Communities at Risk from Air Toxics – Deeper Analysis of NATA Results and Tool for a Path Forward

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ABSTRACT

The US Environmental Protection Agency's (EPA's) National Air Toxics Assessment (NATA) is a state-of-the-science tool to inform both national and localized efforts to collect air toxics information, characterize emissions and help prioritize pollutants and areas of interest for further study to gain a better understanding of risks. In the most recent version of NATA, released on August 22, 2018, the EPA estimated that several communities are exposed to cancer risks greater than 100-in-1 million, which is the level generally considered as the upper limit of acceptable risk. Some of these communities are exposed to cancer risks approaching 1,000-in-1 million, or an order of magnitude greater than the upper limit of acceptability.

In this analysis, we take a deeper look at populations in these communities to estimate the number of people that are predicted to be exposed to elevated cancer risks due to the inhalation of or air toxics. We also evaluate the number of individuals in various demographic groups that are exposed to these higher risks.

The EPA clearly points out that the NATA is a screening tool. Communities may wish to perform more rigorous risk assessments to obtain more accurate estimates of the risks in the communities and to more accurately pinpoint the causes of these risks. In this paper, we also provide steps for such a refined assessment by highlighting the EPA's Human Exposure Model (HEM), which is a ready-made tool that can help state or local agencies, community groups, industry, or the general public perform these more refined assessments.

INTRODUCTION

The National Air Toxics Assessment (NATA) is the US Environmental Protection Agency's (EPA's) ongoing review of air toxics in the United States. EPA developed NATA as a screening tool for state, local and tribal air agencies and the results can help these agencies identify which pollutants, emission sources and locations they may wish to study further, to better understand any possible risks to public health from air toxics. NATA provides a "snapshot" of chronic risks due to the long-term exposure to emissions of air toxics over several years. The sources of air toxic emissions studied in NATA include large and small stationary sources, stationary and non-stationary area sources, and mobile sources.

Specifically, NATA predicts cancer risks, which are defined as "the probability of contracting cancer over the course of a lifetime", assuming continuous exposure. It also calculates the hazard quotients, which are ratios of the potential exposure to the toxic air pollutant and the level at which no adverse effects are expected. A hazard quotient less than or equal to one indicates that adverse noncancer effects are not likely to occur, and thus can be considered to have negligible hazard. NATA also reports hazard indices (HI), which represent the sum of hazard quotients for toxics that affect the same target organ or organ system. A hazard index of 1 or lower means air toxics are unlikely to cause adverse noncancer health effects over a lifetime of exposure, to that organ or organ system. For our analysis, we focused on cancer risks.

The 1989 Benzene National Emission Standards for Hazardous Air Pollutants (NESHAP) rule set up a two-step, risk-based decision framework for the NESHAP program. This rule and framework are described in more detail in EPA's 1999 Residual Risk Report to Congress.[1] First, the rule sets an upper limit of acceptable risk at about a 1-in-10,000 (or 100-in-1 million) lifetime cancer risk for the most exposed person. As the rule explains, "The EPA will generally presume that if the risk to that individual [the Maximum Individual Risk] is no higher than approximately 1 in 10 thousand, that risk level is considered acceptable and EPA then considers the other health and risk factors to complete an overall judgment on acceptability."

Second, the benzene rule set a target of protecting the most people possible to an individual lifetime risk level no higher than about 1-in-1 million. These determinations called for considering other health and risk factors, including risk assessment uncertainty, in making an overall judgment on risk acceptability.

The evaluation presented in this paper is focused on communities estimated at high cancer risks in the 2014 NATA. Specifically, it examines communities for which NATA predicted cancer risks of 100-in-1 million or greater. In this paper, we use the terminology "unacceptable cancer risk" to refer to a predicted cancer risk of 100-in-1 million or greater. We also use the terminology "high-risk community" to characterize communities where the average predicted cancer risk is 100-in-1 million or greater. Finally, we examine the number of people in these communities that are exposed to these potential health risks. This includes an appraisal of the demographic and socioeconomic makeup of these communities where higher cancer risks are predicted.

PROJECT APPROACH AND RESULTS

Our objective was to evaluate the estimated cancer risks for communities with NATA-reported "high" cancer risks. As discussed above, EPA has established a cancer-risk threshold of 100-in-1 million to represent an upper limit of acceptable risk. We selected this as the definition of "high-risk." Next, we selected the definition of a "community." NATA results are provided by census tract. The US Census Bureau defines tracts as "small, relatively permanent statistical subdivisions of a county". Census tracts generally have a population size between 1,200 and 8,000 people, with an average size of 4,000 people.[2] Sometimes, census tracts are characterized as "neighborhoods".[3] Therefore, for the purposes of this analysis, we consider a census tract to represent a community. Throughout this paper, we use the terms "tract" and "community" interchangeably.

The approach that we used consisted of three steps. First, we obtained the nationwide tract-level cancer risks from NATA (specifically the 2014 NATA natl cancer risk by source group (XLS) spreadsheet)[4] and sorted the tracts by the total cancer risk. Cancer risks are typically reported by the EPA to one significant figure, so we selected all tracts with predicted cancer risks of 95 or greater. The results of the 2014 NATA show 117 tracts/communities with an average cancer risk of 100-in-1-million or greater. We will refer to these tracts throughout this paper as “high-risk communities”. Figure 1 illustrates the locations of the communities (not including Puerto Rico). These 117 communities are in 27 counties/parishes in 14 states/commonwealths. Louisiana is the state with the largest number of these high-risk communities (34), followed by Texas (28), Pennsylvania (21), and Illinois (12). The counties/parishes with the largest numbers of high-risk communities are Lehigh County, Pennsylvania (15); St. John the Baptist Parish, Louisiana (12); and Harris County, Texas (11). This information is provided in Table 1.

Figure 1. Location of High-Risk Communities in the United States

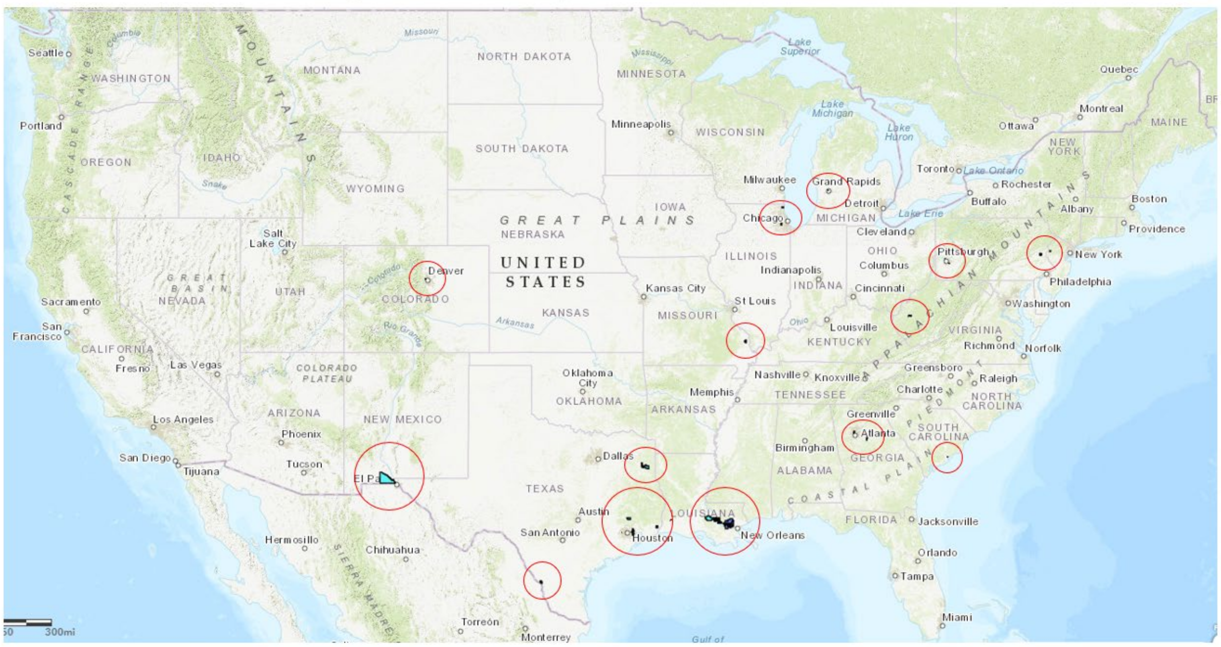
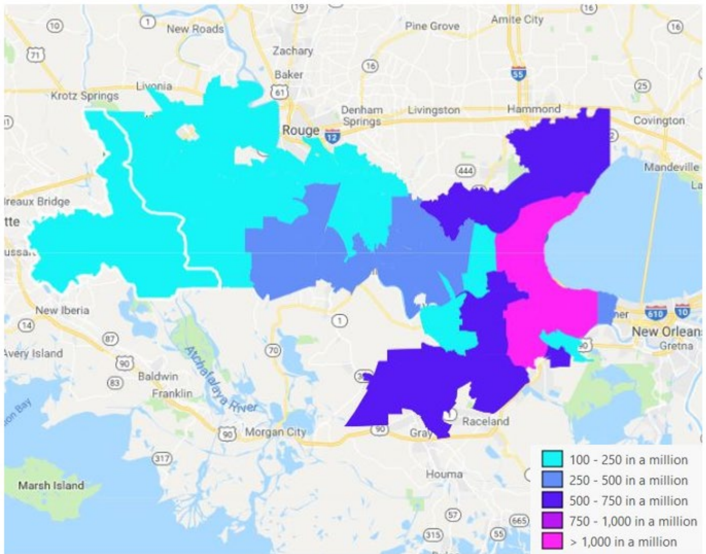


