Public Health Action Plan

Improving Air Quality & Health in Detroit

2017

WORKING TOGETHER TO IMPROVE DETROIT'S AIR

COMMUNITY ACTION TO PROMOTE HEALTHY ENVIRONMENTS

CA-PHE

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Public Health Action Plan Executive Summary

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This work is made possible by National Institute of Health and Environmental Sciences, RO1ES022616, and the Fred A. and Barbara M. Erb Family Foundation. Additional support was provided by the Michigan Center on Lifestage Environmental Exposures and Disease (M-LEEaD), #P30ES017885.

A Public Health Action Plan for Air Quality In Detroit

Detroit's legacy as the "arsenal of democracy" in the World Wars, the "motor city" throughout the 20th century, its major international crossing with Canada, and the many other notable features that have shaped the city and its population have led to the juxtaposition of heavy industry, housing and transportation corridors that expose city residents and workers to elevated levels of ambient air pollutants. Coupled with the greater vulnerability of many residents to air pollution, a result of poverty, limited access to health care, existing disease and other factors, rates of environmentally-related diseases are high in the city. The *CAPHE Public Health Action Plan* provides concrete steps to address these issues and improve health in Detroit and southeast Michigan. This executive summary highlights key elements of the scientifically-informed plan, which was developed using a multi-stakeholder and participatory process. The full plan and accompanying Resource Manual are available at http://caphedetroit.sph.umich.edu/.

The health impact from air pollution in Detroit is substantial. Air pollutants affecting health in Detroit include particulate matter ($PM_{2.5}$), diesel exhaust, sulfur dioxide (SO_2), ozone (O_3), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and toxic metals like lead (Pb). Portions of Detroit do not meet the National Air Quality Standards (NAAQS) for SO_2, and the region will not meet the NAAQS for O_3. Exposure to $PM_{2.5}$, O_3 and other pollutants can cause health effects even at levels below the NAAQS, including asthma and asthma aggravation,[1, 2] hospitalization visits and deaths due to cardiovascular and respiratory disease,[3, 4] lost work and school days, cancer, and adverse birth outcomes.

The magnitude of the public health burden experienced by residents of Detroit and neighboring cities attributable to air pollution is shown in Table 1. **Each year, air pollution causes 690 deaths, thousands of hospital visits, and many other adverse health effects among residents of Detroit and neighboring cities.[5] The direct economic cost of these health impacts is estimated at $6.9 billion dollars each year. The health burden attributable to ambient air pollution represents 7% of deaths in the city (out of approximately 9,500 each year), 1% of hospitalizations (out of more than 162,000 each year), and between 2 and 13% of days with asthma symptoms. Asthma is a special concern in Detroit, given its very high rates. (See asthma sidebar). Importantly, health impacts due to air pollution are preventable.**

TABLE 1. *Annual health burden attributable to ambient exposures to $PM_{2.5}$, O_3, SO_2 and NO_2. Exposure sources are "regional" sources representing pollution from neighboring areas, "point" sources representing local industry, "mobile" sources representing local trucks, cars and other on-road vehicles, and "area" sources representing smaller industrial sources, non-road mobile emissions, and other air pollutant sources. The table excludes cancer.*[5]

		Exposure Source				
Outcome (cases per year)	Age Group	Regional	Point	Mobile	Area	Total[1]
Mortality	< 1, ≥ 30 years	560	20	30	9	690
Hospitalizations	All ages	1200	120	350	150	1800
Asthma ED visit	< 18 years	2600	160	450	170	3,400
Asthma symptom days	6 - 14 years	310,000	23,000	57,000	49,000	440,000
Restricted activity days[2]	All ages	1,300,000	18,000	21,000	65,000	1,400,000
Total DALYs (years)[3]		11,000	440	560	1,600	13,000
Monetized impact ($million)		5,500	230	280	850	6,900

Notes **1.Impact estimates have been rounded to two significant figures**
2. Includes minor restricted activity days, work loss days, and school absences.
3. DALYs are disability-adjusted life-years, representing equivalent years of life lost due to premature death and illness.

