pollution issues. For more information, visit www.ghasp.org.

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Contents

List of Tables

Summary

As the petrochemical capital of the United States, the Houston area is at the center of a toxics storm. Numerous studies have documented dangerous levels of toxic air pollution in the Houston area, including the Milby Park and Galena Park neighborhoods. Communities in other industrialized areas throughout Texas face similar toxic threats. Refineries and chemical plants along the Texas Gulf Coast are major contributors to toxic hotspots in Beaumont, Corpus Christi, Freeport, Port Arthur, Port Neches, and Texas City.

Using Houston as a case study, this report details many of the shortcomings of federal and state toxics regulation, and provides a roadmap for reducing emissions of these harmful pollutants from refineries and chemical plants throughout the state of Texas and beyond.

Unfortunately, Texans cannot count on federal or state laws to protect their health. The U.S. Environmental Protection Agency's industrial toxics program is woefully behind schedule in meeting congressional deadlines. And, even more alarmingly, the federal program does not deal with real-world impacts of toxic pollution, particularly in local toxic hotspots.

To address these deficiencies, a number of states and local governments have adopted their own, more stringent air toxics programs. Texas regulators and politicians, however, have been unable or unwilling to place adequate limits on industrial toxic air emissions to protect the health of Texans. As a result, Texas industry has not been required to utilize the best available controls and practices for limiting toxic emissions, and cities like Houston have struggled to protect their residents' health.

State and federal government officials can help by improving toxic monitoring and taking into account real-world (cumulative) impacts in heavily industrialized neighborhoods. Texas politicians can also help by adopting legislation to require emission reductions in areas where toxic pollution exceeds safe levels, and encouraging, rather than thwarting, local programs designed to protect public health in toxic hotspots.

Perhaps most importantly, it is time for industry leaders to take responsibility to clean up their toxic emissions. Petrochemical industry executives should make toxic pollution reduction a priority second only to safety. They should support reasonable regulatory measures. And, most of all, petrochemical industry leaders should turn loose their plant managers and engineers to come up with the technical solutions to reduce their toxic emissions and protect public health. At a minimum, industry should adopt controls and practices similar to those discussed in this report, or others that achieve equivalent emission reductions.

The Federal Toxics Program Does Not Address Hotspots

National studies have shown that there are too many toxic chemicals in the air in much of the country. The most recent national toxics assessment, released by the U.S. Environmental Protection Agency (EPA) in 2006, found that 270 million Americans, or 90 percent of the nation, were exposed to air toxics at levels that increased their risk of getting cancer by more than the generally accepted "safe" level of 1 in 1 million.[1] According to EPA:

> Based on the results of this national-scale assessment and other studies, millions of people live in areas where air toxics may pose potential health concerns. While air quality continues to improve, more needs to be done to meet the Clean Air Act's requirements to reduce the potential exposure and risk from these chemicals.[2]

This is particularly true for toxic hotspots, which are usually located in urban and/or highly industrial areas. EPA

What is Safe?

For non-carcinogens, a "safe" level of exposure can be set, below which significant damage to the body is not known to occur. But, for carcinogens there is no known "no effect" level—any amount, no matter how small, can contribute to the development of cancer. Risk levels for carcinogens are, therefore, based on *minimization* of the harm.

Generally, scientists and policy makers regard ambient levels of individual carcinogens as "safe" if they create a *no greater than 1 in 1 million* increase in the likelihood of cancer for a person exposed over a 70-year lifetime.

The U.S. Environmental Protection Agency, however, has determined that it need not reduce toxic pollutants to the 1 in 1 million levels in order to protect public health. Instead, EPA has determined it is acceptable for certain refinery units to create a 70 in 1 million increase in risk of cancer, and for certain chemical plant units to create a 100 in 1 million increase in cancer risk. See 72 Fed.Reg. 50716 (Sept. 4, 2007), and 71 Fed.Reg. 34421 (June 14, 2006).

For people living near multiple refineries or chemical plants, the cumulative cancer risks from toxic air pollution are, of course, likely higher. EPA's decisions regarding "acceptable" risk are currently the subject of litigation.

acknowledges that its national studies do not reflect the higher public health risk in such areas, and that the national toxics program does not adequately address these risks.[3]

An Overview of Federal Regulation

In 1990, Congress directed EPA to develop a list of industrial sources that emit air toxics and write regulations to control emissions from these source types. EPA set emission standards or work practices, called maximum achievable control technology, or MACT standards, for each industrial source category. These standards should require the most up-to-date technologies and work practices, for limiting toxic emissions. They do not, however, require that emissions be sufficiently reduced to protect public health.[4]

Congress also directed EPA to assess the residual health risks after 10 years of the MACT standards being in place. If the standards do not reduce risk to levels that will protect public health "with an ample margin of safety," the Clean Air Act requires EPA to impose stronger standards.[5] EPA issued its final MACT standard in 2004. It has issued eight residual risk rules, three of which have been overturned by the courts.[6]

Why Federal Regulation Fails to Protect Public Health in Toxic Hotspots

As noted in various governmental reports, EPA's industrial source toxics program suffers from both structural and implementation failings.[7] The program is woefully behind schedule in meeting congressional deadlines and is seriously under funded.[8] Perhaps more importantly, the Clean Air Act's toxic provisions do not address real world impacts of toxic pollution, particularly in local toxic hotspots.

Toxic Emissions Are Not Monitored and are Under-Reported

EPA evaluates the residual risk from industrial toxic pollutants by modeling the effects of toxic emissions on ambient air. To do this, EPA must estimate how much toxic pollution is released into the air. But, EPA relies largely on industry's self-reported estimates. These estimates are widely acknowledged to be inaccurate.

The most reliable method of measuring emissions is to use continuous emissions monitoring systems, or CEMS. The federal toxics rules, however, do not require companies to use CEMS and, as a result, less than 5 percent of all reported toxic emissions nationally are based on CEMS measurements.[9]

Instead of actually monitoring emissions, industry uses EPA emission factors to calculate estimated emissions.[10] EPA emission factors are formulas for calculating emissions based on factors such as the amount of fuel combusted or production levels. Emissions factors calculate average emissions for a facility-type and often do not result in accurate emission estimates for individual facilities.[11]

EPA grades its emission factors based on their reliability for predicting individual facility emissions. As of 2004, 62 percent of these emission factors were rated as *below average or poor* at predicting actual emissions.[12] Studies by EPA have confirmed that the emission factors for toxics are among the least reliable and include the most uncertainty.[13] The EPA Office of Inspector General has noted:

> The heavy use of emissions factors in the NEI makes the reliability of the data highly uncertain. Emissions factors can result in emissions data of questionable reliability, particularly at the facility level. . . A prior [Office of Inspector General] report also noted instances where the use of

unreliable emissions factors resulted in underreporting of emissions.[14]

Actual air monitoring often shows much higher levels of toxic pollution than reported in estimates based on emission factors. Recent Houston studies found levels of actual volatile organic compounds (VOCs) from petrochemical facilities to be one to two orders of magnitude (10 to 100 times) higher than reported levels.[15] Monitoring in Canada and Europe has found refinery VOC emissions to be 10 to 20 times higher than reported, with refinery benzene emissions being 18 times higher than calculated emission estimates.[16]

Because reported emissions included in health effects models are likely lower than real world emissions, those health models necessarily under-predict risk. And as the Inspector General noted, "[i]f emissions and the subsequent risk derived from those emissions for specific source categories are understated, important regulations to protect public health may go undeveloped."[17]

EPA needs to work expeditiously to improve its emission inventory program by:

- Expanding the universe of source tests used to develop factors;
- Ensuring that site-specific variables relevant to emissions are included in factors; and
- Clearly limiting the non-inventory use of factors.

In addition, EPA should establish clear protocols and quality control procedures for the use of newer facility monitoring technologies like Differential Absorption Light Detection and Ranging, and Solar Occultation Flux, described in more detail in this report.

EPA Fails to Consider Aggregate or Cumulative Health Risks

EPA's risk models are not designed to reflect the true risk to the public from air toxics. Real people are exposed to a variety of pollutants from a variety of sources, which interact to affect their health. EPA's Guidance on Cumulative Risk Assessment states:

> The practice of risk assessment within the Environmental Protection Agency is evolving away from a focus on the potential of a single pollutant in one environmental medium for causing cancer toward integrated assessments involving suites of pollutants in several media that may cause a variety of adverse effects on humans, plants, animals, or even effects on ecological systems and their processes and functions.[18]

EPA's air toxics risk analyses, however, do not consider either the aggregate effects of multiple sources of a single pollutant, or the cumulative impacts of emissions of multiple pollutants. Instead, these analyses consider only the "incremental risk of a particular source or activity and compare[s] that risk to an acceptable risk criterion."[19]

In other words, when evaluating residual risk, EPA only looks at the risk from certain pollution sources, or units, at an industrial plant.[20] The risk analysis does not consider all toxic emissions from the plant. Nor does it consider toxic emissions from surrounding plants. And, it does not address the health impacts from exposure to multiple toxic pollutants at once.

As a result, the U.S. Government Accountability Office noted in 2006, "facilities with a high impact on public health may avoid additional control requirements because EPA's focus on limited portions of facilities may underestimate the risk posed by whole faciities."[21]

Underestimating Toxic Risk: The Refinery Example

In 2007, EPA completed assessing the residual risk posed by refineries. The agency found that communities living close to refineries are exposed to a 70 in 1 million increased cancer risk due to toxic refinery emissions. See, 72 Fed.Reg. 50716 (Sept. 4, 2007). But, the real cancer risk from toxic air pollution for people living near refineries is likely significantly higher than EPA estimates, for the following reasons.

First, EPA's risk analysis, took into account *only* those toxic emissions from certain pollution sources at refineries and ignored toxic emissions from:

- Refinery vents associated with catalytic cracking units, catalytic reforming units and sulfur recovery units;
- Leaks in heat exchanger systems;
- Process sewers and wastewater systems;
- Delayed cokers; and
- Tank roof landings.

Second, EPA ignored the substantial emissions that occur during periods of startup, shutdown, maintenance, or plant malfunctions.

And third, EPA failed to include in its risk analysis any emissions from the chemical plants that are often located alongside refineries. (Refineries produce the feedstocks used by chemical plants.) According to EPA data, 21 U.S. refineries actually share an identical address with an associated chemical facility. Yet EPA did not include the emissions from these chemical plants when determining the health risk to nearby communities.

Current Federal Laws Fail to Address Environmental Justice Impacts

One of EPA's national goals is to "address the disproportionate impacts of air toxics pollution across urban areas and, specifically, low-income and people-of-color communities."[22] Yet, when it comes to toxic air emissions, EPA actually sets a separate, weaker, health standard for these communities. EPA's industrial toxics regulations are not intended to protect industrial fenceline communities to the same level that EPA protects the rest of the country. EPA's stated goal is to provide two-tier protection:

> (1) To expose the greatest number of persons possible to an individual lifetime cancer risk of ***no higher than 1 in 1 million***, and
>
> (2) To limit, to ***no higher than 1 in 10,000 [100 in 1 million]***, the estimated excess cancer risk to persons living near an industrial plant.[23]

Communities near industrial facilities are often low-income and thus do not have the resources to cope with and recover from exposure to high levels of air toxics.[24] For example, industrial sources in Harris County are clustered in East Houston, near the Houston Ship Channel. In the nine neighborhoods in this area, median family income is more than 30 percent below the city median and the percentage of people without health insurance is among the highest in the county.[25] Households near the Houston Ship Channel are larger and have a greater number of children than the rest of the county.[26] In addition, these neighborhoods are less transient than the rest of Houston. Thirteen percent of households in the neighborhoods around the ship channel have been living in their current residence since 1969 or earlier.[27] The true risks to such sensitive populations are difficult to determine. As EPA noted:

> The issue becomes complex when other population factors such as age, socio-economic status, proximity to emitting sources, decreased health and nutrition status, and lifestyles are considered because it is known that these factors may lead to increased sensitivity and susceptibility to the effects of HAP [toxic] exposures. Within the general population, children, for example, are likely to have additional susceptibility and vulnerability to HAP exposures because of their daily activities, their immature or developing metabolic systems, or their developing organ systems. In addition, the poverty factor (over 20% of the urban population consists of children in poverty (U.S. Department of Commerce, 1997)) increases their vulnerability because they are more likely than other children to lack sufficient nutrition and access to health care.[28]

If the federal government is to fulfill its goal of addressing disproportionate impacts of toxic pollution, then EPA must adopt standards to ensure that fenceline communities, and other sensitive populations, are protected to at least the same safe risk levels as the rest of the country.

EPA Lacks an Updated List of Air Toxics and Adequate Health Data

EPA currently lists 187 regulated hazardous (or toxic) air pollutants. The Clean Air Act requires EPA to periodically update this list, but EPA has no process for doing so.[29] Despite the fact that approximately 300 new chemicals enter commerce each year, EPA has yet to add one to the list of regulated air toxics.[30] A 2004 study published in the *Journal of the Air and Waste Management Association* screened 1,086 chemicals for potential addition to the toxics list and found that 44 merited consideration for addition.[31] California lists over 700 chemicals as known to cause cancer, birth defects, or other reproductive harm.[32] The International Agency for Research on Cancer has evaluated more than 900 agents and identified approximately 400 as carcinogenic or potentially carcinogenic to humans.[33]

Further, for those chemicals that are on EPA's regulated air toxics list, EPA often lacks adequate health data. The primary database for EPA's chemical health impacts information is the Integrated Risk Information System, or IRIS. IRIS includes information on over 500 of the most widely used and produced chemicals in the U.S. and is EPA's preferred source for the toxicity values used in human health risk assessments.

Approximately one-fifth of the toxics regulated under the Clean Air Act, however, are missing from IRIS.[34] And for those toxics that are included, the information, such as chemical toxicity values, is on average 12 years old.[35] The Government Accountability Office and the National Academies have found that IRIS lacks current, basic scientific information necessary for regulating many air toxics.[36] Because EPA assumes no health effects for pollutants for which it has little or no health data, the lack of updated information in IRIS can lead to underestimation of real world health impacts and the failure to regulate dangerous chemicals.[37]

Until EPA develops a process for screening new chemicals before they enter the marketplace, determining their potential health effects, and regulating those that present a health hazard, the Clean Air Act's goal of protecting public health with an ample margin of safety will not be met.

The European Union is Ahead on Toxics

In December 2006 the European Union adopted the Registration, Evaluation, Authorization and Restriction of Chemical Substances (REACH) regulation. REACH requires companies to provide safety data for large volume chemicals that they produce or import into Europe. It also has a mechanism for the substitution of safer alternatives for persistent and bioaccumulative chemicals. The regulation, which became effective June 1, 2007, will be phased in over 11 years.

The federal toxics regulatory system simply does not adequately protect public health, particularly for those living in urban and industrial areas. EPA should require improved monitoring for air toxics, improve the accuracy of emission factors, consider aggregate and cumulative impacts of toxic emissions in regulatory determinations, and analyze the health impacts of chemicals before they enter the market. Congress should adopt legislation to identify and help local governments clean up toxic hotspots.