Table 1. Location and Number of High-Risk Census Tracts/Communities from 2014 NATA

State/Commonwealth (Number of High-Risk Communities)	County/Parish	Number of Communities with Average Cancer Risk Estimated to be 100-in-1 million or greater in NATA
Colorado (4)	Jefferson	4
Delaware (1)	New Castle	1
Georgia (4)	Fulton	3
	Newton	1
Illinois (12)	DuPage	8
	Lake	4
Louisiana (34)	Ascension	6
	Calcasieu	2
	Iberville	5
	St. Charles	7
	St. James	2
	St. John the Baptist	12
Michigan (1)	Kent	1
Missouri (1)	Cape Girardeau	1
New Jersey (1)	Warren	1
New Mexico (1)	Dona Ana	1
Pennsylvania (21)	Allegheny	3
	Lehigh	15
	Northampton	3
Puerto Rico (1)	Anasco	1
South Carolina (2)	Charleston	2
Texas (28)	Harris	11
	Harrison	2
	Jefferson	9
	Montgomery	1
	Webb	5
West Virginia (6)	Kanawha	6
Totals	**27**	**117**

The area of the country with the greatest concentration of high-risk communities is along the corridor between Baton Rouge and New Orleans. Figure 2 shows these communities. This figure also delineates the level of cancer risk predicted for each tract/community.

Figure 2. High-Risk Communities in the Baton Rouge Area



The next step in our analysis was to obtain information from the NATA results regarding the drivers of the cancer risks in these high-risk communities. NATA provides a breakdown of the cancer risk both by pollutant and by general source type that contributes to the risk. Of the 71 air toxics that were included in the NATA assessment, only 14 contributed 1% or more to the tract-level risks reported. These were: 1,3-Butadiene, Acetaldehyde, Acrylonitrile, Benzene, Benzyl Chloride, Chromium VI (Hexavalent), Carbon Tetrachloride, Chloroprene, Coke Oven Emissions, Ethylene Dichloride (1,2-Dichloroethane), Ethylene Oxide, Formaldehyde, Hydrazine, and Naphthalene. For most of the 117 high-risk communities examined, ethylene oxide is the most prevalent and significant contributor to tract-level risk. For 48 of the 117 high-risk communities (41%), over 75% of the predicted cancer risk was caused by ethylene oxide. Two other air toxics also contributed significantly to the high cancer risks – chloroprene and formaldehyde. The risk for the community with the highest predicted cancer risk, in St. John the Baptist parish in Louisiana, was driven by chloroprene. The combined cancer risks caused by these three air toxics (ethylene oxide, chloroprene, and formaldehyde) contributed more than 75% of the risk for 116 of the 117 high-risk communities. Table 2 summarizes the air toxics that contribute most significantly to the estimated cancer risks in these high-risk communities.

Table 2. Contribution of Individual Air Toxics to the Predicted Cancer Risks

Air Toxic	# of High-Risk Communities where the Air Toxic Contributes Specific Percentages to the Tract-Level Average Risk			
	>75%	>25%	>10%	>1%
1,3-Butadiene	0	0	0	54
Acetaldehyde	0	0	0	91
Acrylonitrile	0	0	0	7
Benzene	0	0	0	94
Benzyl Chloride	0	0	0	2
Carbon Tetrachloride	0	0	0	104
Chloroprene	1	7	20	22
Chromium VI (Hexavalent)	0	0	1	6
Coke Oven Emissions	0	3	3	3
Ethylene Dichloride (1,2-Dichloroethane)	0	0	0	13
Ethylene Oxide	48	113	114	114
Formaldehyde	0	8	78	117
Hydrazine	0	0	1	2
Naphthalene	0	0	0	69

NATA also provides information regarding the sources that contribute to the estimated tract-level cancer risks. Specifically, NATA reports the cancer risk from the following broad categories of emission sources:

- Stationary “point” sources,
- Non-point (area) sources,
- On-road mobile sources,
- Non-road mobile sources,
- Fire sources, and
- Biogenic sources.

Non-point, on-road, and non-road categories are further broken down into smaller general subcategories. For example, risks from non-road sources are reported for subcategories associated with recreational pleasure craft, construction, commercial lawn and garden, residential lawn and garden, agriculture, commercial equipment, ports, locomotives, airports, and railyards.

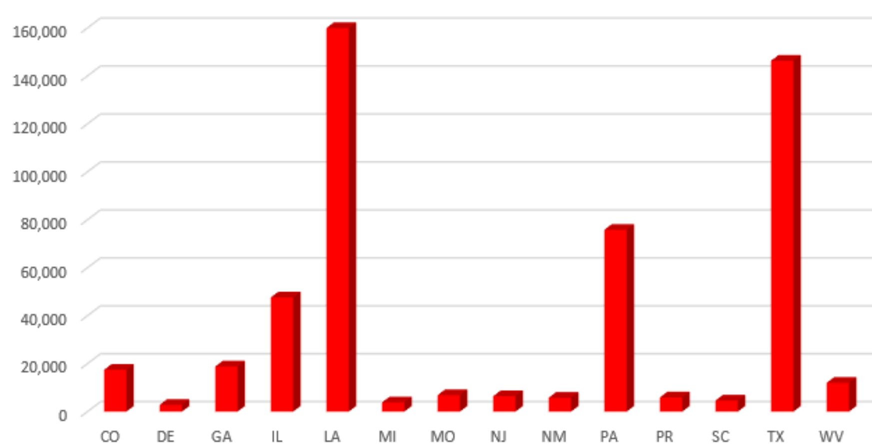
Background cancer risks and cancer risks from secondary formation of air toxics are also provided. Background risks are due to air toxic concentrations that exist in the air that do not come from a specific source. They may come from a natural source or from distance sources. Background concentrations can explain pollutant concentrations found even without recent human-caused emissions. Regarding secondary formation related risks, chemicals emitted from a source can be transformed into other chemicals in the air. In this case, the transformed chemical can be toxic and contribute to the cancer risk. In NATA, EPA predicted the secondary formation of the air toxics acetaldehyde, acrolein and formaldehyde in the atmosphere, along with the decay of 1,3-butadiene to acrolein.

Of the 38 categories and subcategories of sources reported in the NATA results, only 12 contributed more than 1% to the average tract-level cancer risk in these high-risk communities. These included the categories of stationary point sources, onroad sources, nonroad sources, nonpoint sources, fires, and biogenics. Air toxics formed from secondary formation and background also contributed to the high cancer risks. Table 3 provides a breakdown of the subcategories and the number of communities where they significantly contributed to the cancer risk. As can be seen in the table, stationary point sources clearly are the largest contributors to the cancer risks in these high-risk communities. Examples of stationary point sources include large industrial facilities, such as power plants, petroleum refineries, chemical manufacturing plants, pulp and paper mills, and numerous other industrial facilities.

Table 2. Contribution of Sources to the Predicted Cancer Risks

Air Toxic	# of High-Risk Communities where the Source Contributes Specific Percentages to the Tract-Level Average Risk			
	>75%	>25%	>10%	>1%
Stationary Point	71	117	117	117
Onroad LightDuty-OffNetwork-Gas	0	0	0	56
Onroad LightDuty-OnNetwork-Gas	0	0	0	19
Onroad HeavyDuty-Hoteling	0	0	0	1
Nonroad Airports	0	0	0	1
Nonpoint Oil Gas	0	0	0	1
Nonpoint Solvents Coatings	0	0	0	14
Nonpoint Residential Wood Combustion	0	0	0	20
Fire	0	0	0	44
Biogenics	0	0	0	86
Secondary Formation	0	1	62	117
Background	0	0	0	104

Figure 3. Populations Living in High-Risk Communities by State



The final step of our analyses involved investigating the populations exposed to these high risks. Figure 3 illustrates the number of people living in these high-risk communities by state/commonwealth. This information is summarized by county/parish in Table 3. There are over half a million people that live in the communities that are exposed to these "unacceptable" cancer risks due to the inhalation of air toxics. The number of people exposed to these high cancer risks correlates with the number of census tracts/communities that showed cancer risks greater than 100-in-1-million, meaning that more people in Louisiana, Texas, and Pennsylvania are exposed.