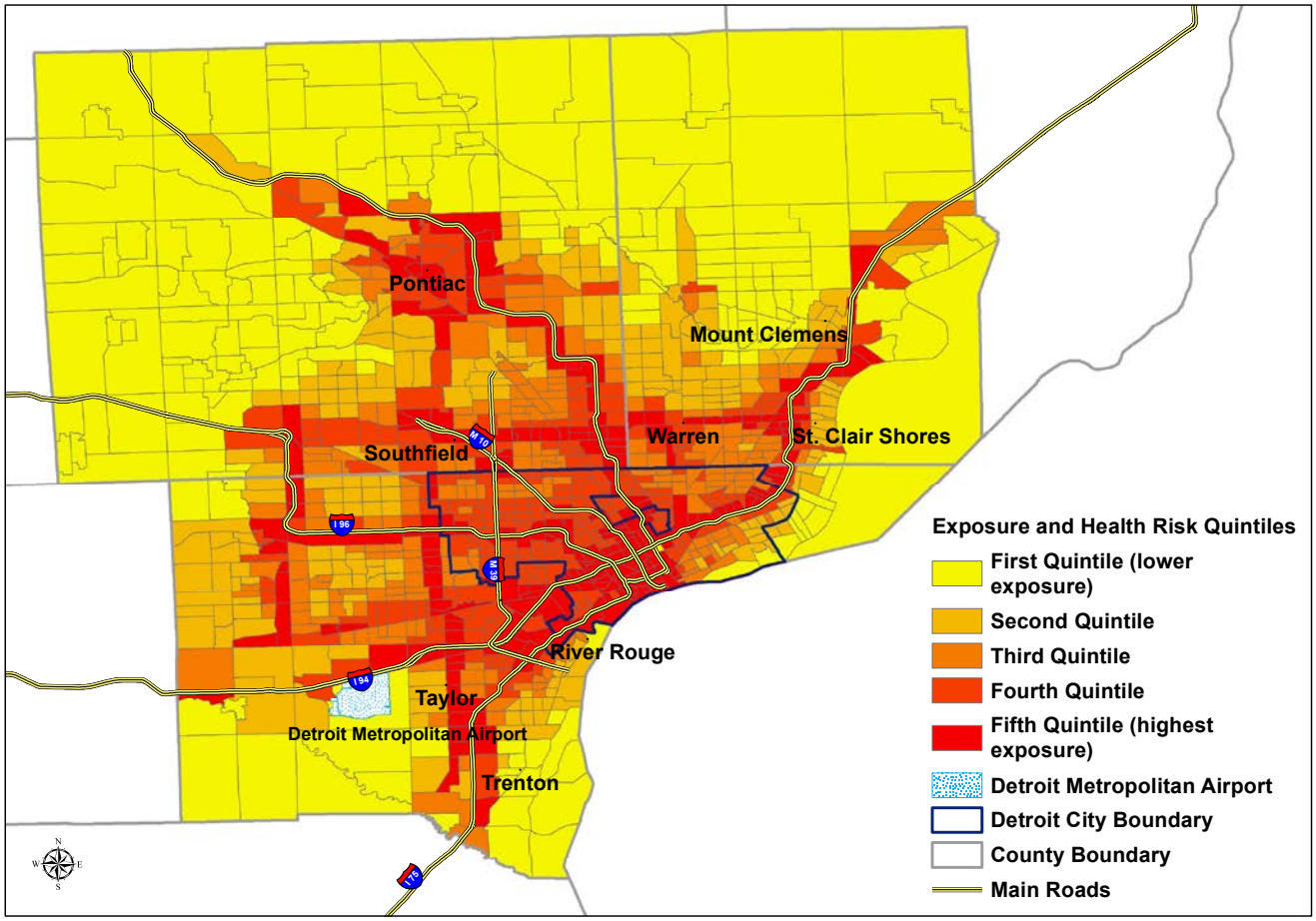
Asthma in Detroit

Asthma is linked to environmental exposures like poor air quality. Detroit has a much higher asthma burden than the State of Michigan overall. Using the most recent statistics[6] and comparing Detroit to the state as a whole:

- Current asthma prevalence among Detroit adults is 29% higher
- Hospitalization rates for asthma are more than three times higher in Detroit
- Emergency department visits for children covered by Medicaid are twice as high in Detroit
- Children covered by Medicaid with persistent asthma in Detroit rely on emergency department 50% more.