State and Local Governments Must Protect Public Health

In light of the federal government's failure to adequately regulate air toxics, state and local governments have an important role to play in protecting public health from toxic air emissions. EPA itself has stated that, in many cases, the residual risks from air toxics may be most appropriately addressed at the local level.[38] According to EPA:

> A successful comprehensive air toxics program will be one that integrates the residual risk and other federal programs with State and local programs and strengthens those existing programs... Additionally, State and local authorities may complement the federal program by addressing local risk issues that may not be effectively addressed nationally.[39]

Some State and Local Governments Have Taken Action

In response to ambient monitoring showing elevated levels of air toxics, a number of states and local air pollution control districts have adopted innovative programs to reduce local public health risks from air toxics.[40] As shown in Table 1, *Sample State/Local Air Toxics Programs*, various state and local programs improve upon EPA's regulatory system by:

- regulating more industrial sources than EPA,
- setting more stringent standards than EPA,
- using risk-based approaches for setting priorities,
- considering cumulative impacts,
- identifying and prioritizing new chemicals, and
- requiring standardized, certified, toxic emission reporting.[41]

TABLE 1. SAMPLE STATE/LOCAL AIR TOXICS PROGRAMS[42]

State	Program Description	Pollution Thresholds
California Air Resources Board[43]	AB1807 requires identification of toxic air contaminants and exposure levels to protect public health. If necessary to reduce risk CARB must adopt control strategies.	
	Hotspot program requires certain large and small stationary sources to report emissions of air toxics, estimate the public health impact of their emissions, notify neighbors, and take all possible actions to reduce emissions as necessary to meet health-based standards within 5 years.	Threshold for program applicability is the 1-in-1-million risk level. Notice is required to the affected public if risk exceeds 10-in-1-million. Facility risk reduction levels are set by local air district. Sacramento uses 10-in-1-million; Los Angeles 25-in-1-million; San Diego and the Bay Area use 100-in-1-million.
Louisiana[44]	Requires sources to: (1) use Maximum Achievable Control Technology for reducing toxic emissions if the source exceed established Minimum Emission Rates (MERs) and (2) meet ambient toxic air standards. Also requires state toxic emission inventory.	MERs were initially set based on 1-in-a-million risk level. Ambient air standards are set at 1-in-10 thousand risk level.
Louisville, KY[45]	Louisville's program was instituted because levels of 17 Toxic Air Contaminants (TACs) in the area exceeded 1-in-1 million cancer goal. The program includes a general duty to not emit a TAC in an amount or duration that is harmful to the health and welfare of humans, animals or plants. In addition, the program requires large and medium industrial sources to report emissions and determine if toxic emissions exceed health-based thresholds. If thresholds are exceeded, sources must submit plans for reducing emissions of TACs. Reductions in 18 priority TACs must be achieved by 2011. Finally, the program requires a study of whether specific reductions are needed from other sources, such as smaller businesses and cars.	Individual pieces of: (1) existing and (2) new and modified equipment must meet the 1-in-1-million for single TACs. The cumulative emissions of all applicable TACs must not exceed: (1) 3.8-in-1-million from all collective new and modified equipment, and (2) 7.5-in-1-million from all collective existing and new and modified equipment.
New Jersey[46]	Requires facilities seeking permits to apply air toxic emission "state-of-the-art" control technologies. Facilities must estimate the risk posed by their emissions. If benchmarks are exceeded a case-by-case review is conducted and the state may require more stringent controls.	Benchmarks are set at the 1-in-1-million level.
Oregon[47]	"Safety Net" program targets facilities that alone cause exceedances of ambient benchmarks.	
	Geographic hotspots must develop plans to meet the ambient benchmarks within 10 years. Hotspots are designated based on criteria including number and extent of benchmark exceedances and the risk from multiple pollutants and pollutant mixtures. Some source category rules limit emissions from sources that contribute to benchmark exceedances.	Ambient benchmarks are set at the 1-in-1-million level.

Texas Lacks an Enforceable Hotspots Program

Unlike some states, Texas implements the federal toxics program, but does not have its own enforceable toxics standards.[48] The state environmental regulatory agency, the Texas Commission on Environmental Quality (TCEQ), sets target health-based ambient toxics levels, which it refers to as Effects Screening Levels, or ESLs. These ambient toxic goals are designed to ensure a no greater than 1 in 100,000 increase in the risk of cancer from individual air toxics, and are used as guidelines during the permitting process.[49] TCEQ does not, however, treat these health-based ambient toxic goals as enforceable limits, and the agency routinely issues permits for sources whose emissions cause exceedances of the ESLs.

Table 2, *TCEQ's Air Pollutant Watch List,* identifies 14 areas of the state where air monitoring shows ambient toxic levels above the health based goals, or ESLs. These areas have been identified as areas of concern for short or long term health effects, and have been placed on the state's Air Pollutant Watch List.[50]

Unfortunately, there is no formal mechanism for ensuring that toxic pollution in these areas is reduced to healthier levels (i.e., toxic levels that are lower than the state's ambient toxic goals, or ESLs). TCEQ does try to target industries in areas on the state's watch list, but the agency largely relies on voluntary toxics reductions. As a result, some areas, such as Port Neches and Corpus Christi, have exceeded the state's health-based toxic goals for a decade or more.

While there are some examples of TCEQ and local governments obtaining voluntary pollution reductions, these efforts generally have a poor track record in Texas.[51]

Furthermore, TCEQ's ambient toxic goals, or ESLs, should not be used as the benchmark for determining whether the air is safe. Areas that do not exceed these ambient toxic goals may *still* present health threats. This is because these levels are based on how much of an individual pollutant can be present in the air without causing more than a 10-in-1million increase in cancer risk. But, health experts prefer the more stringent 1-in-1 million standard, cited in the federal Clean Air Act as the level necessary to protect public health with an "ample margin of safety," and used by a number of other states. The less protective 10-in-1 million standard should not be used as a default, and should certainly not be considered acceptable unless all best controls and practices for minimizing emissions have been implemented. This is particularly true because TCEQ's

TABLE 2. TCEQ'S AIR POLLUTANT WATCH LIST

County	City	Pollutant	Listed Since
Bastrop	Bastrop	hydrogen sulfide	2007
Bowie	Cass	hydrogen sulfide	1999
Brazoria	Freeport	Arsenic	2005
		Cobalt	
		Nickel	
		Vanadium	
Dallas	Dallas	Nickel	2004
El Paso	El Paso	hydrogen sulfide	2004
Galveston	Texas City	Acrolein	2001
		Butyraldehyde	
		propionaldehyde	
		Valeraldehyde	
		Benzene	2003
		hydrogen sulfide	2004
Harris	Lynchburg Ferry	benzene	2002
		Styrene	
	Galena Park	Benzene	2000
	Houston	1,3-butadiene	1999
Jasper	Evadale	hydrogen sulfide	2003
Jefferson	Beaumont	hydrogen sulfide	2002
		sulfur dioxide	2003
		Benzene	2004
	Port Arthur	Benzene	2001
	Port Neches	1,3-butadiene	1996
Nueces	Corpus Christi	Benzene	1998

acceptable 10-in-1 million risk level is the risk from exposure to a *single* chemical, while in many of Texas' industrial areas, residents breathe a cocktail of various toxic chemicals. The risk from this suite of chemicals is poorly understood, but is almost certainly higher than the risk from any one chemical.

Given elevated ambient toxic levels and its concentration of industry, Texas should be at the forefront of innovative regulations to control toxics. Yet despite air monitoring data that clearly show there is a problem, Texas has failed to adopt a toxics program to ensure protection of public health.

The Texas State Legislature Fails the Public

There have been numerous efforts to strengthen Texas' regulation of air toxics. Groups including the Texas Medical Association, Texas Parent Teacher Association, Harris County Public Health and Environmental Services, Texas Catholic Conference of Bishops, the City of Houston Mayor's Office, Christian Life Coalition, the Harris County Commissioner's Court, and many others have pushed to clean up toxic hotspots.[52]

In the 2007 Texas legislative session, for example, no less than 15 bills were introduced relating to air toxics. But none were passed into law. In fact, none of these bills were even given a hearing by the Texas House of Representatives environmental committee chair, Representative Dennis Bonnen, whose district lies near the Houston area, along the Gulf Coast. In the Texas Senate, where two bills were given a public hearing, the only opposition came from five industry associations: the Texas Chemical Council,[53] Texas Oil and Gas Association,[54] Texas Association of Business, American Electronics Association,[55] and the Association of Electric Companies of Texas.[56] The text box, *Who Opposed Toxic Hotspot Public Notice,* lists some of the members of these lobbying groups that opposed modest toxics legislation.

Not only did the 2007 Texas legislature fail to adopt legislation to improve the toxics program, it almost adopted legislation that would have prohibited Texas local governments from taking any action on their own to protect their residents' health from toxic air pollution.[57] The anti-local government bill

WHO OPPOSED TOXIC HOTSPOT PUBLIC NOTICE?

Texas Senate Bill 1924 (2007) would simply have required public notice of toxic hotspots. The following lobbying groups opposed the measure:

Texas Chemical Council, whose current members include: BP, Chevron Phillips Chemical Co., Citgo Petroleum Corp., Dow Chemical Company, DuPont, Eastman Chemical Co., Equistar Chemicals LP, ExxonMobil Chemical Co., Formosa Plastics Corporation, Texas, Goodyear Chemical, Huntsman, LLC, Lyondell Chemical Co., Marathon Petroleum Co., LLC, OxyChem, Rohm and Haas Texas, Inc., Shell Chemical LP, Solutia Inc., Solvay Chemicals, Inc., Sunoco Chemicals, Texas Petrochemicals, and TOTAL Petrochemicals USA, Inc.

TxOGA, whose current members include: ExxonMobil Corp., BP America, Inc., ChevronTexaco, Conoco Phillips Co., Valero, Shell Exploration & Production Co., and Marathon Oil Co.

TAB, whose current members include: ExxonMobil, Chevron, Walmart, Sunoco, Inc., TXU, Trendmaker Homes, Walter P. Moore, Texas Children's Hospital, and Unicare Life and Health Insurance.

AeA, whose current members include: Agilent Technologies, Inc., Apple Computer, Bridge360, Inc., Cirrus Logic, Inc., Cushman & Wakefield, Dell, Inc., Ernst & Young, Freescale Semiconductor, Inc., Fulbright & Jaworsky LP, Intel Corp., INX, Inc., Motorola, National Instruments Corp., SEMATECH, Samsung Austin Semiconductor LP, Texas Instruments, The Staubach Co., Sun Microsystems, Inc., United Healthcare, Valerent, and Vignette Corp.

AECT, whose current members include: American Electric Power Company, Southwestern Electric power Company (SWEPCO), CenterPoint Energy, Direct Energy, El Paso Electric Company, Entergy Texas, Exelon Generation, Luminant, NRG, Oncor, PNM Resources, Reliant Energy, TXU Energy, and XCEL Energy.

was largely aimed at preventing the City of Houston from taking action.

The Houston Example

As the petrochemical capital of the United States, the Houston area is at the center of a toxics storm.[58] Recent studies by the City of Houston, local universities, and medical schools have documented dangerous levels of toxic air pollution in parts of the city. The City of Houston recently identified 12 chemicals that are present in the air at levels that pose a definite health risk.[59] See Table 3, *Houston's Definite Risk Pollutants.*

A study by Rice University, Baylor College of Medicine, Texas Southern University, University of Houston Law Center and the University of Texas Medical Branch at Galveston looked in detail at four pollutants and found:

> Mounting evidence demonstrates that the population of Southeast Texas is exposed to disproportionate levels of toxic air pollutants considered to be a health risk to this population. In Southeast Texas, benzene, 1,3-butadiene, formaldehyde, and diesel particulate matter (diesel PM) have been identified as particularly pernicious pollutants requiring priority regulation. Based on the toxicological information and the concentrations seen in the Houston area for the selected four air pollutants, it is clear that large portions of the city have ambient air concentrations posing a risk higher than one excess cancer death in every 100,000 people. Observed concentrations of 1,3-butadiene and diesel PM approach a level indicating risk greater than one excess cancer death per 10,000 people.[60]

Houston-area residents pay a price for this toxic pollution. Individuals pay with their health, due to exposure to toxics and to ozone. The general public pays for increased health costs and lowered productivity.[61] In addition, Houston has gained a negative reputation for its air pollution, which makes it harder to attract new companies and the workers Houston needs. According to a recent study by CEOs for Citizens, out of the 50 fastest growing metropolitan areas, Houston ranks 49th for its ability to attract college-educated 25-to-34 year olds. The report shows that a major factor in recent college graduates' choice of cities is a green environment.[62] As Houston

TABLE 3. HOUSTON'S DEFINITE RISK POLLUTANTS

Pollutant	Causes Cancer?	Other Health Risks
Ozone		Respiratory, Cardiovascular, Immune
Fine Particulate Matter ($PM_{2.5}$)	Yes	Respiratory/Cardiovascular
Diesel Particulate Matter	Yes	Respiratory
1,3-Butadiene	Yes	Female reproductive
Chromium VI	Yes	Respiratory
Benzene	Yes	Immune
Ethylene Dibromide	Yes	Male reproductive
Acrylonitrile	Yes	Respiratory
Formaldehyde	Yes	Respiratory, Eyes
Acrolein	No	Respiratory
Chlorine	No	Respiratory
Hexamethylene Diisocyanate	No	Respiratory

Mayor Bill White noted in his 2005 State of the City address:

> Cleaning our air is also important to our ability to attract new jobs, preserve the value of our homes, and protect the respiratory health of younger people who we want to make Houston their home.

The Source of Houston's Problems

Houston's toxic air pollution comes from many sources, including industry. Benzene, for example, is emitted by industry, as well as mobile sources (i.e., from the tailpipes of cars and trucks). But, because mobile source emissions are dispersed across a wide area, they do not generally cause toxic hotspots. Large industrial facilities, by contrast, are often clustered together, such as along the Houston Ship Channel.

Industry representatives often blame mobile sources, like cars, as the true source of the Houston area's high benzene levels, citing the statistic that on-road mobile sources are responsible for 55 percent of Harris County benzene emissions, while industrial sources emit 14 percent.[63] Even assuming this statistic is accurate,[64] it has little relevance when it comes to analyzing public health impacts. In terms of health risk for an exposed population, it is the *concentration* of the benzene (or any toxic) exposure that matters, and not the total amount emitted countywide. A simple analogy is rainfall: one inch of rainfall over the entire county poses no problem, but if that same volume of water falls entirely on one neighborhood, there very likely will be flooding.