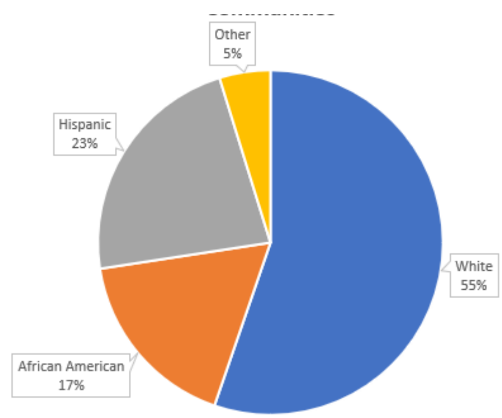
Table 3. Population in High-Risk Communities

State/Commonwealth	County/Parish	Population in Communities with Risks of 100-in-1-million or greater
Colorado	Jefferson	17,468
Delaware	New Castle	2,848
Georgia	Fulton	10,484
	Newton	8,377
	State Total	**18,861**
Illinois	DuPage	28,289
	Lake	19,370
	State Total	**47,659**
Louisiana	Ascension	55,776
	Calcasieu	7,311
	Iberville	22,537
	St. Charles	22,440
	St. James	7,432
	St. John the Baptist	45,924
	State Total	**161,420**
Michigan	Kent	3,869
Missouri	Cape Girardeau	6,908
New Jersey	Warren	6,461
New Mexico	Dona Ana	5,842
Pennsylvania	Allegheny	8,044
	Lehigh	60,126
	Northampton	7,692
	Commonwealth Total	**75,862**
Puerto Rico	Anasco	5,979
South Carolina	Charleston	4,680
Texas	Harris	59,818
	Harrison	8,356
	Jefferson	37,937
	Montgomery	10,144
	Webb	30,121
	State Total	**146,376**
West Virginia	Kanawha	12,067
Grand Total	—	**516,300**

We then explored these populations more closely, examining several broad demographic parameters of the populations that live in these 117 high-risk communities. We obtained the tract-level population demographic information from working files compiled in EPA's Environmental Justice Screening and Mapping Tool, EJSCREEN.[5] The data compiled in EJSCREEN are originally derived from the Census' American Community Survey (ACS) 5-year averages for 2010-2014.[6] Results from this demographic analysis include:

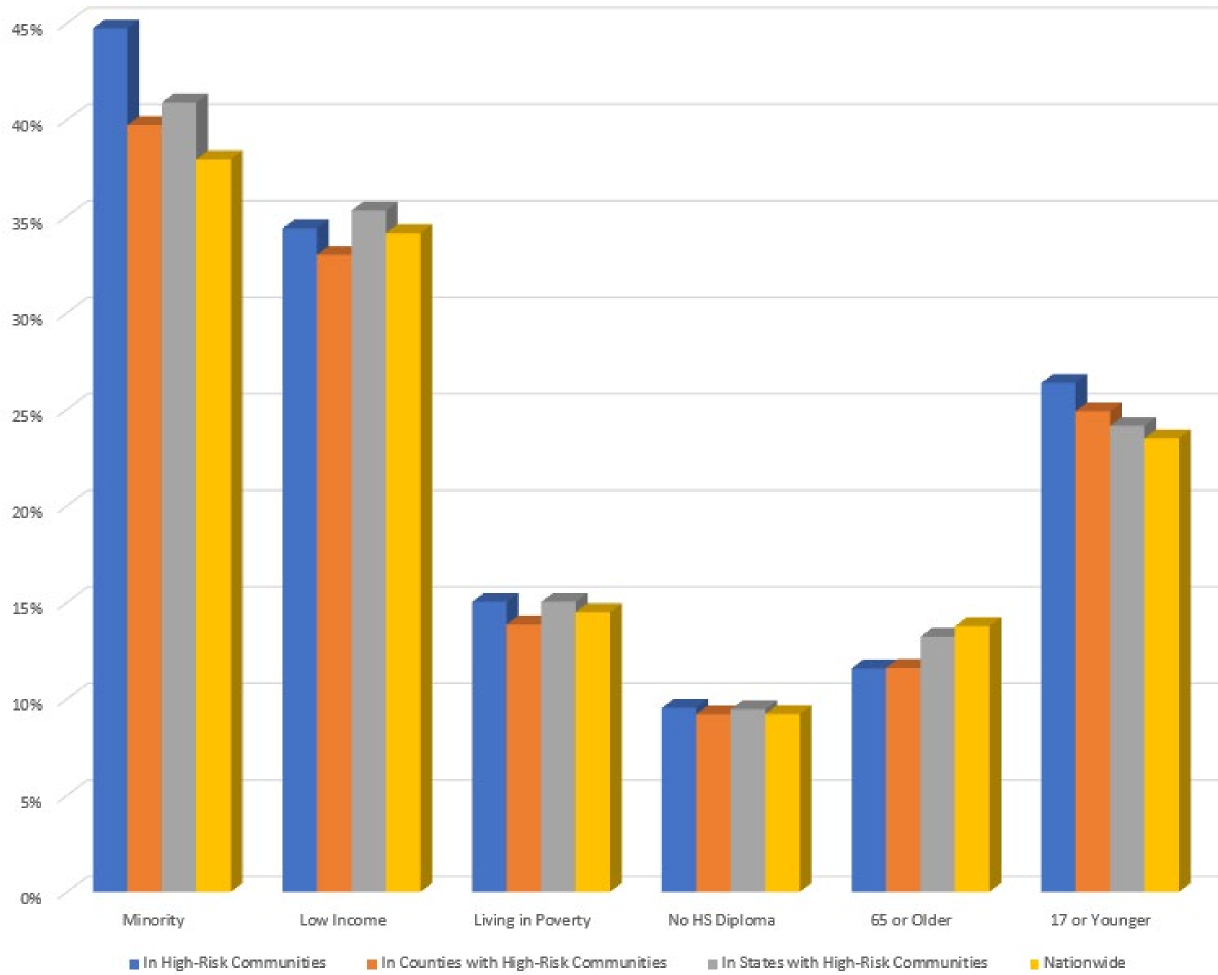
- Around 45% of the individuals living in these high-risk communities are minorities (Figure 4 provides a breakdown of these individuals by race);
- Almost 35% of the individuals living in these high-risk communities are considered "low income," and around 15% are living at or below the poverty level.
- Approximately 10% of the adult individuals living in these high-risk communities did not graduate from high school;
- Just under 12% of the individuals living in these high-risk communities are age 65 or older.
- Over 26% of the individuals living in these high-risk communities are age 17 or younger.