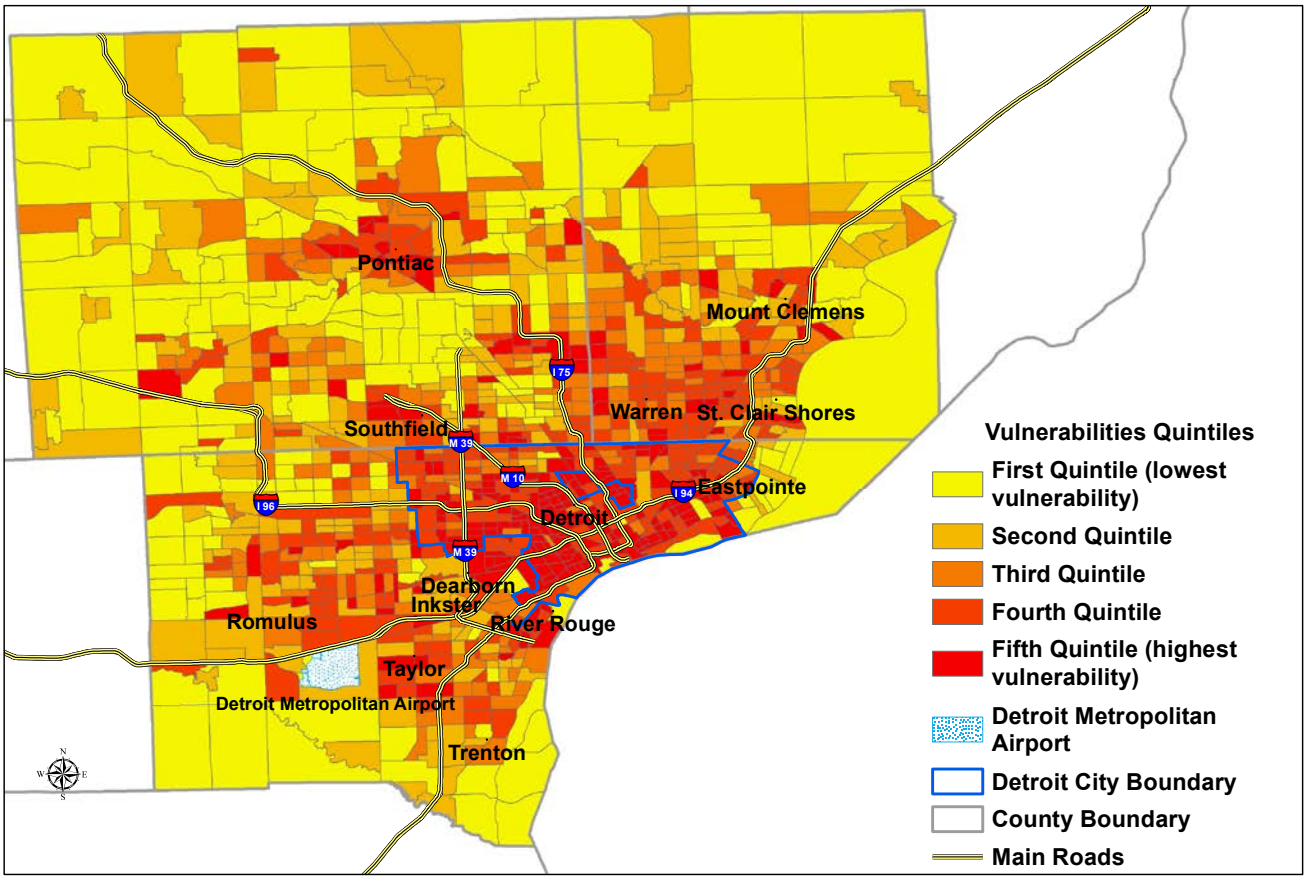
The impacts of poor air quality disproportionately fall on poor and minority populations. Figure 1 shows the distribution of diesel PM exposure and respiratory and cancer risks associated with air pollution in the Detroit metropolitan area. Residents of census tracts with the highest levels of exposure and associated risk (Quintiles 3-5) have a 12% greater chance of death due to cardiopulmonary (heart and lung) disease compared to those living in census tracts with the lowest exposures (Quintiles 1-2) after controlling for individual risk factors such as education and smoking. Approximately 260 deaths due to cardiopulmonary disease would be averted each year if census tracts with the highest levels of exposure (Quintiles 3-5, Figure 1) were reduced to levels currently found in low exposure census tracts (Quintiles 1-2).

FIGURE 1: *Diesel PM exposure, cancer and respiratory risk attributable to air pollution in the Detroit metropolitan area.*[7]



Cumulative impact polygons (CI) include: residential areas, child care facilities, health care facilities, schools and playgrounds. Exposure and Health risk include: 2011 NATA estimates of respiratory risk, cancer risk and diesel PM (non-cancer) concentration.

FIGURE 2: *Population vulnerability, defined as percent below poverty, renters, low median home value, less than high school education, adults over age 60, and children below age 5, in the Detroit Metropolitan Area.*[7]



Cumulative impact polygons (CI) include: residential areas, child care facilities, health care facilities, schools and playgrounds. Vulnerabilities includes: % below the national poverty level, % renters, median house value (reverse coded), % > age 24 with < high school completion, children age < 5, adults age >= 60, and linguistic isolation.

The census tracts in the Detroit metropolitan area with higher levels of air pollution are also more likely to be home to residents who are more vulnerable to adverse health effects associated with those exposures. Figure 2 shows the distribution of vulnerabilities (e.g., lower educational levels, incomes below the poverty line, people of color, children below the age of 5, adults over 60) across census tracts. The majority of deaths attributable to air pollution each year in the Detroit metropolitan area occur in census tracts with the highest levels of population vulnerability (Quintiles 3-5, Figure 2).

What Can We Do About Air Pollution?

Many approaches and interventions can be used to improve Detroit's air quality and improve public health. The *CAPHE Public Health Action Plan* contains a comprehensive set of 10 strategies for achieving healthier air and 25 specific recommendations to reduce emissions, lower exposures, and improve public health. These range from simple, small-scale actions such as installing a better filter in a home's heating and air conditioning system, to large-scale policy solutions such as promoting low emission transportation alternatives and improving monitoring and enforcement of industrial facilities. The strategies fall into three types: (1) **lowering emissions** using emission controls, clean fuels, anti-idling and other actions applied to industrial and mobile sources; (2) **reducing exposure to air pollutants** using buffers and air filters to reduce the amount of pollution that people are exposed to; and (3) **improving enforcement and compliance** of existing air quality standards by bolstering monitoring and enforcement activities and increasing public understanding and engagement.