There is mounting evidence that industry, not cars, is responsible for Houston's toxic hotspots. For example:

- The areas on the state's Air Pollutant Watch List, where concentrations of toxics exceed the state's health-based goals (ESLs), are primarily industrial areas, or are directly downwind of industrial areas.[65] (Appendix A contains TCEQ's maps showing the areas impacted by the petrochemical industry);
- Monitoring during airplane flyovers has found that benzene levels in downtown Houston are similar to those in Dallas, but that benzene levels rise substantially over the Houston Ship Channel;[66] and
- High benzene levels over the Houston Ship Channel are not associated with high carbon monoxide levels, showing that cars are *not* the problem. Cars emit carbon monoxide as well as benzene. In locations that do not have industrial complexes, ambient benzene levels rise in proportion to ambient carbon monoxide levels. Along the Houston ship channel, benzene levels rise without associated rises in carbon monoxide, suggesting that the main source of the benzene along the Ship Channel is not cars.[67]

In addition to creating toxic hotspots, emissions of toxics and other VOCs, combine with industrial emissions of nitrogen oxides (NOx), resulting in plumes of high ozone that originate near the Houston Ship Channel and then spread across the city.[68] High ozone levels create a health threat for all of Houston. High ozone can cause chest pain, coughing, and throat and lung irritation. It can also worsen bronchitis, emphysema, and asthma, reduce lung function, and permanently scar lung tissue.[69]

Because toxic industrial emissions have a significant effect on public health, it is important to identify the sources of such pollution. In Harris County, 74 percent of industrial benzene emissions, and 79 percent of 1,3- butadiene emissions, are emitted by the organic chemical, petroleum refining, and petroleum bulk station and terminal industries. See Table 4, *Industrial Benzene and Butadiene Emissions in Harris County.*

TABLE 4. INDUSTRIAL BENZENE AND BUTADIENE EMISSIONS IN HARRIS COUNTY[70]

Standard Industrial Code	1,3- Butadiene Emissions (tpy)	Percent of County 1,3- Butadiene Emissions	Benzene Emissions (tpy)	Percent of County Benzene Emissions
Industrial Organic Chemicals (2869)	200.19	50%	223.44	41%
Petroleum Refineries (2911)	70.11	18%	106.39	19%
Petroleum Bulk Stations & Terminals (5171)	44.52	11%	77.63	14%

As noted above, however, it is not solely the quantity of a chemical emitted that determines the potential health impacts. The City of Houston evaluated health impacts due to benzene emissions in the ten-county Houston region according to EPA's Risk-Screening Environmental Indicators (RSEI) Model. The RSEI Model considers the amount of a chemical released, the location of the release, the toxicity of the chemical, the fate and transport through the environment, the route and extent of human exposure, and the number of people exposed. It then generates a facility score that can be compared to other facility scores to assess the relative health risk posed by different facilities.

Table 5, *Largest Benzene Emitters in the Houston Area*, includes the results of the city's study, identifying the industrial facilities that emit the largest quantities of benzene and pose the greatest human health risk from benzene air pollution exposure in the ten-county Houston area.

TABLE 5. LARGEST BENZENE EMITTERS IN THE HOUSTON AREA

Company	County	Benzene (tons/yr)	Risk Level[71]
BP Products North America, Texas City	Galveston	86.68	7
Equistar Chemicals LP, Channelview Complex	Harris	51.55	3
Exxon Mobil Chemical, Baytown Chemical Plant	Harris	49.53	2
Lyondell Houston Refining LP	Harris	41.77	1
Shell Oil Deer Park	Harris	34.25	5
Lyondell Chemical Channelview	Harris	28.95	10
Exxon Mobil Baytown Facility	Harris	26.11	9
Dow Chemical Co., Plant B	Brazoria	31.80	14
Equistar Chemicals Chocolate Bayou Complex	Brazoria	29.04	17
Georgia Gulf Chemicals & Vinyls	Harris	21.07	8
Rohm & Haas Texas, Deer Park Plant	Harris	18.69	11
Sterling Chemicals Inc., Texas City Plant	Galveston	17.88	13
Goodyear Tire and Rubber	Galveston	16.80	15
Marathon Petroleum Co LLC, Texas City Refinery	Galveston	15.61	6

SOURCE: City of Houston, *Houston Regional Benzene Air Pollution Reduction: A Voluntary Plan for Major Sources*, p. 9, Tables 1, 3, and 4. (Feb. 2007).

The City of Houston Steps Up

In light of the high toxic levels in certain neighborhoods, and the failure of federal and state programs to ensure the protection of Houston residents, city leaders decided to take action.

Initially, the City of Houston encouraged voluntary pollution reductions, and developed a voluntary benzene reduction plan.[72] This plan identified seven facilities whose benzene emissions presented the greatest health threat to Houston-area residents, and included draft benzene reduction plans for those facilities. The city's proposal was to serve as a starting point for voluntary agreements with industry, and included recommendations, such as: flare minimization and flare gas recovery; controls on tanks and wastewater systems; and improvements to leak detection and repair programs. Unfortunately, industry failed to either adopt the city's reduction plans or come up with an alternative plan to reduce toxic emissions.

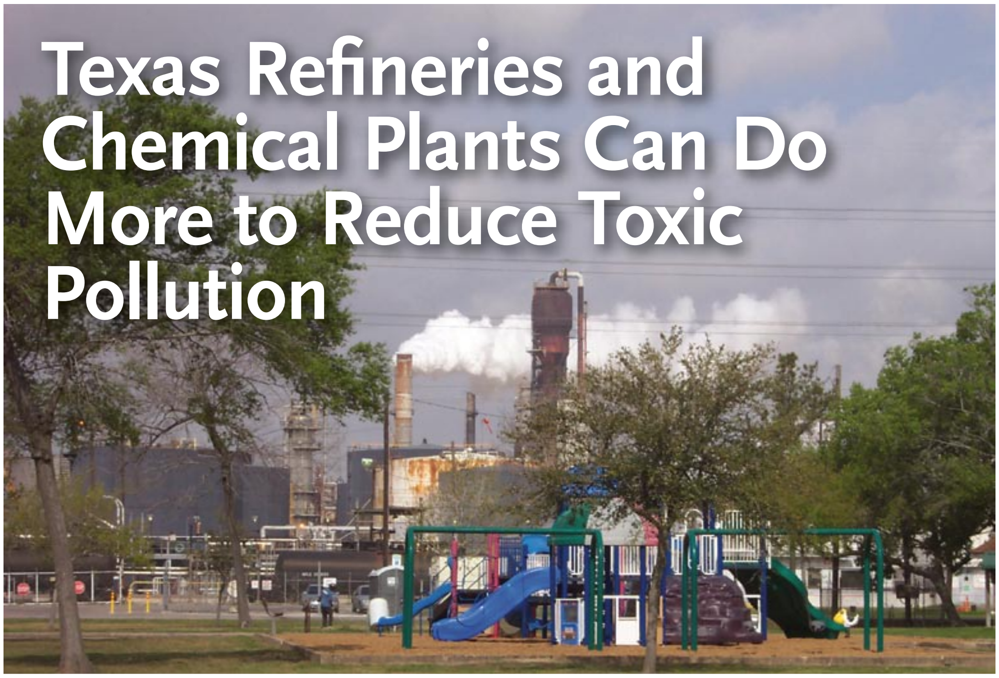
> "Clean air is a moral and ethical issue, because no one should have the right to make risky chemical alterations to air which they don't own and others must breathe."
>
> —Houston Mayor Bill White, State of the City Address (Jan. 24, 2005)

In early 2007, the city proposed a nuisance ordinance, which set standards for the levels of toxic pollution in the air. The ordinance would have allowed the city to abate toxic nuisances, and penalize the companies responsible for the nuisance. But, the proposed ordinance faced strong opposition from industry and state officials and was never adopted.

Instead, the City of Houston agreed to participate, with business leaders and public health and environmental groups, in an Air Quality Task Force, to develop a plan to address Houston's toxic air pollution problem. In November 2007, the task force released its much-anticipated report, but failed to outline concrete steps for industrial toxic emission reductions. Instead the report called for voluntary industry efforts, public outreach and more studies.

Houston Mayor Bill White said he welcomed industry's voluntary efforts, but wanted to see real results. Frustrated by industry's foot-dragging, the mayor gave Houston industries six months, until May 1, 2008, to reduce ambient levels of air toxics.

Texas Refineries and Chemical Plants Can Do More to Reduce Toxic Pollution



With the Houston Mayor's deadline for voluntary toxic reduction approaching, what has industry done?

One positive step is that at least two companies have entered into agreements with the state environmental agency (the TCEQ) and the City of Houston, to reduce toxic emissions. For example, the city and TCEQ entered into an agreement with Texas Petrochemicals for significant 1,3-butadiene reductions.

In March of 2008, Houston's Air Quality Task Force held a public education forum on clean air. According to the task force, the event would highlight the actions that individual companies have taken to reduce emissions, and allow companies to report on their leak detection and repair, storage tank, flare minimization, and other programs.[73] But, no company actually produced a report or indicated how much pollution they will reduce. The task force claims that Houston area industries still need more time.

It is clear that considerable health risks remain for many Houstonians exposed to unhealthy ambient concentrations of benzene and other air toxics. While science has only begun to quantify cumulative risks, like those from the variety of toxic chemicals present in Houston's air, we do know that public exposure to individual chemicals such as benzene remains too high in parts of the city. Some Houston air monitors still show levels of benzene above the state's ambient toxic goals, or Effects Screening Levels. As explained above, these levels, even when they are met, do not ensure adequate protection of public health.

Furthermore, according to the City of Houston's analysis of benzene monitor data, more than half of the Harris County monitoring sites examined — including two of the most contaminated sites, Lynchburg Ferry and

Channelview — showed no statistically significant improving trend in benzene concentrations in the past five years.[74] This data, coupled with the region's failure to attain acceptable risk levels of other air toxics, such as 1,3-butadiene, and the inability to meet the federal air quality standard for ozone, suggest that Houston is a long way from having healthy air.

History has shown that industry can rise to meet most challenges. Yet, when it comes to reducing toxic emissions at Houston's refineries and chemical plants, instead of turning the engineers loose to solve the problem, industry leaders have opted to put their lobbyists and lawyers to work, pointing the finger (mainly at cars) and touting emission reductions made more than a decade ago. Meanwhile, Houston's toxic hotspots persist and ozone levels repeatedly exceed federal standards.

For the air to be safe to breathe for all the state's residents, Texas industry leaders must do their part to clean up toxic emissions. The following roadmap lays out minimum actions that refining and petrochemical companies should be undertaking to protect the health of their fellow Texans.

Every refining or petrochemical company should:

- Make pollution reductions a corporate priority second only to safety;
- Increase monitoring and verify the accuracy of any formulas used to calculate emissions;
- Use current best controls and practices for minimizing toxic emissions; and
- Support reasonable regulation to ensure a level playing field and protect public health.

Make Pollution Reduction a Corporate Priority Second Only to Safety

Prioritizing toxic emission reductions requires more than generic "green" corporate goals. It requires a detailed analysis of a company's practices, and incentives to ensure that emission reductions are a top priority second only to safety.

Many companies base bonuses on throughput, creating an incentive to increase production at the expense of preventing emissions.[75] If the goals of environmental staff and production staffs are at odds, and production staff are reluctant to temporarily cease operations in order to make repairs, then even those repairs that result in long-term cost savings may not be made.[76]

As Dow Chemical explained when describing its project to reduce startup, shutdown and off-specification product emissions:

> One of the main contributors to the overall success of this project was the adoption of a philosophy that it is an unacceptable practice to flare. This philosophy had to be accepted at all levels. Management (Leadership) supported the project efforts by allowing operations the liberty to slow down the process of upset recovery if the efforts would result in less emissions. Under these conditions, production rates were third in priority — safety first, flare minimization second, and finally production rates. This allowed operations more freedom to think through upset situations and take more appropriate action in an effort to reduce flaring. This mindset also opened the doors to a larger group to generate further improvements. Even the smallest upset events are now managed to reduce flaring.[77]

Industry leaders can reduce toxic emissions and eliminate toxic hotspots if they make it a priority. The goal should be to eliminate all emissions that contribute to unsafe ambient levels of air pollution.

Increase Monitoring and Verify the Accuracy of Emission Estimates

As explained in this report, most estimates of industrial emissions are based on outdated and unreliable "emission factors." As a result, industry self-reported emissions do not correspond to the actual quantity of pollution released into the air. More than 30 studies of refinery emissions using ambient monitoring technologies have been conducted over the past 20 years. The best performing refinery emitted three times its reported emissions. The worst emitted twenty times its reported emissions.[78]

Relying on inaccurate and outdated emission factors in order to estimate emissions is unacceptable. Where continuous monitoring of actual emissions is possible, industry should use such monitoring. Where it is not, companies should verify the accuracy of emission calculations at least every two years, using ambient monitoring technologies that permit site-specific emission estimates. Several such technologies are available, including:

- ***Differential Absorption Light Detection and Ranging (DIAL)***— These systems are used extensively in Europe and are being used in Canada. The systems use ultraviolet and infrared lasers to measure pollutants, including criteria pollutant, light aromatics, methane and total hydrocarbons. The DIAL system has been validated in European studies for hydrocarbon emissions and its results, while generally found to be conservative, have proven more accurate than prior estimates based on emission factors.
- ***Solar Occultation Flux (SOF)*** — These systems can quantify pollutants, much like the DIAL system, and are used in Sweden to monitor whole plant emissions. SOF systems are less expensive than DIAL, but they are dependent on high sun and steady winds.

If monitoring results based on technologies like DIAL and SOF differ from emission calculations, companies should work with regulators to determine why, and should amend past emission reports to reflect accurate emission levels. EPA should establish protocols, training and quality control procedures for the use of technologies such as DIAL and SOF to ensure that their use results in accurate emission estimates.

In addition, companies located in areas where ambient levels of toxics exceed Texas' ambient toxic goals, or ESLs, should implement fenceline monitoring systems to measure the ambient concentrations at the fenceline, both downwind and upwind of the facility.

Use Current Best Controls and Management Practices

Better performing facilities nationwide are implementing technologies and best practices that could be used to minimize toxic emissions in the Houston area. Many of these technologies have been required for years in other jurisdictions or have been required by EPA to resolve enforcement actions.

Table 6, *Harris County Industrial Emissions by Unit*, lists the largest sources of industrial emissions of benzene and 1,3-butadiene, according to state data.[79] Because emission reporting is notoriously inaccurate, however, there may be additional sources of toxic emissions that warrant improved controls.

TABLE 6. HARRIS COUNTY INDUSTRIAL EMISSIONS BY UNIT (2004)

Units	1,3-Butadiene Emissions (tons/yr)	Percent Total Butadiene	Benzene Emissions (tons/yr)	Percent Total Benzene
Tanks	31.82	8%	209.95	38%
Fugitives	168.08	42%	155.74	28%
Flares	135.18	34%	51.18	9%
Wastewater	9.28	2%	24.42	4%
Cooling Towers	3.03	1%	45.37	8%
TOTALS	347	87%	487	87%

There are technologies and practices that can be implemented *today* that will reduce emissions from tanks, fugitives, flares, wastewater systems, cokers,[80] and cooling towers. Some of these technologies and best practices are explained in this section. But these recommendations are certainly not exclusive. There are likely other innovative ways to reduce toxic emissions from Houston's petrochemical facilities. Plant managers and the engineers working in these facilities are the best equipped to identify ways to reduce toxics. Until company executives decide to make toxic reduction a priority, government officials (both the City of Houston and the state of Texas) should demand anti-pollution controls and practices, like those identified below that have proven track records of achieving emission reductions.

Eliminating Leaks Often Pays for Itself

"In the process of focusing on pollution sources, owners of industrial facilities often find they ultimately save money by locating leaky equipment. In the Shoreacres investigation, once the emissions problem was resolved, the company was no longer losing valuable raw product. In these cases, the pollution control equipment pays for itself in short order."

— TCEQ, *Forecast for Houston: Air Quality Improving,* Natural Outlook (Spring 2008).