Figure 4. Racial Makeup of Populations Living in High-Risk Communities



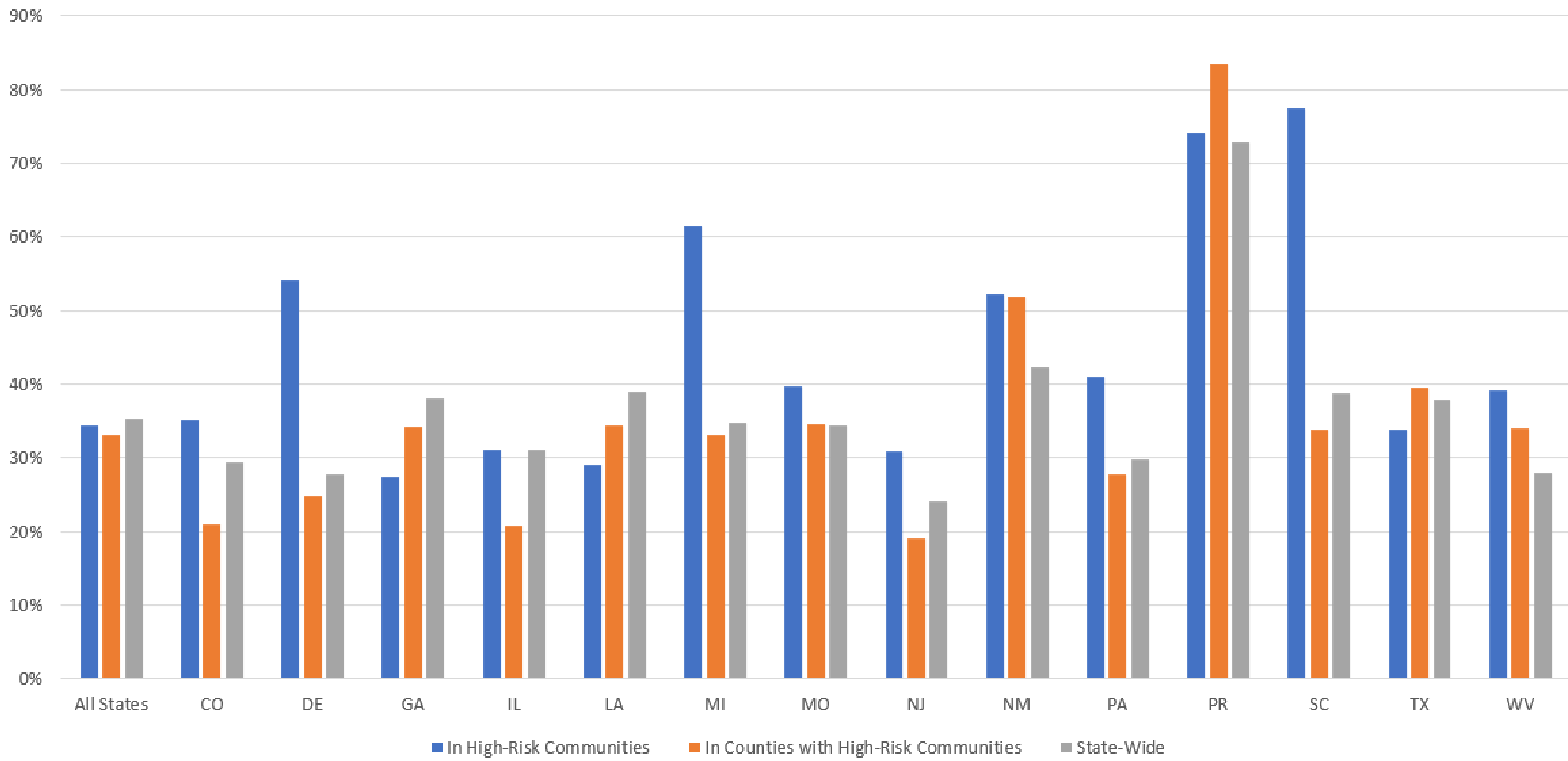
In order to provide context for this demographic information, we compared these percentages to larger segments of the population in the United States. Specifically, we compared them to the percentages of the same parameters for (1) the counties in which the communities are located, (2) the states in which the communities are located, and (3) nationwide. Figure 5 illustrates these comparisons for the total population of all 117 communities.

Figure 5. Percentages of Populations in Specific Demographics



Other than the slightly higher percentage of minorities in the high-risk communities and the slightly higher percentages of people 17 years old and younger, none of the other demographic parameters show a major difference between the high-risk communities and the other segments of the population. However, this is not the case when this information is broken down by state. Figure 6 provides a comparison of the high-risk community, county, and state for low-income populations. For 8 of the 14 states/commonwealths in which these high-risk communities are located, the percentage of the population in the high-risk communities that is low-income is higher than both the county-wide and state-wide percentages of these demographic populations. (For three states, the percentage of low-income population in the high-risk communities is lower than both the county and state levels.) This same basic trend is evident for the percentage of the population that are minorities, populations living below the poverty level, and for populations that do not have a high school degree. Figures analogous to Figure 6 for these parameters, as well as for populations 65 years old and greater, and populations 17 years old and younger, are provided in Appendix A.

Figure 6. Percentages of Low-Income Populations



APPROACH FOR COMMUNITIES MOVING FORWARD

As a reminder, EPA clarifies that NATA is only a screening tool. As can be seen from the brief analyses presented in the earlier section, there is quite a bit of information that can be gleaned from NATA results and other publicly available data. However, there are questions that a state or local agency or a community would need to answer to be able to better assess the risks and the causes, and to begin to develop solutions to reduce the risks. Perhaps the two most key questions are:

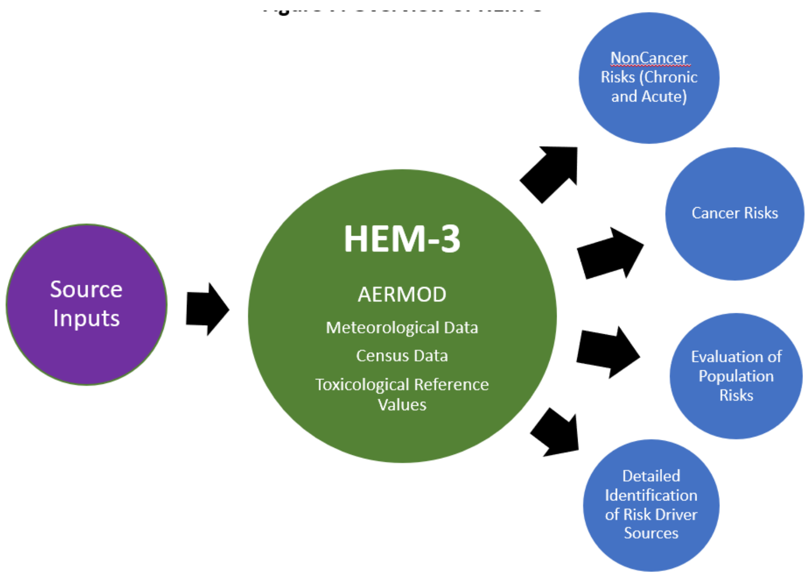
1. Where exactly are the individuals that are exposed to the highest risks? and
2. What are the specific sources that are causing the risk?

The resources needed to answer these questions can be overwhelming. One of the dangers that can occur is spending resources on improvements to the risk assessment that may not provide substantial value in obtaining the basic answers needed to move forward.

Human Exposure Model (HEM-3)

We offer a progressive approach that does initial evaluations with readily available data and tools, followed by targeted refinements informed by the previous phases. The foundation of this resource-efficient approach is the Human Exposure Model, or HEM. HEM (**HEM-3**), version 1.5 is the most current version, and it is available on the EPA website.[7] There are two HEM-3 applications: (1) the single facility version and (2) the multi-facility version. The multi-facility version is the one best suited to conduct community-level risk assessments, as it can account for the complete range of sources of air toxics in an area and estimate the cumulative impacts and risks.

Figure 7. Overview of HEM-3



HEM-3 evaluates cancer risks, as well as chronic and acute non-cancer health effects, and population exposures due to emissions of air toxics. The HEM-3 model framework uses EPA's state-of-the-science AERMOD dispersion model on an unprecedented scale. It also contains 2010 Census data (at the census block level), as well as databases containing nationwide meteorological data and toxicological reference values. A simple view of HEM-3's inputs and outputs is provided in Figure 7.

HEM-3 allows the user to consider elevation and terrain, complex source configurations, temporal and wind variations, as well as building downwash effects. The user can also estimate ambient concentrations of pollutants considering additional dispersion factors such as wet and dry deposition and depletion, which allows estimation of multimedia concentrations and the effects of changes in those concentrations. While the 2014 NATA was conducted using AERMOD and large regional photochemical grid models, HEM-3 was used for previous versions of NATA to model stationary point sources, onroad sources, nonroad sources, nonpoint sources, fires, and biogenics across the entire nation.

There are many aspects of HEM-3 that can add efficiency to a community-based risk assessment. In the following we focus on six of these aspects.