Implementing any of the strategies in the *CAPHE Public Health Action Plan* will help to improve air quality and public health. A coordinated approach that implements multiple strategies will be most effective and will benefit the most people. Some of the strategies are cost effective and will reduce air pollutants quickly – these include recommendations for anti-idling restrictions, clean fuels, and air filters. Other strategies will take more time to implement – such as transitioning to renewable energy, widespread use of vegetated buffers between pollution sources and people, and the development of environmentally sustainable and healthy mobility and transit options. All of our recommendations are based on scientific evidence summarized in *CAPHE's Public Health Action Planning Resource Manual,* which have been reviewed by many contributors, and have been vetted through a thorough process that considered their appropriateness and feasibility for Detroit (See Acknowledgements for a listing of participants).

The strategies and recommendations described in *CAPHE's Public Health Action Plan,* when implemented, will substantially improve the health and well-being of Detroiters.

Structure of the Public Health Action Plan

The *CAPHE Public Health Action Plan* is organized into 10 chapters that address: (1) point source controls; (2) renewable energy; (3) diesel engine retrofits; (4) idling controls; (5) clean fuels; (6) transportation control measures; (7) indoor air filters; (8) buffers and barriers; (9) compliance and enforcement of air quality rules; and (10) monitoring. Each chapter includes a brief introduction and specific recommendations, including specific actions for implementation that cover: (1) **education and outreach** – intended to raise knowledge about air pollution, health effects, and effective strategies; (2) **support and coordination** – describing current and potential partnerships to implement the strategy; (3) **incentives and funding** – listing funding and incentive opportunities for the strategy; and (4) **planning and regulations** – policy actions and regulatory changes that could be put in place to support the recommendation.

This *Executive Summary,* highlights only a subset of the implementation activities described in the full *CAPHE Public Health Action Plan*. In addition, the full plan provides many examples of activities ongoing in Detroit and in other communities to improve air quality and public health.

The *CAPHE Public Health Action Plan* is supported by a comprehensive *Public Health Action Planning Resource Manual* that provides additional depth on the science and status of air quality in Detroit, as well as the approaches that can be used to improve air quality and public health. This *Resource Manual* provided the basis for the Plan and our recommendations.

MITIGATION STRATEGIES

Many strategies can be used to reduce air pollutant emissions and lower people's exposure to air pollutants (See side bar: "Top Ten Strategies"). The following summarize key elements of the ten strategies for healthy air included in the *CAPHE Public Health Action Plan.* The Plan provides full details on each strategy and recommendation, and includes suggestions and examples of how these can be implemented.

The "Top Ten" CAPHE Public Health Action Plan Strategies

1. ***Point source controls*** – control and reduce emissions at industrial facilities.
2. ***Renewable energy*** – replace fossil fuels with non-polluting solar and wind energy.
3. ***Diesel engine retrofits*** – fix or replace older and polluting diesel engines in buses and other equipment.
4. ***Idling controls*** – idling engines waste fuel and money and reducing idling reduces emissions.
5. ***Clean fuels*** – replace fossil fuels with cleaner fuels like biodiesel.
6. ***Transportation control measures*** – improve mobility to reduce congestion and emissions.
7. ***Indoor air filters*** – install filters in buildings to effectively reduce $PM_{2.5}$ levels.
8. ***Buffers and barriers*** – separate schools, residences and other places from highways and industry.
9. ***Enhanced compliance and enforcement of air quality rules*** – enforce stricter laws to reform polluters.
10. ***Enhanced ambient monitoring*** – document pollution problems to raise awareness and identify solutions

HEALTHY AIR STRATEGY 1: Point Source Controls

Point source controls reduce the amount of pollutants emitted by industry, such as power plants, refineries, coke and steel facilities, incinerators and manufacturing plants. This reduces air pollution at its sources - before it reaches nearby communities. This is particularly important for Detroit, given its extensive industrial activity, many old and relatively "dirty" facilities that lack modern emissions controls, and the large and vulnerable populations who live near to these facilities. **Point source controls** reduce emissions by using cleaner fuels and processes, or by using scrubbers, filters and other equipment that clean pollutants from the air before it leaves the source. Controls can also reduce "fugitive emissions" from open storage piles and handling and transport operations. *Point Source Controls* includes three recommendations summarized below: Please see Chapter 1 for the full set of activities and examples.

RECOMMENDATION 1-1: Improve emissions controls and monitoring at point sources.

Emissions controls reduce the quantity of pollutants emitted, while "stack" (or source) monitoring ensures that the controls are working properly. Both are needed to ensure effective control. (Source monitoring differs from ambient air quality monitoring, which is described in Strategy 10.)