FUGITIVES. Fugitive emissions are leaks from equipment like valves, connectors, pumps, and compressors. According to TCEQ's 2004 Point Source Emission Inventory for Harris County, 42 percent of butadiene emissions, and 28 percent of benzene emissions, were fugitive emissions. And, fugitive emissions are likely underestimated. In 1999, EPA's National Enforcement Investigation Center found refinery leaks were on average 10 times greater than reported.[81] Although there have been some improvements since 1999, facility audits still show "significantly elevated leak rates," particularly at chemical plants.[82]

Fugitive emissions often mean lost profit because the gases leaking into the air could otherwise be sold or used on-site as fuel. As a result, many requirements for reducing these leaks result in cost-savings.

Federal and state regulation of fugitives is generally done through Leak Detection and Repair (LDAR) programs. These programs set a leak limit (called a leak definition), require periodic monitoring, and establish a timeline for repairing leaks.

TABLE 7. LEAK DEFINITIONS (PPM)

Equipment	TCEQ Highly Reactive VOCs[83]	TCEQ All Other VOCs[84]	BAAQMD All VOCs[85]
Pumps and compressors	500 ppm	10,000 ppm	500 ppm
Pressure relief valves	500 ppm	500 ppm	500 ppm
Valves, connectors and other equipment	500 ppm	500 ppm	100 ppm

Recommendations: Petrochemical companies should implement enhanced leak detection and repair programs that include the following:

- ***A well-managed LDAR program:*** a written LDAR program covering all units in toxic service should include a facility-wide leak goal with compliance established on a unit-by-unit basis, training for LDAR employees, contractor accountability and LDAR audits, including annual independent audits. Components on the delay-of-repair list should be included in leak rates.

- ***Lower leak definitions:*** for all equipment in toxics service, facilities should use lower leak definitions, 100 ppm for valves, connectors and other equipment and 500 ppm for pumps, compressors and pressure relief valves. These leak definitions are currently in place in the Bay Area Air Quality Management District (BAAQMD) and are more stringent than the levels required in Texas. See Table 7, *Leak Definitions*.

- ***Tighter repair timelines:*** For equipment in toxics service, any leaks should be minimized within 24 hours of identification. Repairs should be made within seven days. These timelines are more stringent than currently required by Texas and are consistent with those required by the BAAQMD and SCAQMD. See Table 8, *Repair Timelines*.

- ***Repairs using best available technologies:*** When repairs are made, they should be made using the best available technologies for minimizing leaks, including low leak valve packing. If a component

TABLE 8. REPAIR TIMELINES

Actions	SCAQMD[86]	BAAQMD[87]	TCEQ (HRVOC)[88]	TCEQ (Non HRVOC)[89]
Minimization		24 hours		
First Attempt Repair			1 day for leaks greater than 10,000 ppm. 5 days for all other leaks.	5 days
Repair	1-7 days based on component and size of leak[90]	7 days if discovered by operator 24 hours if discovered by agency[91]	7 days for leaks greater than 10,000 ppm 15 days for all other leaks.[93]	15 days[92]

in toxic service requires more than five repair actions in any 12-month period for leaks greater than 10,000 ppm, it should be replaced using the best available technology, or permanently routed to recovery or controls. Pressure relief devices should be routed to recovery or controls following: (1) any release involving more than 2,000 pounds VOC in any 24-hour period, or (2) a second release of 500 pounds or more VOC in any 24-hour period within a five year period. The SCAQMD currently has similar requirements.[94]

To the extent consistent with good engineering practice, all leaking components should be replaced with leakless components, such as bellows or diaphragm valves. Similarly pumps should be replaced with seal-less pumps such as diaphragm or magnetic drive pumps. Flanged connections should be replaced with welded connections.

- ***Passive Optical Gas Imaging:*** Facilities should use Passive Optical Gas Imaging devices at least quarterly to detect leaks. These are portable, video camera-like devices that can visually identify plumes of leaking emissions. While Gas Imaging is wonderful for identifying previously unknown sources of leaks and for monitoring "difficult-to-monitor" or "unsafe-to-monitor" components, it is not reliable for leaks below 500 ppm or for all chemicals.[95] It should, therefore, be used to supplement rather than replace traditional LDAR monitoring. Any equipment found to be leaking with Passive Optical Gas Imaging, which does not qualify as difficult or unsafe-to-monitor, should be added to the list of monitored LDAR components and made subject to traditional LDAR monitoring.

FLARES. To the general public, flares are the most easily identifiable pollution source at petrochemical facilities. Some flare stacks can reach 600 feet, and their flames are often visible for miles. Flares are used by petrochemical facilities to burn gases. The combustion process does not, however, completely eliminate all emissions of toxics and other pollutants, and the destruction efficiency can be compromised by operational and meteorological variables.

As with fugitives, flare emissions are likely underreported. Flare emissions are generally calculated based on the assumption that flaring destroys 98 to 99 percent of the VOCs sent to the flare. But, real-world factors, like weather (e.g., high winds) or operating conditions (e.g., poor steam ratio) can result in significantly higher emissions.

Because flares are significant sources of toxic emissions, they should be strictly limited. Their sole purpose should be treating large volumes of gases that are released as a result of emergency facility failures and cannot be recovered. Unfortunately, instead of using flares for emergencies, companies often use flares as a part of routine operations. In some cases, TCEQ has even permitted facilities to flare emissions during routine operation.

California's South Coast Air Quality Management District found that between 1999 and 2003, only 4 percent of flaring events could be attributed to emergencies.[96] Similarly, EPA investigations found that flaring "frequently occurs in routine, non-emergency situations or is used to bypass pollution control equipment. This results in unacceptably high releases of sulfur dioxide and other noxious pollutants …"[97]

Recommendations: Refineries and petrochemical plants should install flare gas recovery systems, develop flare minimization plans, conduct root cause analyses of flaring events, and improve flare monitoring.

- ***Flare Gas Recovery:*** Petrochemical facilities have alternatives to flaring. Flare gas recovery systems allow plants to recover gases, which are valuable product, rather than simply burning them. Federal regulators acknowledge the benefits of flare gas recovery, and state that routine flaring is not good air pollution control practice.[98] Several state and local air pollution control districts have adopted rules prohibiting all routine flaring.[99]

  Flare gas recovery systems reduce emissions. California's Bay Area Air Quality Management District prohibits flaring in non-emergencies unless the flaring is consistent with a facility's flare minimization plan, which must include all feasible flaring prevention measures.[100] The district found that adding compressor capacity and instituting better flare management practices resulted in an 85 percent reduction in VOC emissions between 2002 and 2005.[101]

  California's South Coast Air Quality Management District flaring rule requires: (1) improved monitoring, (2) flaring only as a result of emergency, shutdown, startup, turnaround, or essential operational need, and (3) minimization of flare emissions during such events.[102] The district estimates that its rule will reduce flare emissions, including VOC emissions, by more than 50 percent from 2003 levels, by 2010.[103]

  Many Houston-area refineries have signed consent decrees to settle enforcement actions by the EPA. Some of these agreements call for enhancements to flare gas recovery systems. Valero touts recent investments in flare-gas recovery systems at some of its facilities, and notes that the company is considering the "feasibility of applying this emission-reducing technology at others."[104]

  All petrochemical facilities should install sufficient flare gas recovery capacity to handle all gases from: (1) routine operations, (2) planned startup, shutdown and maintenance, and (3) small upsets. Elimination of flaring, except during true emergencies, will be the proof of whether facilities have installed adequate flare gas recovery capacity.

- ***Flare minimization plans.*** In addition to flare gas recovery, petrochemical facilities should develop detailed flare minimization plans to eliminate routine flaring and reduce flaring during

Flare Gas Recovery Virtually Eliminated Flaring at Lion Oil's El Dorado Refinery

Lion Oil Company's El Dorado Refinery, in Arkansas, installed 2 flare gas recovery systems, which "reduced flaring to near-zero levels, thereby achieving the refinery's emission-reduction objectives and conserving facility resources."

—Hydrocarbon Processing, *Minimize Flaring with Flare Gas Recovery* (June 2002), pp. 83–85.

Reducing Flaring Saved Dow Chemical Company $2.5 Million

From 2001 to 2003, Dow Chemical Company, in Freeport, Texas, reported a 54 percent reduction in emissions from startup, shutdown and off-spececification incidents. The project optimized the use of equipment to re-circulate off-spec hydrocarbons to the front of the plant to be reprocessed. In doing so, Dow documented savings of $2.5 million.

—Steven Krietenstein, Dow Chemical Co., *Flare Minimization Strategy During Plant Upsets: Freeport* (April 12, 2005).

emergency events. The plans are currently required by two air districts in California and have been proposed by EPA for refineries subject to New Source Performance Standards.[105] Such plans should include all feasible flare reduction measures, including operational procedures such as slower vessel depressurization, as well as training and awareness programs to focus plant personnel on flare reduction.

- ***Root cause analysis.*** California's South Coast and Bay Area Air Quality Management Districts require refineries to conduct root cause analyses of flaring events.[106] EPA has required investigations, reporting, and corrective action for refinery hydrocarbon flaring events in some of its enforcement actions against Houston area refineries.[107]

  While Texas requires facilities to report on the likely cause of, and any actions taken to minimize, an exceedance of authorized pollution limits and the actions taken to minimize emissions, these reports do not include root cause analyses. All refining and petrochemical facilities should conduct root cause analyses for flaring events resulting in 100 pounds or more of VOCs.[108] The analysis should include a detailed determination of the root cause and all contributing causes to the flaring event, an analysis of all means available to reduce the likelihood of another similar flaring event (including design, operation and maintenance changes), and a schedule for implementation of corrective measures.

- ***Flare monitoring:*** Flare emissions are difficult to measure due to high temperatures and radiant heat, the irregular nature of flare flames due to winds and turbulence, the undefined dilution of the plume with ambient air, and flare heights.[109] Without proper monitoring, however, it is impossible to know whether flares are performing adequately or whether flare emissions are presenting health risks to the surrounding community.

  Flares in the Houston-Galveston area in HRVOC service are currently required to conduct enhanced monitoring of the gas stream going to the flare, including: continuous flow monitoring, temperature and pressure monitoring, and HRVOC content monitoring by on-line analyzer capable of determining VOC content, molecular weight and net heating value at least every 15 minutes.[110]

  All petrochemical facilities should conduct enhanced flare monitoring to include:
  - continuous volumetric vent gas flow,
  - hourly exit velocity calculations,
  - speciated composition for benzene and any other toxics for which the area exceeds an ESL,
  - net heating value,
  - steam flow rate,
  - water seal integrity, and
  - video monitoring.

TANKS. Storage tanks are the single largest source of benzene emissions in the Houston area, according to TCEQ's 2004 Point Source Emission Inventory for Harris County. Actual tank emissions, however, are likely much higher than what is reflected in the inventory. Studies by TCEQ as well as other studies using LIDAR, have found tank emissions to be underreported by factors of 10 or more.[111]

Most tanks are equipped with a fixed or floating roof. Emissions leak out of holes in the roof and from the seals where the roof meets the walls of the tanks. This is particularly true where tanks get out-of-circular due to wind or poor maintenance. Rain (e.g., standing water on a floating roof) or changes in atmospheric pressure can also lead to emissions. In addition, tank emissions are extremely high during the landing of floating roofs for maintenance, cleaning, or a change of product.

Recommendations: Facilities should reduce emissions from storage tanks by improving inspections for and repairs of leaks, and by using closed vent systems for tanks with excessive toxic emissions.

- ***Inspections and Passive Optical Gas Imaging:*** All floating roof tanks and seals should be visually inspected twice per year. Passive Optical Gas Imaging should be used to search for leaks in all fixed and floating roof tanks quarterly and after any repairs. Results should be documented. If leaks are found, inspections should be conducted to determine their source and repairs made.

- ***Leak Minimization and Repair:*** Leaks from tanks storing toxics should be minimized to the extent possible within 24 hours. Repairs or replacement of any piping, valves, vents, seals, gaskets, or covers of roof openings with defects or visible gaps should be completed before filling an emptied and degassed tank, or within 7-days of discovery of defect. The South Coast Air Quality Management District requires such repairs within 72 hours of detection.[112] Repairs should be made using the best available technologies, including the best seal systems.

- ***Gas Recovery:*** Companies should increase the number of tanks routed to vapor recovery or control devices.[113] Vapor recovery systems are relatively inexpensive and their costs can often be recovered through the sale or reuse of the capured vapors.

  At a minimum, the following tanks should be routed to recovery or controls: (1) all tanks with a maximum capacity of 10,000 gallons or greater and a maximum organic vapor pressure of 11 psi or greater, (2) all tanks with a maximum capacity of 40,000 gallons or greater and a maximum organic vapor pressure of 4.0 psi or greater, and (3) all tanks that are found to be chronic leakers. Control devices should have a minimum 95 percent efficiency.

  Texas currently requires controls for tanks with a maximum organic vapor pressure of 11 psia or greater if: (1) those tanks store crude oil and condensate and have a maximum capacity of 40,000 gallons or greater or (2) the tanks store other liquids and have a 25,000 gallon maximum capacity.[114] As shown in Table 9, *Tanks Required to Route to Controls,* more stringent requirements are currently required by the Bay Area Air Quality Management District and federal regulations applicable to certain storage tanks.

EPA Touts Benefits of Vapor Recovery for Crude Oil Storage Tanks

"VRUs (Vapor Recovery Units) are relatively simple systems that can capture about 95% of the Btu-rich vapors for sale or for use onsite as fuel. Currently between 8,000 and 10,000 VRUs are installed in the oil production sector, with an average of four tanks connected to each VRU. Natural Gas STAR partners have generated significant savings from recovering and marketing these vapors while at the same time substantially reducing methane and HAP emissions. Partners have found that when the volume of vapors is sufficient, installing a VRU on one or multiple crude oil storage tanks can save up to $260,060 per year and payback in as little as three months."