1. **Meteorological Data**. AERMOD requires surface and upper air meteorological data that meet specific format requirements. Because HEM-3 has the meteorological data included, there is no need to obtain and process meteorological data. HEM-3 includes a library of meteorological data from National Weather Service (NWS) observation stations. The current HEM-3 AERMOD Meteorological Library includes over 800 nationwide locations. HEM-3 automatically obtains the meteorological data for the station nearest the source/community. However, the user has the option of selecting a different NWS station, or to provide and upload their own processed meteorological data into HEM-3 (e.g., from a community-based station).
2. **Receptor Locations.** HEM-3 automatically establishes receptors at the geographic centroid of each census block in the modeling domain. For each of these receptors, HEM-3 contains coordinates, the elevation, and the controlling hill height. Obtaining block-level results immediately provides considerable refinement to the tract-level results reported in NATA. HEM-3 also has location information for over 125,000 schools in the U.S., along with over 1,000 ambient air monitoring locations. Receptors can be added for these locations, as well as any other user-defined location.
3. **Impacts of Multiple Pollutants**. HEM-3 analyzes multiple pollutants concurrently, with the capability of including particulate and gaseous pollutants in the same model run.
4. **Contribution of Individual Sources**. HEM-3 calculates (and saves) the contribution from every source modeled to every toxic air pollutant concentration at every receptor. This allows the user to pinpoint the specific sources (e.g., a specific stack at an industrial facility) that cause elevated risks.
5. **Toxicological Reference Values.** For each air toxic that is classified as a hazardous air pollutant (HAP) in the Clean Air Act, the HEM-3 Chemical Health Effects Library includes the following parameters, where available: (1) unit risk estimate (URE) for cancer; (2) reference concentration (RfC) for chronic noncancer health effects; (3) reference benchmark concentration for acute health effects; and (4) target organs affected by the chemical (for chronic noncancer effects). These parameters are based on the EPA's database of recommended dose response values for HAP,[8] which is updated periodically, consistent with continued research on these parameters. HEM-3 also allows users to replace these reference values with user-defined values.
6. **Census Data.** As noted above, HEM-3 automatically establishes receptors at the geographic centroid of every census block in the modeling domain. In addition to the coordinates, elevation, and controlling hill height, HEM-3 also includes the population in each block. HEM-3 assumes that all individuals living in the census block are exposed to the concentration/risk predicted at the centroid This allows the swift determinations of the number of individuals exposed to various risk levels. Note that while HEM-3 only contains total population of each census block, SC&A has developed for

the EPA an add-on to HEM-3 that provides assessment of the risks by various demographic and socioeconomic groups. Note that this “Environmental Justice Risk and Proximity Analysis Tool” is not currently available on EPA’s website.

Simplified HEM-3 Based Approach to Assess Community Risks from Air Toxics

Your community has been identified in NATA as a high-risk community, or other information is available that raises a concern about the risk to residents resulting from the inhalation of air toxics. You need to obtain more information - but resources are limited. Figure 8 illustrates a HEM-3 based iterative approach that can both inform a community about the severity of the air toxics problem and start the process of corrective measures to improve it.

As illustrated in the first section of this paper, the NATA provides a great deal of screening-level information that can aid communities in determining the extent of the air toxics problem. However, there are limiting factors to the NATA results. Three of the most significant are (1) the results are average risks across relatively large geographic areas (i.e., census tracts), (2) there are no acute risks evaluated, and (3) the pollutant and source drivers are only provided at a high level.

The source input data used for NATA is EPA’s National Emissions Inventory (NEI).[9] HEM-3’s source input files are based on using NEI data, so it is a low hurdle to perform a preliminary assessment using the same NEI data used in NATA. This would provide considerably more detail regarding the two significant limitations noted above.

First, a HEM-3 assessment would provide census block results. Census blocks are the smallest geographic group for which the Census provides data and contain, on average, about 50 people. In a city, a census block often looks like a city block bounded on all sides by streets. Census blocks in suburban and rural areas may be large, irregular, and bounded by a variety of features, such as roads, streams, and transmission lines. In remote areas, census blocks may be geographically large. The number of census blocks in a tract can vary considerably.

Census Tract # 22095070800 in St. John the Baptist Parish, Louisiana, was the tract that showed the highest average cancer risk in the NATA results. Figure 9 shows this tract, along with the approximately 45 census blocks contained in it. As pollutants disperse from a source, a few hundred feet can make a significant difference in the concentration, and thus the risk. It is very easy to see how the average concentration across this 2-square mile tract would not represent the risk to individuals living very near the source.

To illustrate this further, we conducted a HEM-3 model run for a single facility in the Midwest using publicly-available NEI data. The average risk reported in NATA for the tract nearest this facility was 80-in-1 million. Our HEM-3 run resulted in block-level risks that ranged from 1 to 8,000-in 1 million. In other words, there are individuals living near this facility that are exposed to cancer risks 80 times greater than the level generally considered to be unacceptable. This sample tract has a population of 5,445 who are exposed to a NATA average risk of 80-in-1 million. The HEM-3 block-level results within this tract show 35 blocks with a risk of 100-in-1 million or greater affecting 656 people, and 14 blocks with a risk of 1,000-in-1 million or greater affecting 152 people. Figure 10 shows the risks across the census tract. The primary point of this example model run is to illustrate that individuals in many communities across the country are likely exposed to unacceptable cancer risks due to air toxics even if this is not indicated by the very broad tract-level NATA results.

Using HEM-3 to obtain the block-level risks will provide insights into both the maximum risks to which individuals in the community are exposed, as well as the locations of the residences of these individuals. It also provides the opportunity to include special receptors in locations such as schools to predict the risks there. Assessment at the block level also allows a more robust characterization of the number of individuals that are exposed to varying risk levels. Further, the risk impacts on various demographic and socioeconomic populations can be better characterized.

Acute risks are a standard output of HEM-3. HEM-3 compares the short-term estimated concentrations of each air toxic to the applicable toxicological benchmarks that represent an acute health risk.

Regarding the sources that contribute to the risk, HEM-3 can provide the specific contribution of every source modeled to the risk at every receptor. Based on our experience, we would recommend that communities exercise caution before basing any significant action on the results of a risk assessment using NEI data. The NEI is an excellent source of information on which to base wide regional and large-scale assessments. However, small errors in point source information (e.g., emission rate, coordinates, stack height, etc.) can make a significant difference in the risk. In addition, for many smaller sources, EPA does not have an exact location in the NATA inventory. They modeled these as nonpoint sources. Emissions from homes, such as wood-burning stoves and fireplaces or solvent emissions, are examples of nonpoint sources. EPA usually inventories nonpoint sources by county, then divides each county into smaller, square "grid cells," then assigns nonpoint emissions to each cell using population or another method that realistically distributes the emissions across the county.[10] They used a similar approach to assign most mobile source emissions. An exception is for airports, which were modeled using their actual locations.

Our suggestion would be to use the results of the quick preliminary assessment to inform areas where the input information can be refined to better estimate the risks. For example, up-to-date emissions information could be obtained from stationary sources, along with confirmation of coordinates and other location information. Additional information could be obtained to refine the modeling to include aspects like the effects of building downwash. For non-stationary sources, identifying specific sources of interest (e.g., a congested road), then specifying their location and configurations and generating more site-specific emissions estimates will improve the risk estimates. Note that some communities may already have better data and want to move ahead initially with a more refined assessment. Or they may already have answers to the key questions of the location and sources of interest. HEM-3, which includes the full capabilities of AERMOD, is also an efficient tool to perform these more refined assessments.

Figure 8. Simplified HEM-3 Based Approach to Assess Community Risks from Air Toxics