Activities to support this recommendation include: disseminating information about point source controls that show facility impacts; coordinating efforts with current and upcoming SO_2 and O_3 non-attainment plans; promoting cooperation between City and State departments; using Michigan's Air Pollution Control Facility Tax Exemption and allowing permit violation fines to support emissions reduction efforts; and adopting more stringent state and local regulations.

RECOMMENDATION 1-2:
Require quantitative and qualitative health impact assessments (HIAs) and equity assessments when developing air quality management strategies.

These assessments improve understanding of the true impacts of point sources, beyond current compliance-oriented reviews that do not fully account for health impacts.

Examples of activities to promote the use of HIAs include: sharing information and educating residents and decision makers about health impact assessments; coordinating state agencies, community groups, academic partners and others in conducting these assessments; creating funding mechanisms to enable the Michigan Department of Environmental Quality (MDEQ) to include HIAs in decision-making and permit reviews; and developing, vetting and implementing HIAs conducted by MDEQ.

RECOMMENDATION 1-3:
Improve safety and awareness of industrial facilities and air emissions.

Upsets, malfunctions, fires, explosions, emergency releases, and other types of accidents can occur with public health impacts.

Strategies to achieve greater safety and awareness include: providing emergency response education and information and improving worker training; collaborating between industry, government, trade organizations and others to improve safety; providing tax incentives for participation in safety training programs and imposing stricter penalties for repeated safety violations; and banning open storage and material transfer processes and increasing safety inspections.

As noted earlier, this Executive Summary collapses CAPHE's recommendations and strategies. Please see Chapter 1 of the CAPHE Public Health Action Plan for full set of implementation activities and many examples that pertain to point source controls.

Open storage piles can be sources of air pollutants. Emissions of particulate matter (PM) can be reduced using fences and wind screens, but full enclosure is needed to control PM, volatile organic compounds and odors.

Focus On Sulfur Dioxide

Point source controls can fix long-standing SO_2 pollution problem in Detroit

Coal is used to produce electricity, steel, lime and cement in Detroit. Unfortunately, none of the industrial facilities in the Detroit area that use coal employ point source controls like scrubbers to reduce the sulfur dioxide (SO_2) emissions that results from burning coal and coke. As a result, portions of Detroit do not meet the SO_2 National Ambient Air Quality Standard (NAAQS). Figure 3 shows nine major sources (each emitting over 100 tons per year) that contribute to SO_2 pollution in Detroit. Many additional but smaller point sources in the area also emit SO_2. The figure also shows the SO_2 non-attainment zone designated by MDEQ, where the NAAQS is exceeded.

SO_2 concentrations extend across the city, and are not limited to just in the non-attainment zone. Figure 4 shows the pattern of peak concentrations, based on dispersion modeling.

Exposure to SO_2 significantly affects health, especially in southwest Detroit. Figure 5 shows the risk due to SO_2 as disability-adjusted life years or DALYs, a summary measure of the health impact. Children are most susceptible to adverse health effects of this pollutant. In Detroit and downriver cities, exposure to current levels of SO_2 each year causes:

- 67 hospitalizations among children and adults for asthma and chronic obstructive pulmonary disease
- 95 to 110 visits of children to the emergency department for asthma attacks
- 6,100 to 26,000 cases of asthma exacerbation (repeated cough, inhaler use, etc.) among children, many of which result in school absences.

The adverse health impacts from SO_2 are preventable. Point source controls should be applied to reduce SO_2 emissions at the major point sources, and also at smaller sources that are close to neighborhoods.

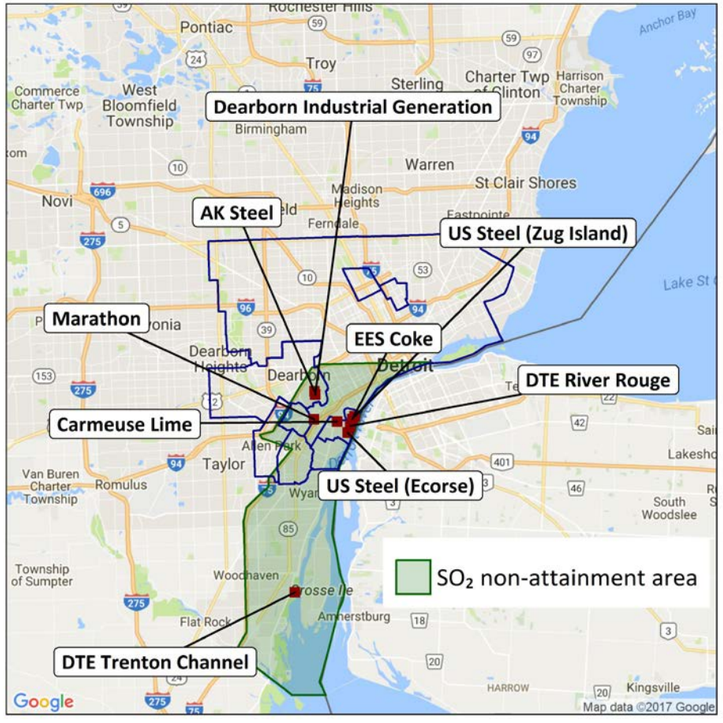


FIGURE 3. *Boundaries of the SO_2 non-attainment area, and locations of major point sources of SO_2.*