— U.S. EPA, *Lessons Learned: Installing Vapor Recovery Units on Crude Oil Storage Tanks,* (Oct. 2003). www/epa.gov/gasstar/pdf/lessons/11_final_vap.pdf

TABLE 9. TANKS REQUIRED TO ROUTE TO CONTROLS

Rule	Tank Max. Capacity (gallons)	Tank Maximum Organic Vapor Pressure (psi)	Controls
BAAQMD 8-5-301	≥ 265	≥ 11.1	Requires pressure tank or control system
40 CFR Part 61, Sub FF (61.343)	≥ 20,000 ≥ 40,000	≥ 11.1 ≥ 4	Exemption from requirement for fixed roof and closed vent systems only for tanks below these limits.
40 CFR Part 60, Sub KB (60.112(b))	≥ 20,000	≥ 11	Requires closed vent system or the equivalent.
40 CFR Part 63, Sub G (63.119(a)(2))	≥ 10,000 & ≤ 40,000 ≥ 40,000	≥ 1.9 (maximum vapor pressure of total organic HAP) ≥ 0.1 (maximum vapor pressure of total organic HAP)	Requires control, routing to fuel gas or process, or vapor balance

WASTEWATER. Industrial wastewater systems are large systems that serve each unit at the facility and often span hundreds of acres. The EPA has determined that wastewater systems are the third largest source of VOC emissions at refineries nationwide.[115] The City of Houston found that wastewater systems were responsible for 10 percent of benzene emissions in the ten-county Houston region.[116]

Recommendations: To reduce toxic emissions from wastewater systems, facilities should:

- ***Expand control requirements:*** Current control requirements for wastewater systems should be expanded to cover additional sources as follows:
  - Any wastewater system with total annual benzene quantity from facility waste equal to or greater than 5 megagrams per year (Mg/yr) should comply with the federal Benzene Waste NESHAP. This would lower the current threshold of 10 Mg/yr.[117]
  - Refineries and chemical plants should comply with TCEQ's wastewater rules without utilizing the exemptions for: (1) plants with annual VOC loading less than or equal to 10 Mg, or (2) affected VOC waste streams for which the sum of annual VOC loading is less than or equal to 10 Mg.I n addition, sources should achieve at least a 95 percent VOC reduction when utilizing biotreatment or the alternative "90 percent overall control option."[118]
- ***Improve Monitoring:*** Companies should inspect all wastewater collection and treatment facilities with Passive Optical Gas Imaging quarterly. Routine visual inspection of pea traps to ensure they are not dry should be increased to twice per week. Facilities in the Houston area in HRVOC service are currently required to inspect water seals weekly, with monitoring increased to daily if three or more inspections are failed in a 12-month period.[119]
- ***Add Wastewater Components to LDAR List:*** Facilities' list of LDAR monitored components for wastewater streams should include: sewer hubs, junction boxes, hatches, and any wastewater components found to be leaking during Passive Optical Gas Imaging.

COOLING TOWERS. Cooling towers are used to transfer process waste heat to the atmosphere. Hot process gases are cooled in heat exchangers by running through tubes immersed in water. The gases in these tubes are typically at a high pressure and will leak into the cooling water if holes or cracks develop in the tubing. VOCs, including toxics that have leaked into the cooling water, are released to the atmosphere as the water is cooled in the tower. Cooling towers emit large quantities of toxics that have historically been largely unreported.[120] Investigations by TCEQ in 2002, measured VOCs from nine cooling towers totaling 2.3 million pounds per year, almost half of the 4.9 million *total* pounds per year that these facilities reported from *all* of their emission sources.[121] TCEQ has since adopted rules requiring monitoring of highly reactive VOCs in cooling towers. These rules, together with increased enforcement, appear to have been successful at reducing emissions from cooling towers and should be expanded.[122]

Recommendations: To reduce toxic emissions from cooling towers, companies should expand TCEQ's current cooling tower rules to include the following.

- ***Improve Monitoring:*** Cooling tower monitoring should include speciation for benzene and any other toxics for which an area exceeds the state's ambient toxic goals, or ESLs.

- ***Set Repair Deadlines:*** Repair of any exchanger leaks involving benzene, or other toxics for which an area exceeds an ESL, should be made within 48 hours.

- ***Use of Best Available Technologies*****:** Plants should use best available technologies and management practices for reducing leaks into cooling water, including installation of redundant heat exchanger capacity, where feasible, to allow for rerouting of hot process gases when a leak occurs.

DELAYED COKERS. Delayed cokers are used at refineries to convert petroleum residuals into liquid and gas products. A byproduct of the process is petroleum coke, a solid concentrated carbon material.

Delayed cokers are significant sources of toxic emissions that are not included in emission inventories. The Alberta DIAL Study found that the delayed cokers are the single largest source of refinery benzene emissions.[124] Yet U.S. refineries do not report fugitive emissions of VOC or benzene from the delayed coking process.[125]

Recommendations: Petrochemical facilities should, at a minimum, take the following steps to reduce toxic emissions from cokers:

- ***Improved Monitoring:*** Coker emissions, including VOC and benzene emissions, should be monitored during drilling. Drilling is part of the coking process during which pressure water jets are used to fracture the coke bed in a drum and allow it to fall into the receiving area.

- ***Best Available Technologies and Practices:*** All new or modified coke drum unheading areas and coke handling areas should be enclosed and vented to a blowdown system. Conoco has installed an enclosed blowdown and coke handling system for a Billings, Montana refinery and has designed totally enclosed systems for California and German refineries, including the Tesoro Refinery in Martinez, California.[126]

For existing systems, gases, including gases from blowdown systems, should be routed to fuel gas recovery systems. Facilities should develop coker operational plans for minimizing the accumulation of gases in the coke drum, and cokers should be de-pressured, via a blowdown system, to 2 psig before venting. Depressurization to 2 psig before venting is currently required at a California refinery and has been recommended by SCAQMD for inclusion in the Refinery NSPS.[127]

Support Reasonable Regulation to Eliminate Toxic Hotspots

Houston's toxic hotspot problem has been well documented. Industry has enjoyed ample time to voluntarily reduce ambient toxic levels and while some reductions have been achieved, particularly where regulators have targeted those responsible, there are clearly still areas of Houston that are unsafe.

Many Houston area petrochemical companies, including ExxonMobil, Shell, Texas Petrochemicals, Equistar, and BP, opposed state toxics legislation, even legislation that would have merely required the state environmental agency to notify the public about toxic hotspots. Yet, while industry repeatedly decries regulation, and protests that environmental regulations will drive them out of business, actual studies show that costs of pollution controls are usually much lower than industry predicts.[128] As this report explains, some toxic controls can even save companies money. Regulation serves to drive technology innovation, level the playing field, and reduce the price of pollution controls through economies of scale.[129]

It is time for the petrochemical industry to do its part to protect public health by supporting concrete, measurable and enforceable requirements for reducing industrial toxic emissions. Industry should work with state and local regulators, as well as community health and environmental groups, to develop reasonable regulations to eliminate toxic hotspots.

Conclusion: A Roadmap for Reducing Industrial Toxic Emissions

Existing ambient air monitoring data confirms that toxic hotspots warrant immediate action in urban areas such as Houston. These hotspots are the result of inadequate public health consideration by environmental regulators, and the absence of concerted remedial action by industry and government to reduce ambient toxics to safe levels.

Federal, state and local governments, as well as industry, should implement these steps in order to protect people from the health threats posed by toxic air pollution.

The federal government should:

- Improve toxic monitoring and reporting requirements, including requiring the use of new technologies for measuring facility-wide emissions;
- Consider aggregate and cumulative impacts of toxic emissions in regulatory determinations;
- Require information regarding the health impacts of chemicals before they are released to the market; and
- Adopt legislation to identify and assist in the cleanup of local toxic hotspots.

The State of Texas should:

- Adopt enforceable ambient toxic standards;
- Adopt hotspots legislation requiring state or local governments to identify and clean up local areas with unsafe ambient levels of air toxics; and
- Encourage local governments to implement programs to protect residents from adverse health effects due to toxic air pollution.

Industry should:

- Make toxic pollution reduction a company priority, second only to safety;
- Increase toxics monitoring and verify the accuracy of emissions estimates through the use of LIDAR or similar facility-wide monitoring;
- Use current best available technologies and management practices to reduce toxic emissions, including:
  - Flare gas recovery to eliminate routine flaring;
  - Passive Optical Gas Imaging to support LDAR programs by identifying unknown sources of leaks, and supplement storage tank and wastewater monitoring programs;
  - Venting to controls for storage tanks with potentially large toxic emissions;
  - Additional speciation requirements for cooling tower monitoring and deadlines for leak repair; and
  - Use of fuel gas recovery systems and best management practices to reduce delayed coker emissions; and
- Support reasonable regulatory proposals, instead of using publicly unaccountable lobbying firms and trade associations to fight toxic control requirements.

Notes

[1] 1999 National-Scale Air Toxics Assessment (NATA). http://www.epa.gov/ttn/atw/nata1999/risksum.html.

[2] http://www.epa.gov/ttn/atw/nata1999/nata99faq.html.

[3] http://www.epa.gov/ttn/atw/nata1999/limitations.html.

[4] Federal Clean Air Act §112(d)(2) & (3).

[5] For carcinogens the Clean Air Act states that the "ample margin of safety" standard requires lifetime excess cancer risks from the source-category to be less than one in one million. CAA §112(f). EPA is required to review and update its MACT technology determinations every eight years. CAA §112(d)(6).

[6] EPA, Office of Inspector General, *Improvements in Air Toxics Emissions Data Needed to Conduct Residual Risk Assessments,* Report No. 08-P-0020 (Oct. 2007), p. 3.

[7] See U.S. General Accounting Office, *Air Pollution: EPA's Strategy and Resources May Be Inadequate to Control Air Toxics*, (June 26, 1991); *Air Pollution: Progress and Problems in Implementing Selected Aspects of the Clean Air Act Amendments of 1990* (Oct. 29, 1993); *Air Pollution: Reductions in EPA's 1994 Air Quality Program's Budget* (Nov. 29, 1994); and *Clean Air Rulemaking: Tracking System Would Help Measure Progress of Streamlining Initiatives* (Mar. 2, 1995). See also, U.S. Government Accountability Office, *EPA Should Improve the Management of its Air Toxics Program* (June 26, 2006). See also, EPA Office of Inspector General, *Progress Made in Monitoring Ambient Air Toxics, But Further Improvements Can Increase Effectiveness*, (March 2, 2005); *Improvements in Air Toxics Emissions Data Needed to Conduct Residual Risk Assessments* (Oct. 31, 2007).

[8] U.S. Government Accountability Office, *EPA Should Improve the Management of its Air Toxics Program* (June 26, 2006) (Report No. GAO-06-669).

[9] EPA Office of Inspector General, *Improvements in Air Toxics Emissions Data Needed to Conduct Residual Risk Assessments* (Oct. 31, 2007), p. 19. (Report No. 08-P-0020)

[10] EPA Office of Inspector General, *EPA Can Improve Emission Factors Development and Management* (March 22, 2006), p. 1. (Report No. 2006-P-0017). Eighty percent of industry estimates were made using U.S. EPA emission factors.

[11] *Id.* at p. 3–4.

[12] EPA Office of Inspector General, *Improvements in Air Toxics Emissions Data Needed to Conduct Residual Risk Assessments* (Oct. 31, 2007), p. 19. (Report No. 08-P-0020).

[13] EPA, Office of Air Quality Planning and Standards, *Emission Factor Uncertainty Assessment Review Draft* (Feb. 2007) p. 2–11.

[14] EPA Office of Inspector General, *Improvements in Air Toxics Emissions Data Needed to Conduct Residual Risk Assessments* (Oct. 31, 2007), p. 18. (Report No. 08-P-0020).

[15] TexAQS II Rapid Science Synthesis Team, *Final Rapid Science Synthesis Report: Findings from Second Texas Air Quality Study (TexAQS II)* (Aug. 31, 2007), p. 7 Finding C2. http://www.esrl.noaa.gov/csd/2006/rss/rsstfinalreport083107.pdf. VOCs are chemical compounds that have high enough vapor pressures under normal conditions to significantly vaporize and enter the atmosphere or to participate in a photoreaction.

[16] EPA, *Technical Memorandum: Potential Low Bias of Reported VOC Emissions from the Petroleum Refining Industry* (July 27, 2007), p. 1. (EPA Docket No. EPA-HA-OAR-2003-0146).

[17] EPA Office of Inspector General, *Improvements in Air Toxics Emissions Data Needed to Conduct Residual Risk Assessments* (Oct. 31, 2007), p. 17 (Report No. 08-P-0020).

[18] EPA, Science Policy Council, *Guidance on Cumulative Risk Assessment. Part 1 Planning and Scoping* (July 3, 1997).

[19] EPA, Office of Air Quality Planning and Standards, *Residual Risk Report to Congress* (March 1999), p. ES-7. U.S. Government Accountability Office, *EPA Should Improve the Management of its Air Toxics Program* (June 26, 2006), p. 6–7. (GAO 06-669).

[20] In fact, EPA does not even consider all emissions from the units it is reviewing. It does not include in its consideration impacts from non-routine events, such as unit startup, shutdown, or malfunction.

[21] U.S. Government Accountability Office, *EPA Should Improve the Management of its Air Toxics Program* (June 26, 2006), p. 36. (GAO 06-669).

[22] EPA Workgroup on Integrated Air Toxics, *EPA Recommended Framework for State/Local/Tribal Air Toxics Risk Reduction Program, Final Workgroup Report* (Sept. 2000), p. 2.27. http://www.epa.gov/ttn/atw/urban/facawg.pdf.

[23] EPA, Office of Air Quality Planning and Standards, *Residual Risk Report to Congress,* (March 1999), p. ES-11.

[24] See, City of Houston, Mayor's Task Force on the Health Effects of Air Pollution, *A Closer Look at Air Pollution in Houston: Identifying Priority Health Risks* (June 2006), p. 18–19.

[25] *Id.* at p. 22.

[26] 2000 US Decennial Census, http://factfinder.census.gov.

[27] *Id.*

[28] EPA, *National Air Toxics Program: The Integrated Urban Strategy Report to Congress* (2000) p. 2-5 to 2-6.

[29] http://www.epa.gov/ttn/atw/orig189.html. See also, U.S. Government Accountability Office, *EPA Should Improve the Management of its Air Toxics Program* (June 26, 2006), p. 19. (GAO 06-669).

[30] GAO 06-669, at p. 19.

[31] *Id.*

[32] http://www.oehha.org/Prop65/prop65_list/files/032108list.pdf.

[33] http://monographs.iarc.fr/.

[34] Rena Steinzor, Katherine Baer, and Matt Shudtz, Center for Progressive Reform, *Overcoming Environmental Data Gaps: Why What EPA Doesn't Know about Toxic Chemicals Can Hurt.* White Paper No. 510, p. 9.

[35] *Id.*

[36] U.S. Government Accountability Office, *EPA Should Improve the Management of its Air Toxics Program* (June 26, 2006), p. 41 (GAO 06-669).

[37] EPA, *National Air Toxics Program: The Integrated Urban Strategy Report to Congress* (2000) p. 2–6.

[38] http://www.epa.gov/ttn/atw/urban/urbandev.html ("although EPA will continue to develop national efforts to address the remaining air toxics risk, in many cases these risks can be more appropriately addressed at the [state, local, and tribal] level, rather than the federal level.")

[39] EPA, Office of Air Quality Planning and Standards, *Residual Risk Report to Congress* (March 1999), p. ES-2.

[40] A 1995 survey by STAPPA ALAPCO found that 60% of respondents had risk-based air toxics programs, 50% of which addressed both new and existing sources.

[41] U.S. Government Accountability Office, *EPA Should Improve the Management of its Air Toxics Program* (June 26, 2006), p. 6–7. (GAO 06-669).

[42] For detailed information regarding other state toxics programs, see Rice University, Baylor College of Medicine, Texas Southern University, University of Houston Law Center and the University of Texas Medical Branch at Galveston, *The Control of Air Toxics: Toxicology, Motivation and Houston Implications* (Sept. 2006), p. 116-154.

[43] CA Assembly Bill 1807, Tanner 1983. CA Assembly Bill 2588, Connelly 1987. Health & Safety Code, Div. 26, Part 6.

[44] LAC33:III.Chapter 51, Subchapter A.

[45] Louisville APCD Regs. Part 5.

[46] N.J.A.C. 7:27–17.

[47] OR Dept. Env. Quality Rules 340-246-0010 through 0230.