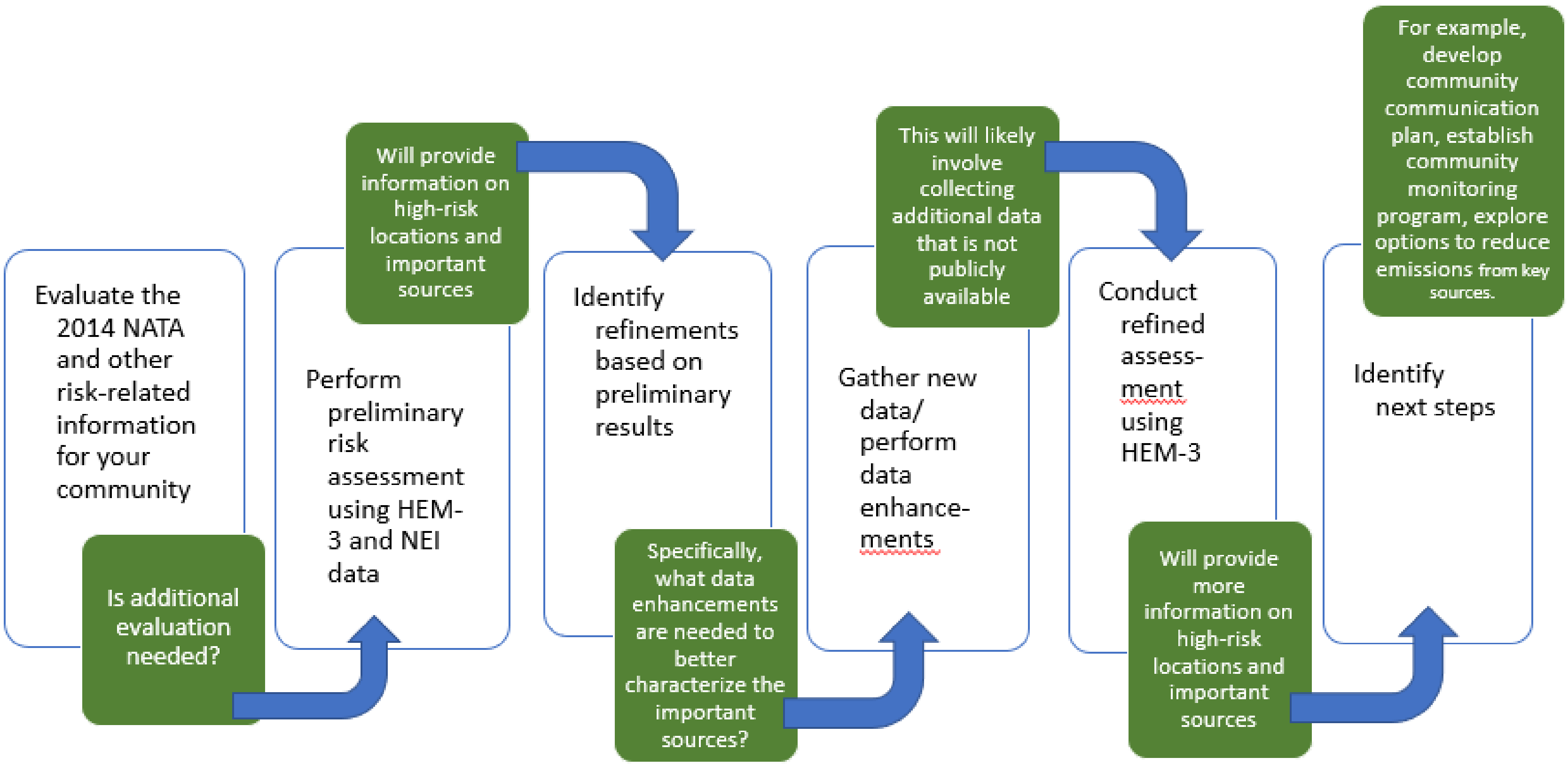
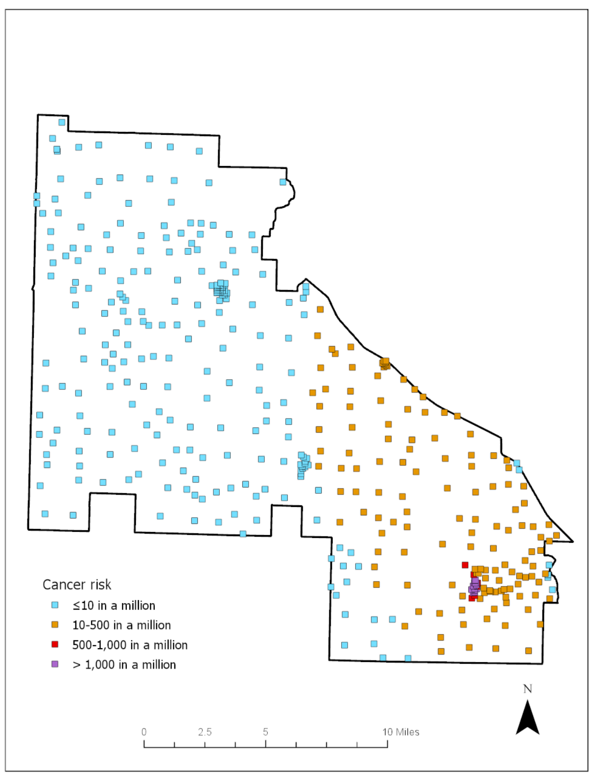


Figure 9. Census Blocks in Track #22095070800 in St. John the Baptist Parish, Louisiana

Figure 10. HEM-3 Cancer Risk Results for One Tract Near an Actual Facility in the Midwest



After the refined assessment is complete, there are several potential steps that community leaders could take. Communication with the potentially impacted community is vital. Frankly, we would recommend that this engagement begin much earlier in the process than after refined results are obtained, to ensure transparency and to gain the public's trust. Many communities have the desire to perform ambient monitoring. With the availability of high-quality low-cost monitoring techniques on the rise, this is becoming a more cost-effective aspect of community air toxics programs. The HEM-3 assessments can also inform the best locations for monitoring devices. Another step is to evaluate the options to reduce air toxics emissions, and thus risks. HEM-3 is also used routinely by SC&A for the EPA in evaluating the residual risk to communities, after control measures are put in place.

SUMMARY

EPA's NATA is a nationwide assessment of the chronic human health risks due to the inhalation of air toxics. It provides basic information about the levels of risks, the number of people exposed to these risks, and the pollutants and source groups that contribute to the risks. In the 2014 NATA, there were over 117 communities in the US for which the NATA reported average cancer risks above the threshold that EPA considers unacceptable. However, the risks reported represent "average" risks across a census tract. The risk within these tracts is most certainly considerably higher nearer the sources. The three air toxics that consistently cause the cancer risks in the communities are ethylene oxide, chloroprene, and formaldehyde. Emissions from stationary (industrial facility) sources emit most air toxics causing the high risks.

HEM-3 is a tool developed by SC&A for EPA to perform assessments of the risks due to the inhalation of air toxics. It is a "one-stop" tool that incorporates EPA's recommend dispersion model AERMOD, meteorological data for stations across the US, census block-level population data for the entire country, and toxicological references values. HEM-3 can be of great value to communities to help them perform risk assessments with limited resources.

On the horizon is a new version of HEM – HEM Version 4 (HEM-4). HEM-4 is currently under development using state-of-the-science open source code (Python). It will retain all the power and utility of HEM-3 but will run more efficiently using less computer resources. In addition to improvements in user-friendliness, HEM-4 will offer greater flexibility in defining receptor locations, support modeling outside of the U.S., and provide greater visualization tools (e.g., contour maps). Use of the Python programming language will let HEM-4 tap into a huge library of software utilities that can extend the functionality of the model. The first beta-version of HEM-4 is scheduled to be released by the EPA laterin 2019.

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The foundation of our risk assessment work is with EPA's Air Toxics Assessment Group in the Office of Air Quality Planning and Standards. We greatly appreciate the opportunity to work with members of this group including Terri Hollingsworth, Mark Morris, Ted Palma, Kelly Rimer, Chris Sarcony, and Darcie Smith. We also acknowledge Dr. William Battye, who foresaw EPA's risk assessment needs, had the vision for HEM-3, and led its development.

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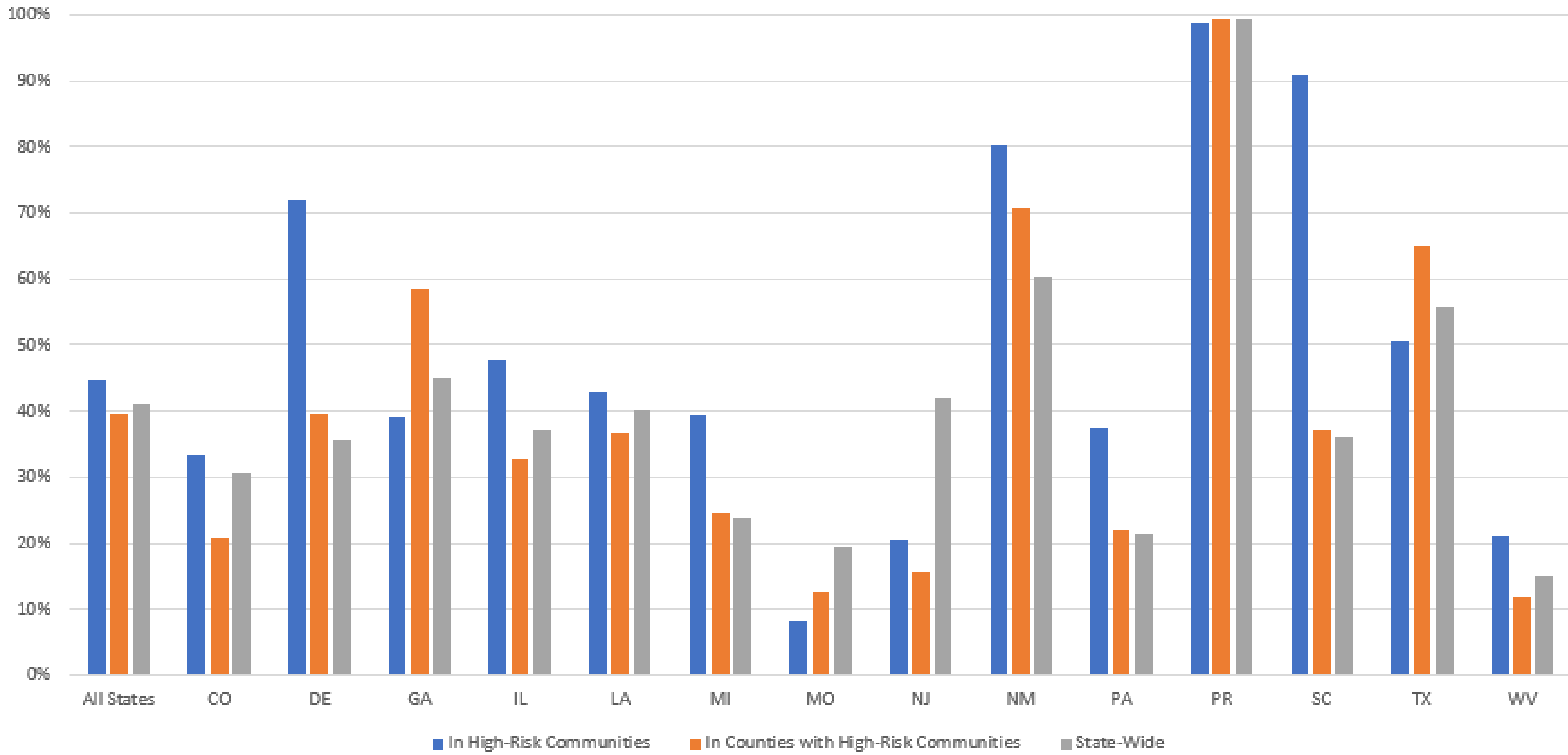
APPENDIX A: BREAKDOWN OF POPULATIONS IN HIGH-RISK COMMUNITIES BY VARIOUS SOCIO-ECONOMIC PARAMETERS