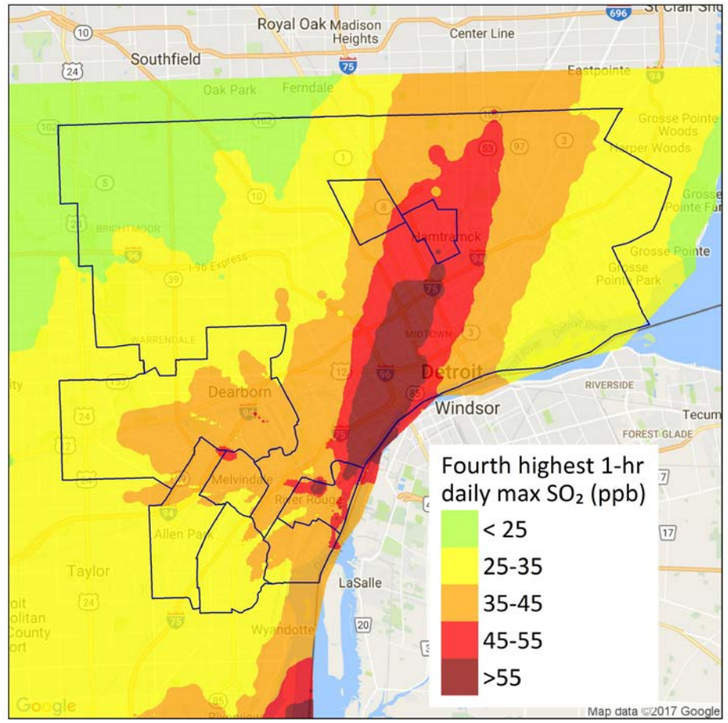


FIGURE 4. *4th highest 1-hr SO_2 concentrations in Detroit area based on dispersion modeling.*

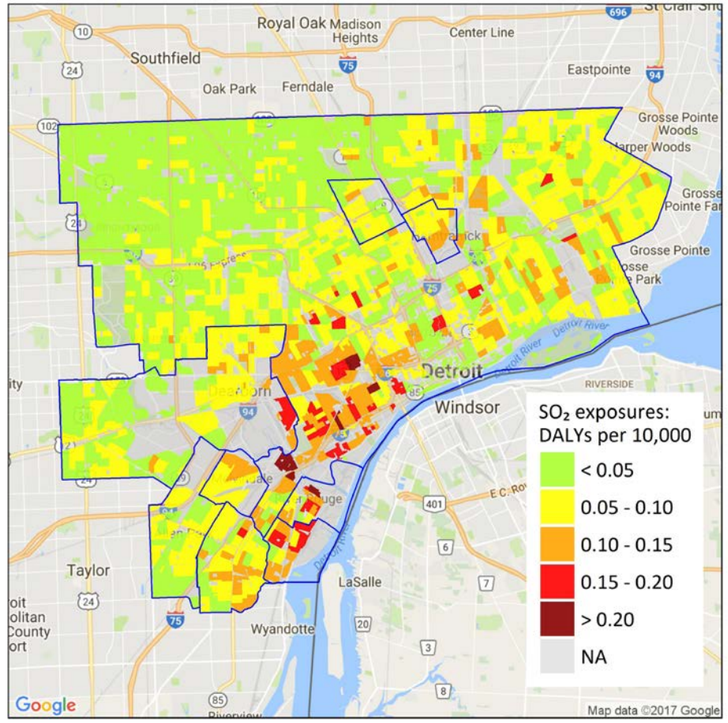


FIGURE 5. *Health risk due to current levels of SO_2 in disability-adjusted life years (DALYs) per 10,000 residents.*

View of Southwest Detroit showing trucking and industrial facilities adjacent to residential areas.

HEALTHY AIR STRATEGY 2: Renewable Energy

Renewable energy sources like solar, wind, geothermal, biomass[8], and hydropower energy have low emissions and low environmental impacts.[9] These sources can replace the energy and reduce the emissions associated with coal, petroleum and other fossil fuels.[10] Renewable energy, especially wind and solar power, can transform the energy and physical landscape in Detroit and promote economic revitalization. Renewable Energy includes two recommendations summarized below. Please see Chapter 2 for the full set of activities and examples.

RECOMMENDATION 2-1: Increase the use of renewable energy sources and transition away from polluting sources.

Strategies to increase renewable energy include: launching a public awareness campaign and joining national campaigns that promote renewable energy; creating consumer education programs; promoting consumer owned electricity generation through energy co-ops; creating partnerships that develop local source of renewable energy; using existing renewable energy incentive and funding programs; and encouraging the City of Detroit to set aggressive renewable energy goals and to remove regulatory and financial barriers to renewable energy.