[48] Some Texas rules for reducing ozone levels, however, require reductions in VOCs, including toxics.

[49] TCEQ, *Guidelines to Develop Effects Screening Levels, Reference Values, and Unit Risk Factors* (Nov. 2006), p. 3–5.

[50] See, http://www.tceq.state.tx.us/implementation/tox/AirPollutantMain/APWL.html.

[51] For example, when the Texas Clean Air Act was passed in 1971, it exempted existing sources from control requirements. By the 1990s, it was clear that these grandfathered sources had to be controlled in order to clean Texas air. After a failed voluntary program, the Texas legislature finally mandated emission reductions from grandfathered facilities, in 2001, fully three decades after passage of the Texas Clean Air Act.

[52] Texas Senate Committee on Natural Resources, Witness List for April 17, 2007 hearing on SB1855 and SB1924. http://www.capitol.state.tx.us/tlodocs/80R/witlistmtg/html/C5802007041713001.HTM

[53] http://www.txchemcouncil.org/index.php?option=com_content&task=view&id=13&Itemid=27.

[54] TXOGA has 2,000 members, some 500 of whom are executives of 50 of the state's largest energy companies. http://www.txoga.org/categories/About-Us/

[55] The American Electronics Association (now AeA) "represents all segments of the technology industry and is dedicated solely to helping our members' top line and bottom line." http://www.aeanet.org/Members/MemberListing.cfm.

[56] http://www.aect.net/.

[57] Texas Senate Bill 1317 (80th Regular Session).

[58] http://www.houston.org/industryGuide/petrochemical.asp.

[59] City of Houston, Mayor's Task Force on the Health Effects of Air Pollution, *A Closer Look at Air Pollution in Houston: Identifying Priority Health Risks* (June 2006), p. 13.

[60] Rice University, Baylor College of Medicine, Texas Southern University, University of Houston Law Center and the University of Texas Medical Branch at Galveston, *The Control of Air Toxics: Toxicology, Motivation and Houston Implications* (Sept. 2006), at p. 181.

[61] MIT Laboratory for Energy and the Environment, Energy Environment (July 2005) *Benefits of Environmental Regulation: Calculating the Economic Gains from Better Health,* p. 6.

[62] L.M. Sixel, Houston Chronicle, *Houston Lacks Pull With New College Grads* (March 19, 2008). http://www.chron.com/disp/story.mpl/business/sixel/5634211.html.

[63] EPA recently adopted a mobile source air toxics rule, which should lead to significant reductions in benzene levels beginning in 2011. Benzene will be reduced through fuel standards and gas can specifications that will affect both exhaust emissions as well as evaporative emissions (which are a big problem in homes with attached garages). Likewise, programs to get older cars off the road will lead to decreases in mobile source toxic emissions. http://www.epa.gov/fedrgstr/EPA-AIR/2007/February/Day-26/a2667a.htm.

[64] The statistic is based on reported emission inventory data, which, as explained above, likely underestimate industrial emissions.

[65] See maps at http://www.tceq.state.tx.us/implementation/tox/AirPollutantMain/APWL.html.

[66] Joost de Gouw, Carsten Warneke, NOAA, Environmental System Research Laboratory and CIRES, University of Colorado, *Emissions and Chemistry of Atmospheric VOCs: New Insights from Airborne and Ship-Based Measurements,* slide 24.

[67] *Id*, at slide 25.

[68] *TCEQ, Final Rapid Science Synthesis Report: Findings from the Second Texas Air Quality Study* (Aug. 31, 2007), Findings A1 and A2 (The highest (i.e. > 125 ppbv) ozone concentrations in the Houston/Galveston/Brazoria area result from rapid and efficient ozone formation in relatively narrow, concentrated plumes, which originate from HRVOC and NOx co-emitted from petrochemical facilities. The Houston Ship Channel (HSC) is the origin of the plumes with the highest ozone concentrations.
Winds carry the emission plumes from the ship channel throughout the Houston area.)

[69] EPA, http://www.epa.gov/air/ozonepollution/health.html.

[70] Data from TCEQ's 2004 Point Source Emission Inventory.

[71] Dow Chemical, Texas City (formerly Union Carbide) was the facility with the fourth greatest risk level, and Marathon Petroleum, Texas City Refinery was the facility with the sixth greatest risk level.

[72] City of Houston, *Houston Regional Benzene Air Pollution Reduction: A Voluntary Plan for Major Sources* (Feb. 2007). http://images.chron.com/content/news/photos/07/02/14/benzenetoxplanmajorsource6.pdf

[73] Houston Region Air Quality Task Force Report (Sept. 2007) at p. 7.

[74] City of Houston, *Comments on National Emission Standard for Hazardous Air Pollutants from Petroleum Refineries: Proposed Rule (Docket ID No. EPA-HQ-OAR-2003-0146)* (Dec. 20, 2007), p. 25–26.

[75] See, for example, U.S. EPA, *VOC Fugitive Loses: New Monitors, Emission Losses, and Potential Policy Gaps 2006 International Workshop* (Oct 25-27, 2006) p. 20.

[76] EPA, *VOC Fugitive Loses: New Monitors, Emission Losses, and Potential Policy Gaps* (2006 International Workshop, Oct 25–27, 2006), p. 19.

[77] Steven Krietenstein, Dow Chemical Co., *Flare Minimization Strategy During Plant Upsets: Freeport* (April 12, 2005).

[78] Alex Cuclis, *Differential Absorption LIDAR (DIAL),* Sunoco LDAR Workshop (Oct. 24, 2007), slide 27.

[79] Data from TCEQ's 2004 Point Source Emission Inventory. Industry reports emissions to the inventory and describes the units responsible for such emissions. There is not, however, a uniform classification system for describing emissions units. For example, one facility may describe emissions from a wastewater pond as wastewater system emissions, while another facility may describe them as fugitives.

[80] EPA has identified cokers as one of the largest sources of refinery benzene emissions, pursuant to LIDAR studies. Coker toxic emissions are not, however, reflected in the state data. U.S. EPA, *Technical Memorandum: Potential Low Bias of Reported VOC Emissions from Petroleum Refining Industry* (July 27, 2007), p. 4–5.

[81] EPA Enforcement Alert, *Proper Monitoring Essential to Reducing 'Fugitive Emissions' Under Leak Detection and Repair Programs* (Oct. 1999).

[82] http://www.epa.gov//compliance/resources/publications/assistance/ldarguide.pdf.

[83] 30 Tex. Admin. Code § 115.781 (b) (9). Applies in the Houston area to equipment at refineries and chemical plants in which highly reactive VOCs are a raw material, intermediate, or final, product, or in a waste stream. HRVOCs are VOCs that TCEQ has determined contribute significantly to rapid ozone formation. They are 1,3-butadiene, butanes, ethylene and propylene.

[84] 30 Tex. Admin. Code §115.352. Applies in Houston and other areas to equipment at refineries and chemical plants not in HRVOC service.

[85] BAAQMD Rule 8-18-301 through 8-18-305.

[86] SCAQMD Rule 1173(g). Applies to chemical plants and refineries.

[87] BAAQMD Rule 8-18-301 through 8-18-305.

[88] 30 Tex.Admin. Code §115.782. Applies in the Houston area to equipment at refineries and chemical plants in which a HRVOC is a raw material, intermediate, final product or in a waste stream.

[89] 30 Tex. Admin. Code §115.352. Applies to equipment not in HRVOC service at refineries and chemical plants in Houston and other areas.

[90] The rules allow a 3–7 day extension for certain leaks.

[91] For pressure relief devices, repairs are required within 15 days if discovered by operator; 7 days if by agency. The BAAQMD allows delay of repair for "non-repairable" equipment. Delay is limited to 45-days for valves unless the leak is less than 15 lbs/day. Equipment on the non-repairable list is limited to 0.30% valves, 1.0% pressure relief devices and 1.0% pumps and compressors.

[92] The rule allows a delay of repair until the next process shutdown if repairs require shutdown and the shutdown would create more emissions than the repair would eliminate. The delay is also allowed if certain other conditions are met.

[93] *Id.*

[94] SCAQMD Rule 1173(g)(2) requires replacement with best available controls or best available retrofit technology, or venting to a control device, for any component that has been subject to five repair actions within 12-months for: (1) a light liquid leak greater than three drops per minute, (2) a leak greater than 10,000 ppm, or (3) a leak greater than 200 ppm for an atmospheric pressure relief device. SCAQMD Rule 1173(h)(6) applies to refineries with a throughput greater than 20,000 barrels per day and requires the routing of pressure relief devices to controls under the conditions listed.

[95] EPA, VOC Fugitive Loses: *New Monitors, Emission Losses, and Potential Policy Gaps* (2006 International Workshop, Oct 25–27, 2006), pp. 19–22.

[96] SCAQMD, *Evaluation Report on Emissions from Flaring Operations at Refineries* (Sept. 3, 2004) p. 2, Table 1.

[97] EPA *Enforcement Alert,* Volume 3, Number 9 (October 2000).

[98] 72 Fed.Reg. 27178, 27195 (May 14, 2007) (noting flare gas recovery can eliminate all routine flaring). EPA Enforcement Alert, Frequent, *Routine Flaring May Cause Excessive, Uncontrolled Sulfur Dioxide Releases* (October 2000).

[99] BAAQMD Regulation 12, Rule 12; SCAQMD Rule 1118; MARAMA Model Rule for Petroleum Refinery Flares, Env-A xxx.03(a)(3).

[100] BAAQMD Rule 12-12-301 and 12-12-401.

[101] BAAQMD, *Staff Report, Proposed Regulation, Regulation 12, Miscellaneous Standards of Performance, Rule 12, Flares at Petroleum Refineries* (July 8, 2005) p. 1.

[102] SCAQMD Rule 1118.

[103] SCAQMD, *Final Environmental Assessment for Proposed Amended Rule 1118* (Oct. 2005), Table 1-3.

[104] http://www.valero.com/Environment/EnvironmentalStewardship.htm.

[105] SCAQMD Rule 1118(c)(2); BAAQMD Rule 12-12-401; and 72 Fed.Reg. 27178, 27182 (May 14, 2007)(proposing flare minimization plans for startup, shutdown, malfunction events).

[106] SCAQMD Rule 1118(c)(1)(D) and (e); BAAQMD Rule 12-12-406.

[107] See, for example, *U.S. v. ExxonMobil Corporation*, Consent Decree p. 80. *See also,* U.S. EPA, *EPA Enforcement: National Petroleum Refinery Initiative* (EPA-HQ-OAR-2007-0011-0112).

[108] SCAQMD requires root cause analyses for events, other than planned shutdowns, startups or turnarounds, resulting in 100 pounds or more of VOCs or for any event resulting in more than 5,000 standard cubic feet of vent gas combusted. SCAQMD Rule 1178(c)(1)(D) & (E).

[109] Marc McDaniel, EPA-600/2-83/052, Flare Efficiency Study. Engineering Science, Inc. (July 1983), p. 1.

[110] 30 Tex. Admin. Code §115.725(d).

[111] According to the Alberta LIDAR study, VOC emissions from tanks were 30 times higher, and benzene emissions were 100 times higher, than the reported emissions calculated using emission factors. U.S. EPA, *Technical Memorandum: Potential Low Bias of Reported VOC Emissions from Petroleum Refining Industry* (July 27, 2007) at 5-6.

[112] SCAQMD Rule 1178(g).

[113] For external floating roof tanks, this would require first installing a domed roof on the tank or otherwise converting it to an internal floating roof tank. See, SCAQMD Rule 1178 requiring domed roofs.

[114] 30 Tex. Admin. Code 115.112 Tables I(a) and II(a).

[115] EPA, *Memorandum: Review of VOC Emissions Sources at Refineries* at 2, Table 1 (Dec. 14, 2005) (EPA-HQ-OAR-2007-0011-0043).

[116] City of Houston, *Houston Regional Benzene Air Pollution Reduction: A Voluntary Plan for Major Sources* (Feb. 2007), p. 4.

[117] 40 CFR §61.342(a).

[118] These exemptions are included at 30 Tex. Admin. Code §115.147(1) & (2).

[119] Ninety-five percent efficiency is required by the Miscellaneous Organic NESHAP, 40 CFR Part 63, Sub FFFF, as well as by other state's rules, such as SCAQMD 1176(e)(6)(A).

[120] 30 Tex. Admin. Code §115.781.

[121] U.S. EPA, *Technical Memorandum: Potential Low Bias of Reported VOC Emissions from Petroleum Refining Industry* (July 27, 2007) at 4.

[122] Galveston-Houston Ass'n for Smog Prevention, *Smoke in the Water* (Feb. 2004), p. 1.

[123] Galveston-Houston Ass'n for Smog Prevention, *Cooling Off: State Investigations Show Reductions in Cooling Tower Emissions,* (Jan. 2007).

[124] Environment Canada, *Refinery Demonstration off Optical Technologies for Measurement of Fugitive Emissions and for Leak Detection,* (Nov. 1, 2006), p. 13.

[125] EPA, "Memorandum: Review of VOC Emissions Sources at Refineries" at 2, Table 1 (Dec. 14, 2005) (EPA-HQ-OAR-2007-0011-0043), at 4–5.

[126] Ehrhardt, Franz, *Delayed Coking, an Attractive Alternative.* www.casaconsulting.com/events/speeches/MOGC.doc.

[127] Letter from Mohsen Nazemi, SCAQMD, *Subject: proposed New Source Performance Standard for Petroleum Refineries in 40 CFR part 60, Subpart Ja [Docket ID No. EPA-HQ-OAR-2007-0011]* (Aug. 24, 2007).

[128] Economic Policy Institute, *Falling Prices: Cost of Complying with Environmental Regulations Almost Always Less than Advertised* (November 1997) p.2. http://www.epi.org/briefingpapers/bp69.pdf.