Figure A-1. Percentages of Minority Populations



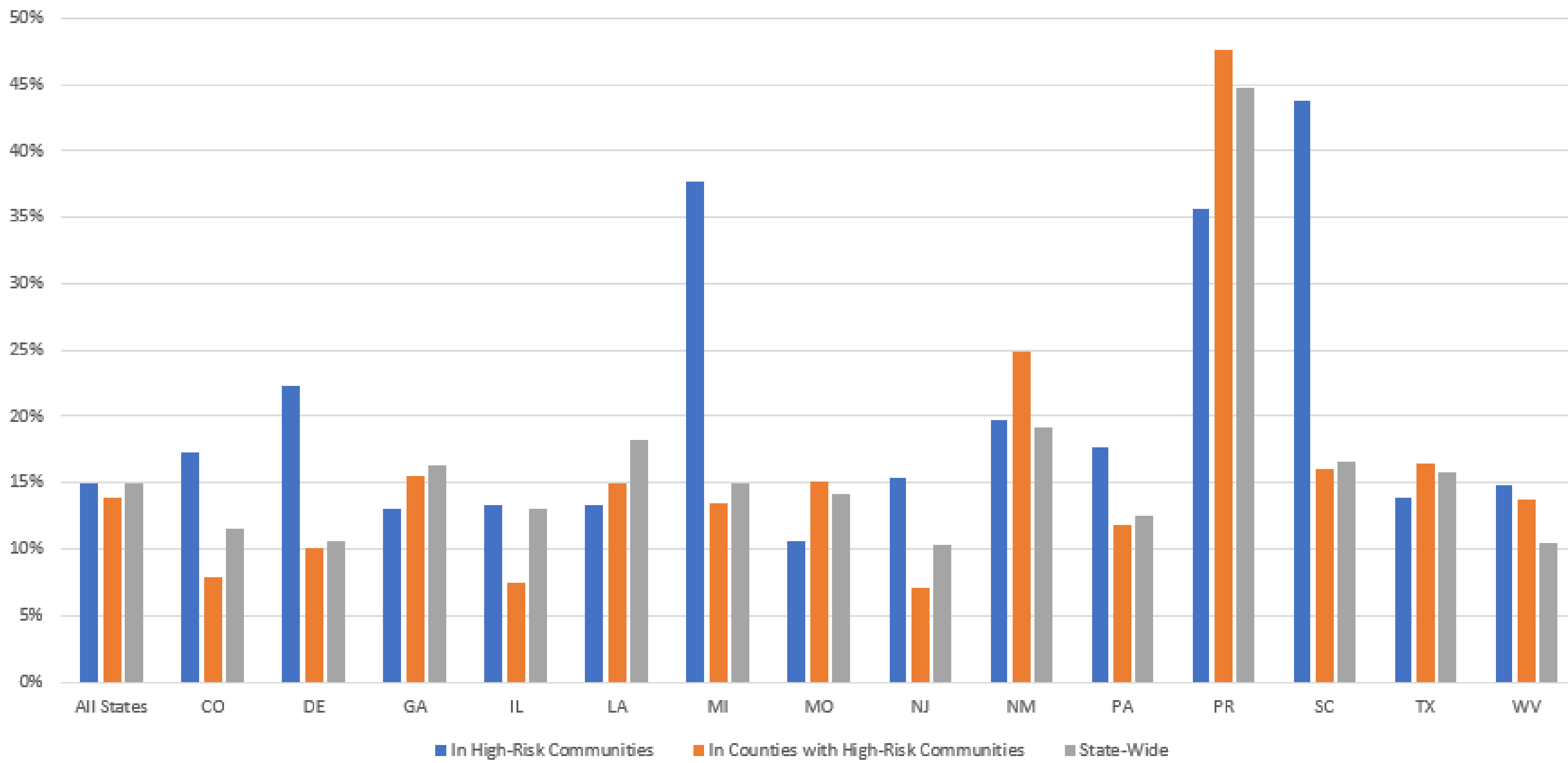


Figure A-2. Percentages of Populations Living in Poverty

Figure A-3. Percentages of Populations Without a High School Diploma

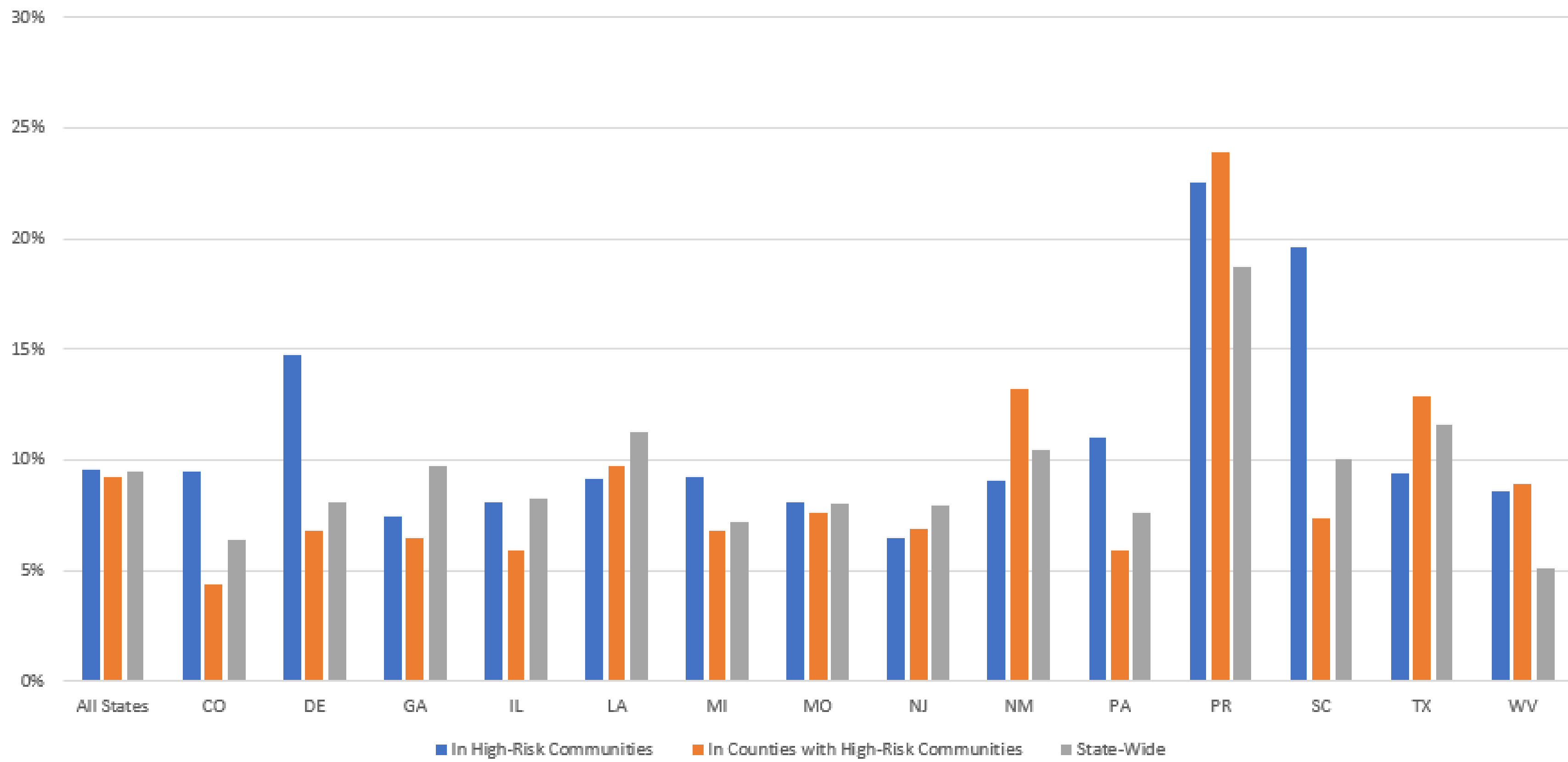


Figure A-4. Percentages of Populations 65 Years Old and Older