RECOMMENDATION 2-2: Use renewable energy and green and sustainable practices for new and renovated buildings and infrastructure.

Buildings make large energy demands for heating, cooling and lighting, but they also present great opportunities to generate a large fraction of energy they use.

Strategies to encourage more efficient buildings include: conducting outreach and education on the economic and health benefits of renewable and green construction practices; creating partnerships and collaborations that expand use of renewable energy practices in new design and renovations; using federal, state and local incentive and funding programs to promote use of renewable energy; requiring or incentivizing all City-owned facilities and construction to implement green practices; and adopting a "Green Building Ordinance."

HEALTHY AIR STRATEGY 3: Diesel Engine Retrofits

Retrofitting old diesel engines with effective emission controls and replacing old diesel engines can significantly reduce pollution. Emissions of pollutants including diesel exhaust $PM_{2.5}$, a cancer-causing pollutant, are greatly lowered by new technologies like oxidative catalysts and diesel particulate traps – technologies entirely lacking on diesel

engines in buses and trucks built before 2007. Retrofits can be used on trucks, school buses, construction vehicles (e.g. dump trucks, cranes), diesel-powered equipment (e.g. generators, pumps), ships and trains. Retrofits would particularly benefit the residents living near busy roads, children riding school buses (70% of DPS's bus fleet is diesel[11]), and truck drivers. The *Diesel Engine Retrofit* recommendation is summarized below. Please see Chapter 3 for the full set of activities and examples.

RECOMMENDATION 3-1:
Expand diesel retrofit and fleet and engine replacement efforts.

Strategies to promote diesel engine retrofits include: creating education and outreach materials for truck owner/operators, trucking businesses, industrial facilities and construction companies that explain why and how to reduce diesel emissions; developing regional and state level partnerships with the Michigan Department of Environmental Quality, Michigan Department of Transportation, U.S. EPA SmartWay Transport, Southeast Michigan Council of Governments, city governments and others to promote current programs, advocate for additional funding, and develop new initiatives; using federal and state funds for retrofit and replacement programs, including the VW settlement funds; increasing the state match for Diesel Emission Reduction Act funds to obtain additional federal-level incentive funding; and enacting a state law requiring heavy duty vehicles contracted in Michigan using governmental funds to be equipped with modern pollution control devices.

HEALTHY AIR STRATEGY 4: Idling Controls

Idling controls reduce emissions by turning off the engine when a vehicle is not in motion. This is accomplished using anti-idling technology, and by operator compliance with policies and ordinances. Given the amount of time idling occurs, idling controls are especially important for truck drivers, residents living near freeways, customs plazas, bridges and intermodal facilities, and children waiting for school buses. *Idling Controls* includes three recommendations summarized below. Please see Chapter 4 for the full set of activities and examples.

RECOMMENDATION 4-1:
Increase awareness of existing anti-idling efforts through an education and outreach campaign.

Actions relevant to this recommendation include: creating and implementing an integrated city-wide education and outreach campaign to build awareness and commitment to anti-idling efforts; posting anti-idling signs in idling "hot spots" and increasing anti-idling signage in these areas; supporting and coordinating activities among organizations working on anti-idling campaigns in Detroit; and using the U.S. Department of Energy's Idle Box Toolkit.

The Dequindre Cut is a below grade pathway in the east-side of Detroit that provides safe and healthy options for walking and cycling.

RECOMMENDATION 4-2:
Increase enforcement of existing anti-idling ordinances.

Enforcement of ordinances is necessary to attain anti-idling goals. Relevant activities include: providing outreach and education to the Detroit Police Department; organizing and conducting community surveys that identify idling hotspots, working with nearby cities and other organizations to pass anti-idling ordinances; and partnering with other organizations to develop state-level anti-idling restrictions.

RECOMMENDATION 4-3:
Encourage and incentivize trucking, delivery and bus companies and their drivers to minimize idling.

Many actions can help promote companies, schools and drivers to minimize their idling, including: using the EPA's outreach materials to increase awareness of SmartWay Partnerships among trucking companies and drivers; at Detroit schools, increase awareness among school officials, bus drivers, and parents and create no-car zones to reduce exposures during school pick-up and drop-off periods; partnering with industry, trucking unions, and transit to create new and innovative models to reduce idling; providing drivers' lounges at terminals and idling hotspots; and using automated management systems at custom stations at border crossings to facilitate traffic flow and minimize backups.

HEALTHY AIR STRATEGY 5: Clean Fuels

Clean fuels can replace conventional fuels (e.g., gasoline and diesel) in cars, trucks, construction equipment, and other motorized vehicles and portable equipment such as generators, lawn mowers and leaf blowers. **Clean fuels include most types of ethanol, biodiesel, natural gas, biogas, electricity, propane and hydrogen. These fuels produce less pollution throughout their life cycle (from production through use and disposal) than conventional petroleum fuels like gasoline and diesel.** Some clean fuels can be substituted directly; others require special equipment or retrofits. *Clean Fuels* includes two recommendations summarized below. Please see Chapter 5 for the full set of activities and examples.