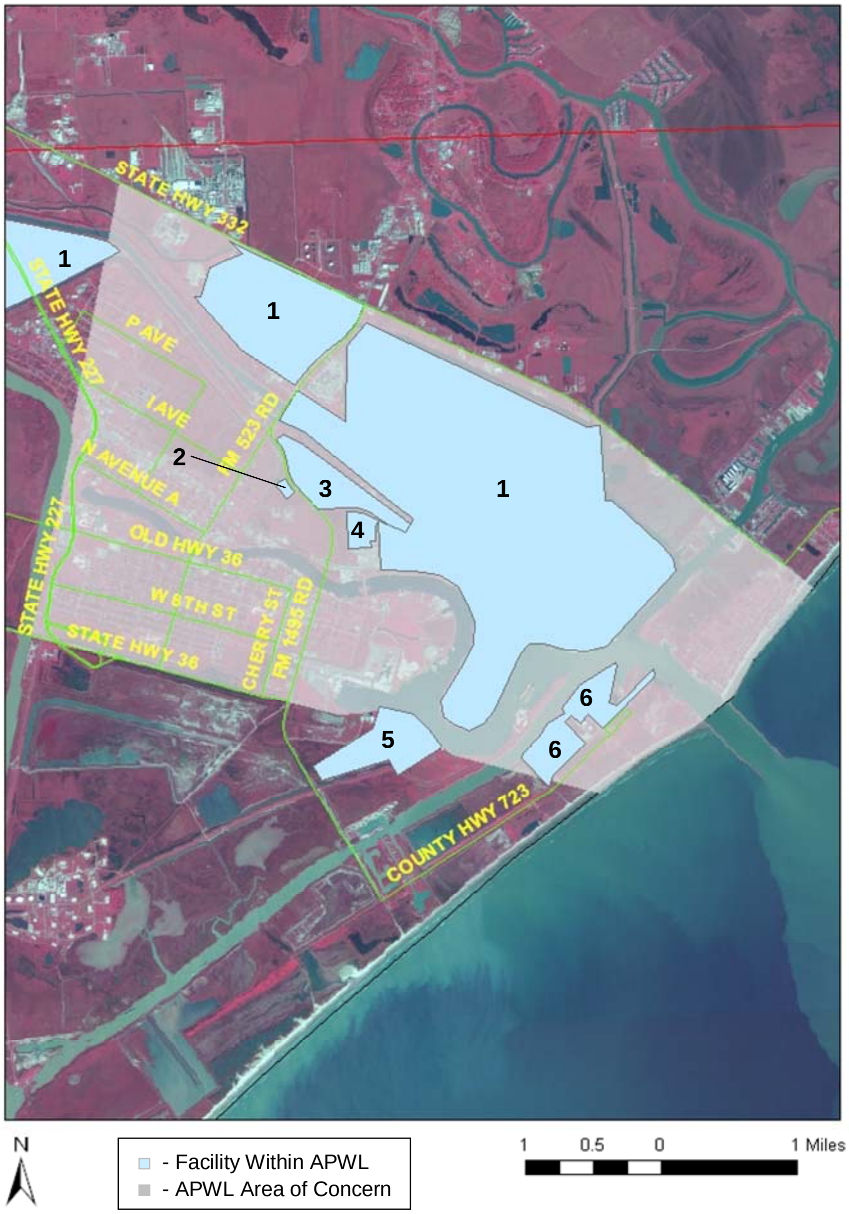
[129] *Id*, at p. 9–12.

APPENDIX

TEXAS GULF COAST TOXIC HOTSPOTS

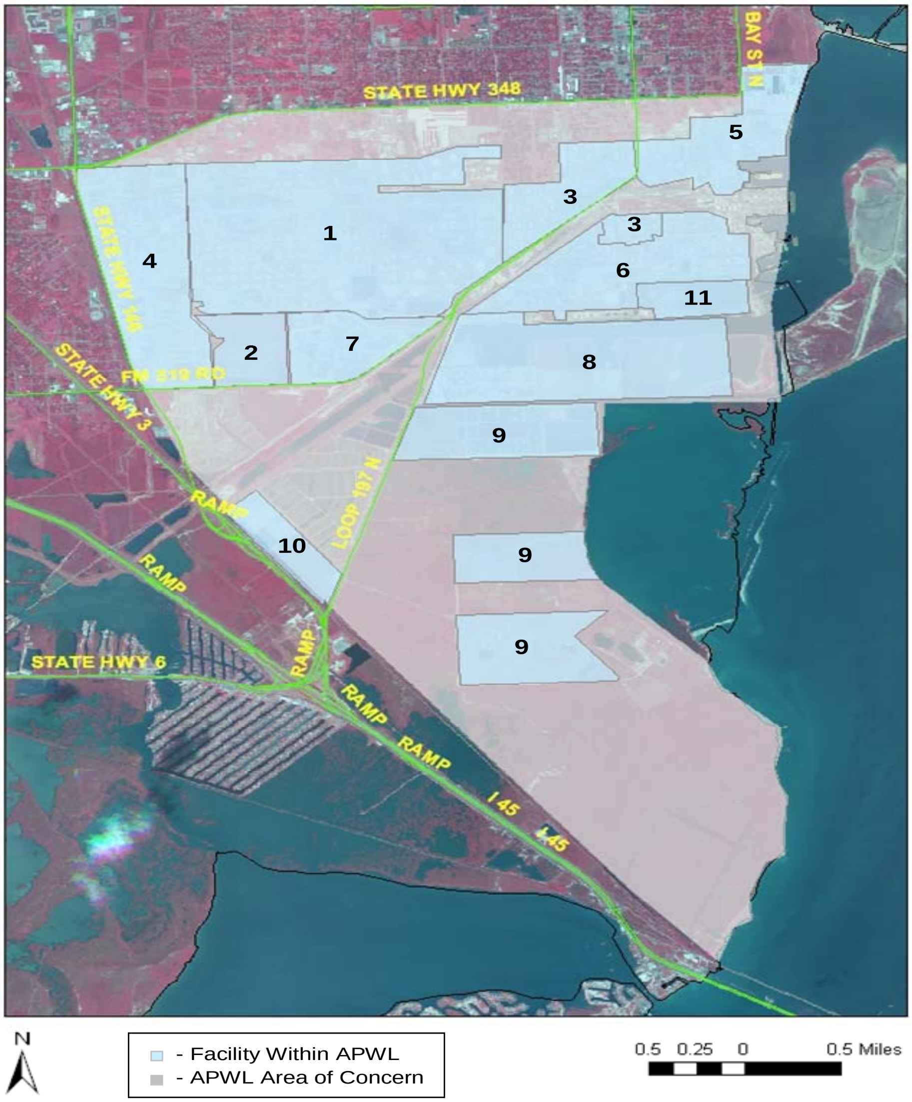
Source: Texas Commission on Environmental Quality
(http://www.tceq.state.tx.us/implementation/tox/AirPollutantMain/APWL.html)

APWL1201 (Freeport) – Arsenic, Cobalt, Nickel, Vanadium



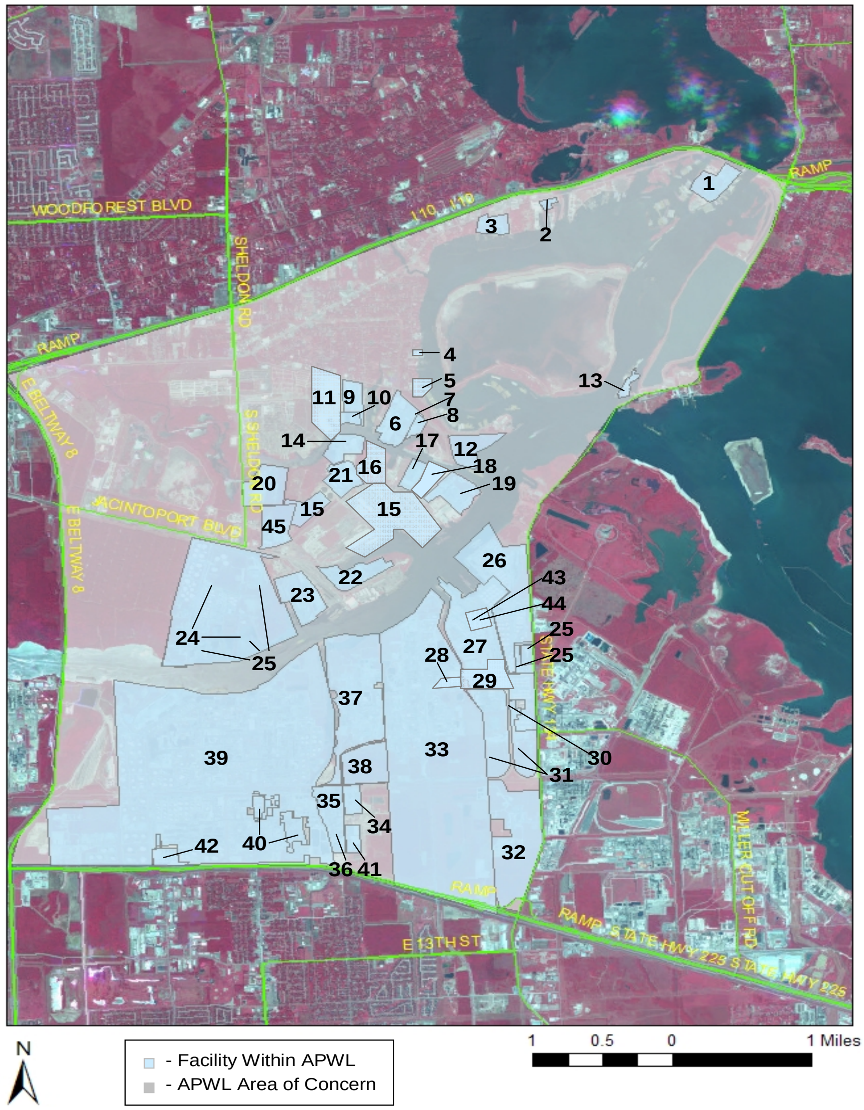
Number	Company Name	RN
1	The Dow Chemical Company	100225945
2	Freeport Welding and Fabricating	105097513
3	Nalco Company	102185717
4	Gulf Chemical & Metallurgical Corporation	100210129
5	Conoco-Phillips Company	100221134
6	Freeport LNG Development, LP	103196689

APWL1202 (Texas City) – Acrolein, Butyraldehyde, Propionaldehyde, Valeraldehyde, Benzene, and Hydrogen Sulfide



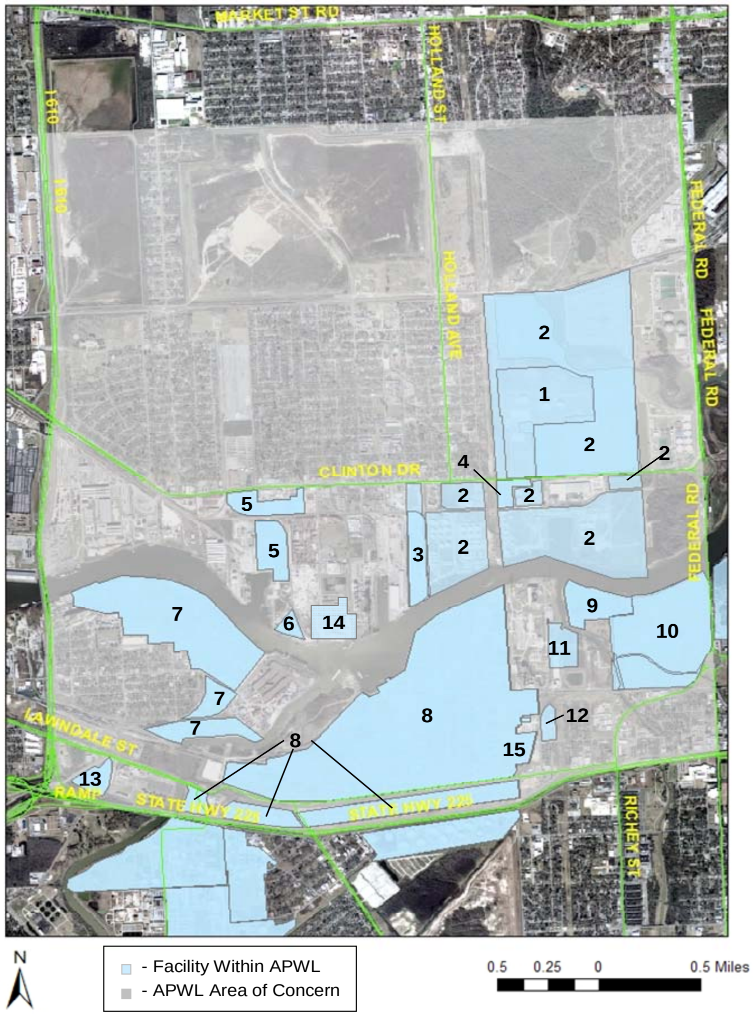
Number	Company Name	RN
1	BP Products North America, Inc.	102535077
2	Praxair, Inc.	104095435
3	Marathon Ashland Petroleum Company	100210608
4	Union Carbide Corporation	100219351
5	Sterling Chemicals Inc.	100212620
6	Valero Refining Company	100238385
7	BP Amoco Chemical Company	102536307
8	Oiltanking Texas City, LP	100217231
9	Gulf Coast Waste Disposal Authority	100212463
10	TEPPCO Crude Pipeline Co.	102560182
11	Applied Industrial Materials Corporation	102707049

APWL1204 (Lynchburg Ferry Area) – Benzene and Styrene



Number	Company Name	RN		Number	Company Name	RN
1	Southwest Shipyard LP	100248749		24	Oiltanking Houston LP	100224740
2	Owens Corning	100210483		25	Stolthaven Terminals Inc.	100210475
3	Sneed Shipbuilding, Inc.	100867498		26	Vopak Industrial Services USA, Inc.	100223007
4	Buffalo Bunker Express	N/A		27	Intercontinental Terminals	100210806
5	K-Solv LP	104963897		28	Air Liquide	102287448
6	Solar Turbines Incorporated	100214477		29	Global Octanes	100542331
7	Flex Tanks Systems LLC	100542489		30	Matlack	101643088
8	DTX Oil LLC	105052500		31	Clean Harbors Environmental Services	102184173
9	Stolt-Nielsen Transportation Group, Inc.	102562063		32	Hampshire Chemical Corp.	100219070
10	Stolt-Nielsen Transportation Group, Inc.	104267133		33	Rohm and Hass Texas Inc.	100223205
11	Boasso America Corp.	103934170		34	Praxair Inc.	102684974
12	Kirby Inland Marine	104352265		35	Lubrizol Corp.	104026950
13	Channel Shipyard	100218429		36	Lubrizol Corp. Deer Park Plant	100221589
14	Delta Engineering Corp.	102574936		37	OxyVinyl Corp. Deer Park	100224674
15	Houston Fuel Oil Terminal Co.	100223445		38	Oxy Vinyl LP - Caustic	100542265
16	Powell Industries	100582352		39	Shell Chemical Inc.	100211879
17	Slay Transportation Company, Inc.	100558600		40	Hexion Specialty Chemicals - Deer Park	102590775
18	Duco, Inc.	100587237		41	Delta Chemical Services	100924042
19	Johann Halterman LLC	100219237		42	Calpine Corporation	100222033
20	Johann Halterman LTD	102610912		43	Valvoline - First Recovery	101719342
21	Precoat Metals (Sequa Corp.)	100217926		44	Valvoline Inc.	102802493
22	GE Packaging Power Inc.	100217959		45	Techcote Industrial Coating LTD	101078210
23	Mosaic Crop Nutrition LLC	102056777				