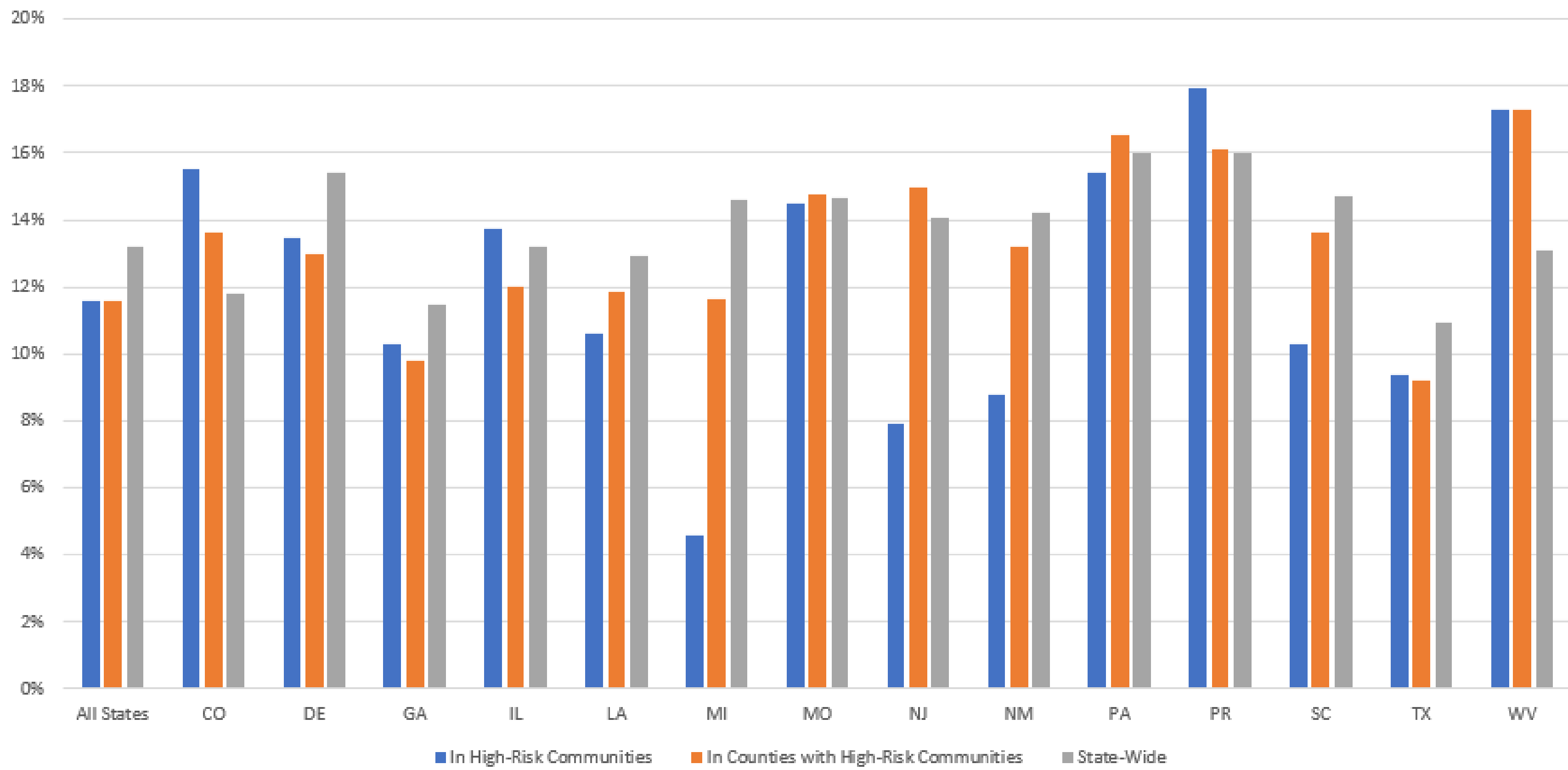
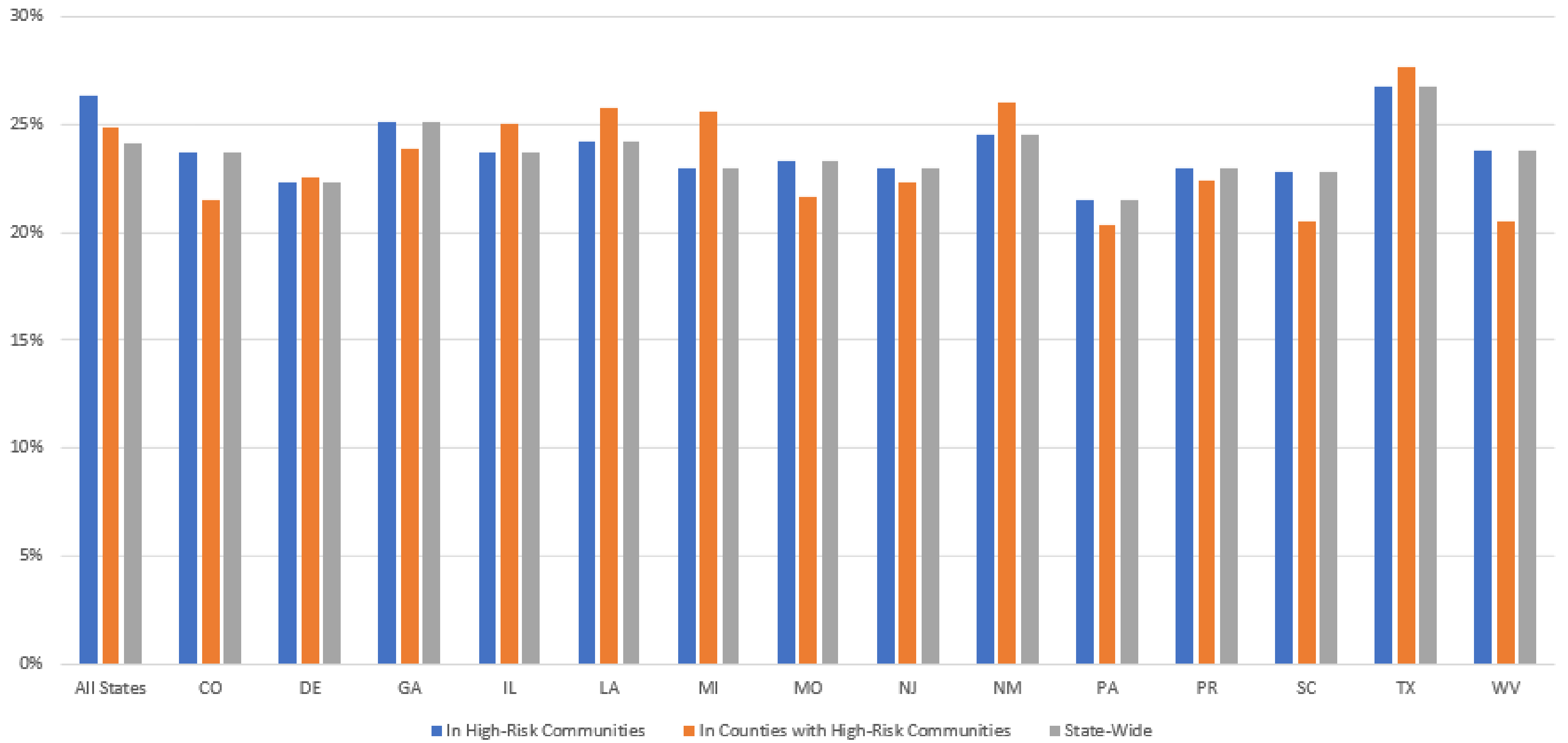


Figure A-5. Percentages of Population 17 Years and Younger



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COMMUNITIES AT RISK FROM AIR TOXICS - DEEPER ANALYSIS OF NATA RESULTS AND TOOL FOR A PATH FORWARD

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