APWL1206 (Galena Park) - Benzene

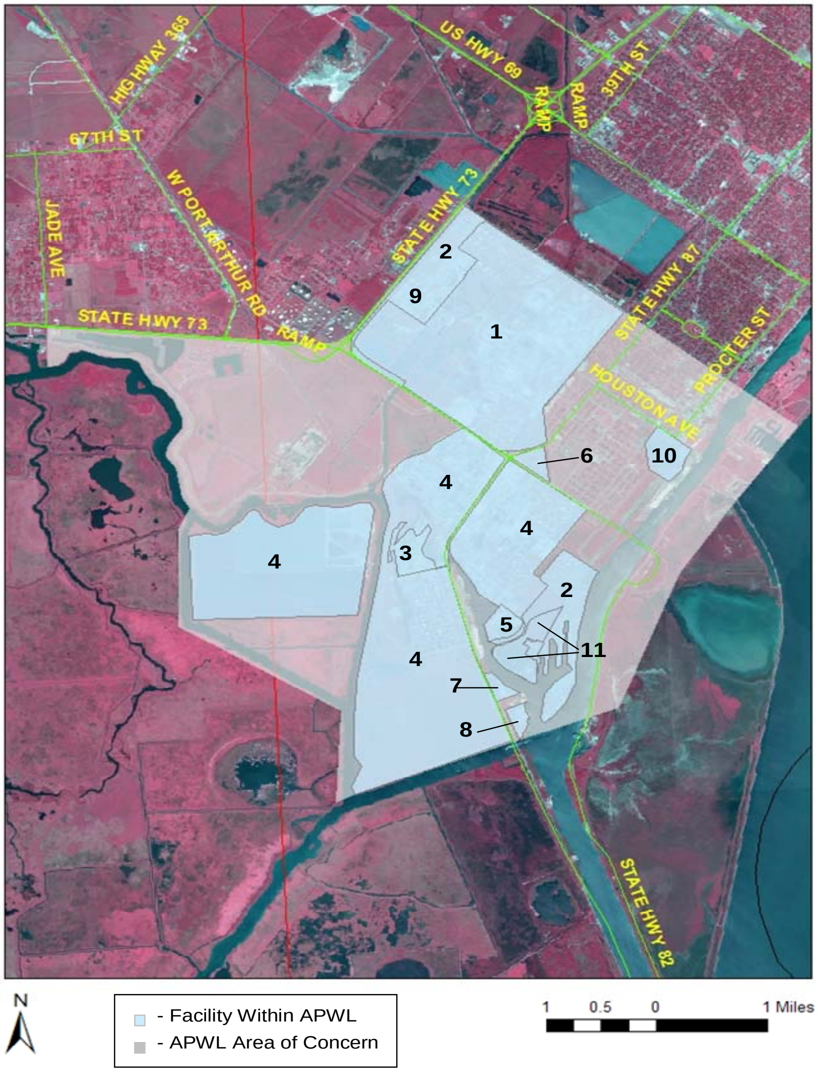


Number	Company Name	RN
1	TEPPCO Crude Pipeline LP	101921781
2	Kinder Morgan Liquid Terminals, LP	100237452
3	Vopak Terminal Galena Park Terminals Inc.	102753670
4	Texmark Chemicals	100238740
5	National Oilwell, LP	102309150
6	Arrow Terminals	100870237
7	Valero Refining Texas LP	100219310
8	Houston Refining LP	100218130
9	Gulf Coast Waste Disposal Authority	100219500
10	Pasadena Paper Co.	100224609
11	Pasadena Refining Systems Inc.	100716661
12	Motiva Enterprises LLC	100211259
13	Matlack Inc./Brite-Sol Services	100894773
14	United States Gypsum Company	100212281
15	Channel Energy Center LP	100213107

APWL1207 (Milby Park) – 1,3-Butadiene

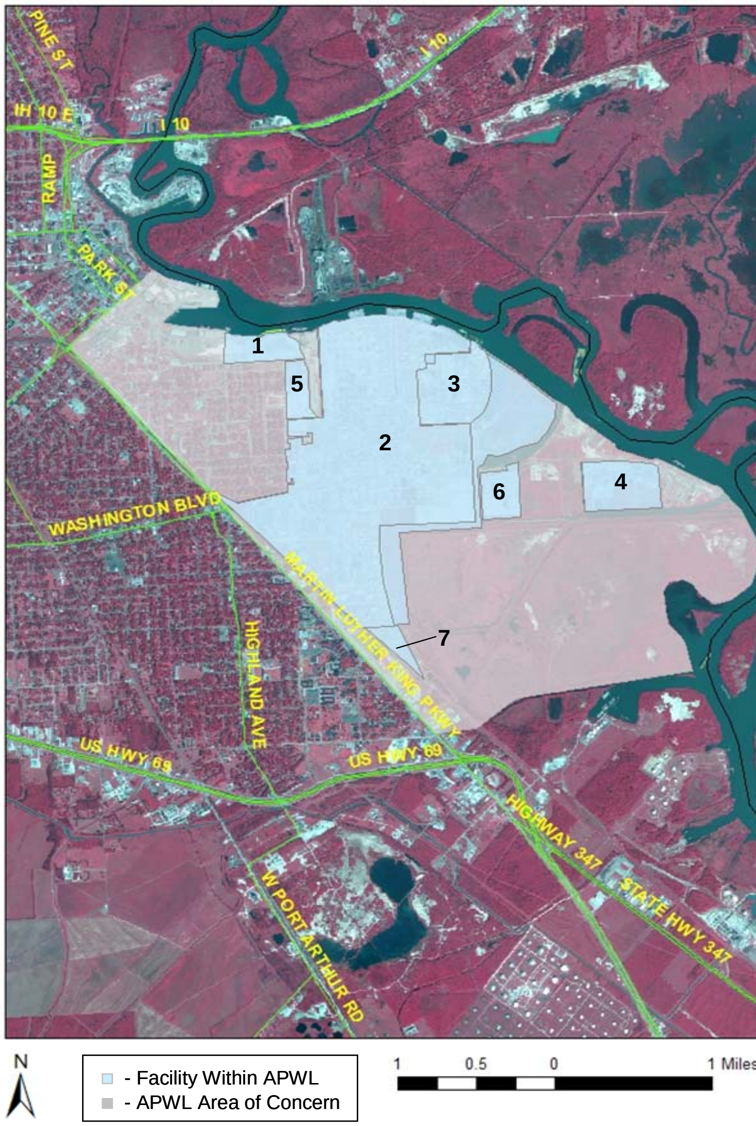
Number	Company Name	RN
1	The Goodyear Tire & Rubber Co.	100870898
2	PL Propylene LLC	102576063
3	Kemiron Gulf Inc.	102510104
4	Texas Petrochemical LP	100219526
5	Sims Bayou South Wastewater Treatment	102949013
6	Kemiron Gulf/Texas Petrochemical Wastewater	N/A

APWL1003 (Port Arthur) - Benzene



Number	Company Name	RN
1	Motiva Enterprises, LLC	100209451
2	Huntsman Peterochemical Corporation	100217389
3	Chevron Phillips Chemical Company	100209857
4	The Premcor Refining Group, Inc.	102584026
5	Chevron USA	102197385
6	INEOS America LLC	104620083
7	Signal International Texas, LP	102509676
8	KMCO , LP DBA KMTEX	100640283
9	Transit Mix Concrete & Materials Corp.	102755667
10	Neofuel USA LLC	105158281
11	Great Lakes Carbon LLC	100209287

APWL1002 (Beaumont) – Benzene, Hydrogen Sulfide, and Sulfur Dioxide

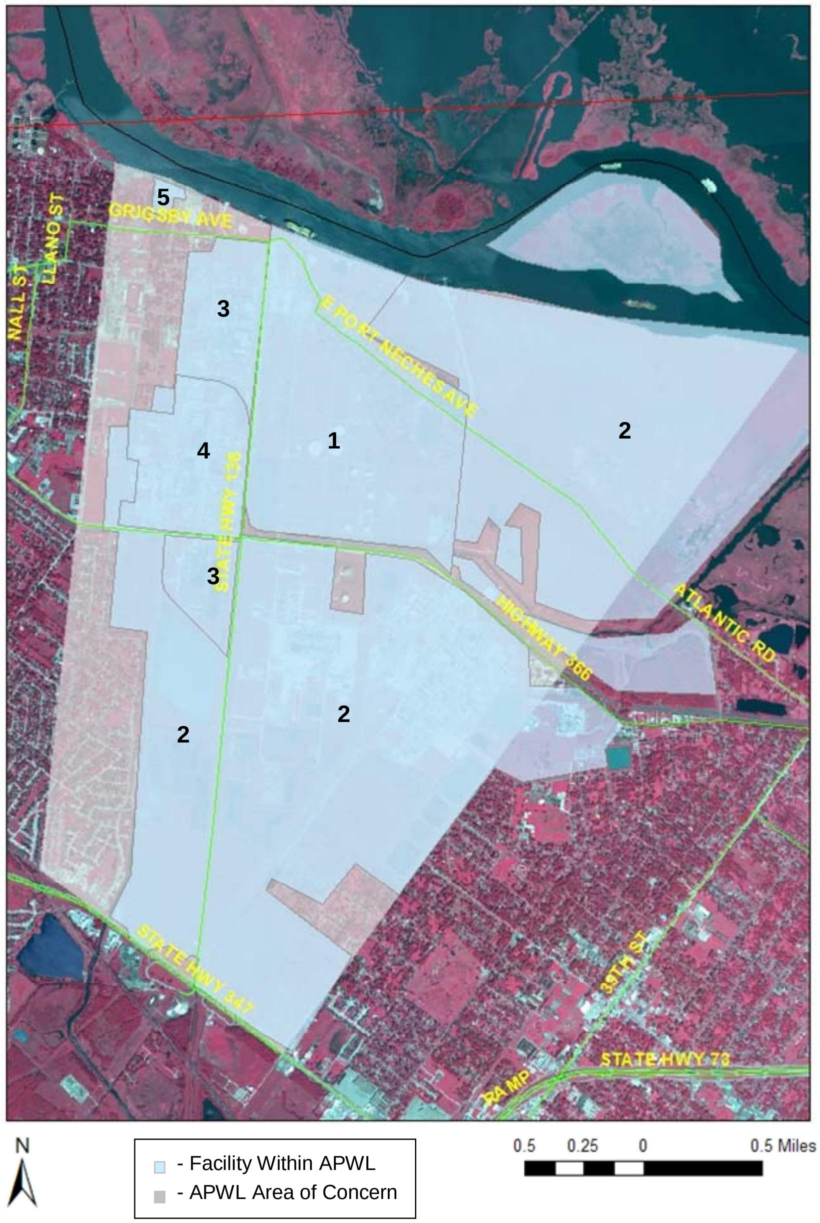


Number	Company Name	RN
1	Kinder Morgan Petcoke, LP	103080883
2	Exxon Mobil Oil Corporatioin	102450756
3	Exxon Mobil Chemicals	100542844
4	Equistar Chemicals, LP	100825413
5	Shawcor Pipe Protection LLC	105230023
6	Arkema Inc.	100216373
7	Chemtrade Refinery Services, inc.	100218392

APWL1402 (Corpus Christi) - Benzene

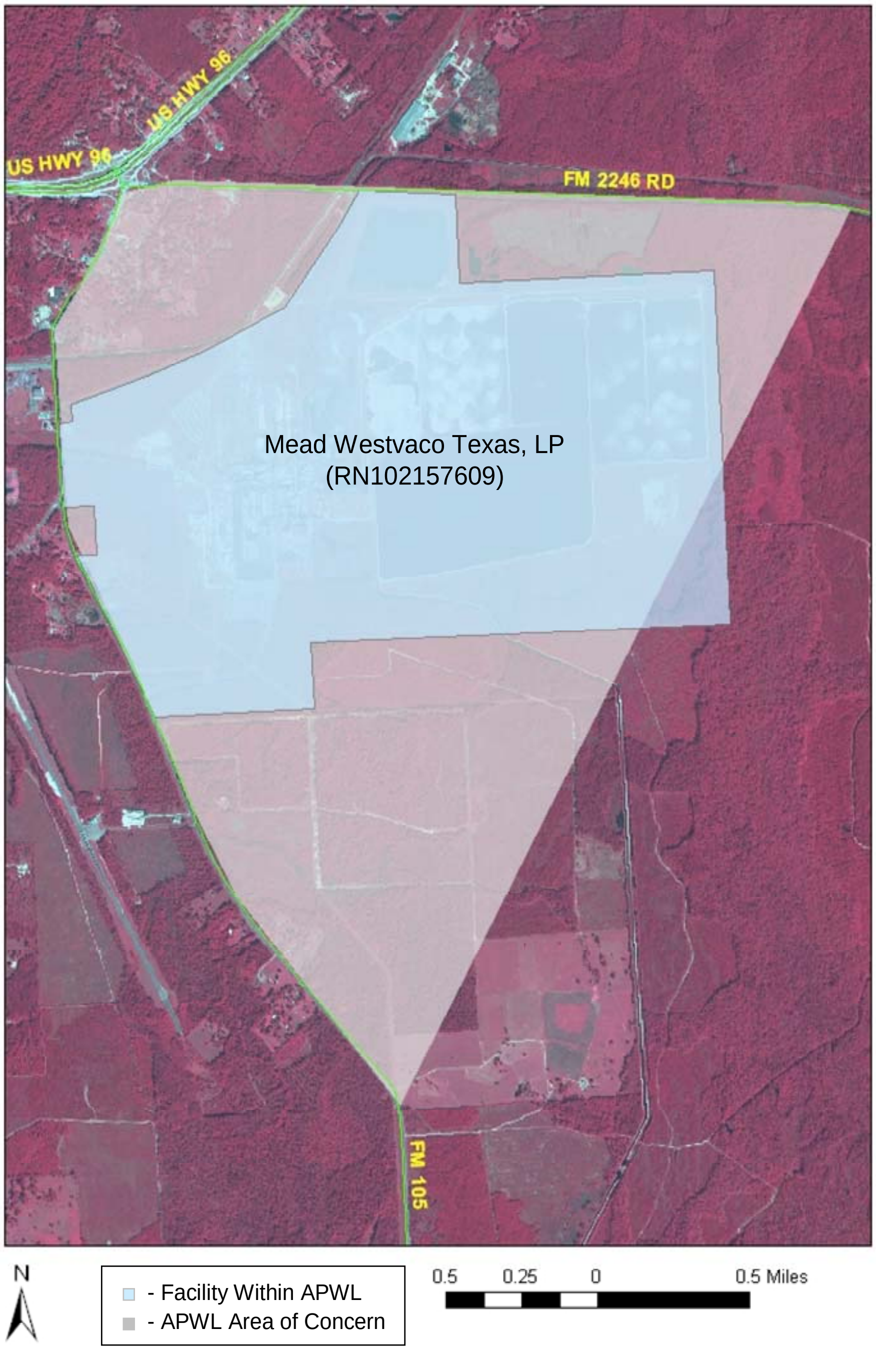
Number	Company Name	RN
1	American Chrome & Chemicals LP	100210814
2	Valero Refining - Texas LP	100211663
3	Citgo Refining and Chemicals Company LP	102612488
4	Megellan Terminals Holdings LP	102536836
5	Citgo Refining and Chemicals Company LP	102555166
6	Flint Hills Resources LP	102534138
7	Corpus Christi Congeneration LP	100224302
8	Nueces Bay Energy LLC	N/A

APWL1004 (Port Neches) – 1,3-Butadiene



Number	Company Name	RN
1	Calabrian Corporation	101645018
2	Huntsman Petrochemical Corp	100219252
3	ISP Synthetic Elastomers LP	100224799
4	Texas Petrochemical LP	104964267
5	Port Neches Towing, Inc.	102881208

APWL1001 (Evadale) – Hydrogen Sulfide



Area of Concern:

- **South** of FM-2246
- **East** of FM-105

Explanation of why this location and pollutant are on the APWL:

Mobile air monitoring trips were conducted within TCEQ Region 10 in 2003, 2004, 2005, and 2006. Several measured hydrogen sulfide (H_2S) levels measured downwind of Mead Westvaco in Evadale, TX were in excess of the 30-minute H_2S TCEQ regulation standard.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