RECOMMENDATION 5-1:
Increase use of the clean fuels best suited for Detroit and Michigan by (1) increasing use of clean fuels in vehicles (e.g., cars, buses, trucks, ships), construction equipment and industry; (2) converting transit vehicles operated by DDOT, SMART, QLINE and schools to clean fuels; and (3) improving the electric vehicle and clean fuels infrastructure.

Selected activities to implement this recommendation include: creating education and outreach programs to inform industry, small businesses, municipalities and citizens about clean fuel benefits; developing and implementing incentive programs to encourage use of zero-emission vehicles; incentivizing companies to operate clean fuel vehicles and equipment in Detroit's contracting and Request for Proposal system; creating tax incentives for individuals, businesses and truck fleet owners to use clean fuels; utilizing state and federal grants to support clean fuels and fleet upgrades; and requiring the use of clean fuels and/or fuel-efficient vehicles in all City contracts.

RECOMMENDATION 5-2:
Increase local production of second generation clean fuels, particularly advanced biofuels and biodiesel from waste oil.

Locally-produced clean fuels can help reduce emissions associated with transporting fuels, increase availability of clean fuels, provide employment, positively impact the local economy, and recycle waste materials. Local production facilities should utilize second generation biofuels (made from feedstocks

Clean fuels can replace conventional fuels (e.g., gasoline and diesel) in cars, trucks, construction equipment, other motorized vehicles and portable equipment, such as generators, lawn mowers and leaf blowers.

other than food crops), employ equipment and practices that minimize pollutant emissions, be sited appropriately, and produce high quality fuel with minimal emissions and odor.

Activities to increase biofuel production include: partnering between local educational institutions and the City of Detroit to develop educational programs, courses, workshops, and certificates in clean fuel production; creating biodiesel cooperatives to facilitate waste grease pick-up and biofuel production; using available incentive and funding mechanisms to build infrastructure and capacity; and revising regulations to make local production more feasible and economically and environmentally sustainable.

HEALTHY AIR STRATEGY 6: Transportation Control Measures

Transit and transportation control measures (TCMs) reduce vehicle-miles-travelled, make travel more efficient by managing and improving the transportation system, and encourage non-motorized alternatives. Steps include expanding public transit, facilitating traffic flow, and improving capacity of existing roads to reduce congestion.[12] TCMs in the Detroit should receive increased attention in the near future due to the likely designation of O_3 non-attainment in the Detroit area, and because O_3 strategies require a regional effort. Transportation Control Measures includes three recommendations summarized below. Please see Chapter 6 for the full set of activities and examples.

RECOMMENDATION 6-1:
Increase public transit ridership by improving regional transit systems and incentivizing their use across southeast Michigan.

Selected activities to promote ridership include: creating outreach to encourage Detroit and nearby communities to create a better integrated and more efficient regional public transit system; encouraging residents to use the public transportation system; providing free internet wireless on buses; releasing public transit data to the public that enables third-party developers to create commercial and social good products; using incentives to increase ridership on public transit like "fare-free" days each month; and integrating transit plans and promoting a regional public transit system.

RECOMMENDATION 6-2:
Encourage higher vehicle occupancy, increase existing road capacity where needed, and improve traffic flow.

Achieving this recommendation will require a

In 2015 AK Steel agreed to install air filters in the Salina Elementary and Salina Intermediate Schools as part of their negotiated Supplemental Environmental Project (SEP).

diversity of actions, and suggestions include: creating and distributing a 'best practices' handbook of employer-based commuter incentive programs to increase awareness of potential options; creating educational materials and outreach to residents interested in improving health and reducing air pollution; coordinating with the Michigan Department of Transportation to implement high occupancy vehicle (HOV) and high occupancy toll (HOT) lanes; encouraging companies to offer incentives for alternative transit; and creating a citywide alternative commuter incentive program.

RECOMMENDATION 6-3:
Encourage active transit (walking and cycling) and mixed-use ("20-minute") neighborhoods by improving planning and the built environment.

Some actions to encourage active transit include: conducting education and outreach to community residents and local decision makers to understand the need for, and the benefits of, public transportation, biking, and walking; using the "complete streets" design principles that combine TCMs, "smart growth" strategies, and design elements like road diets, refuge islands and curb extensions; developing multi-modal transportation systems that increase transportation options and create incentives for using alternative transit forms, including cycling, walking and public transit; creating a coordinated transportation improvement program partnership between Michigan Department of Transportation, Detroit Department of Transportation, Detroit Planning Commission, Southeast Michigan Council of Governments, the City of Detroit and others; and reallocating federal transportation funding for non-highway projects.

HEALTHY AIR STRATEGY 7: Indoor Air Filters

Air filters or purifiers in buildings remove particulate air pollutants, including $PM_{2.5}$, dust, small particles, pollen, allergens, animal dander, and fibers. Enhanced filters are much more effective than standard furnace filters and can be installed in a building's heating, ventilating and air conditioning (HVAC) system; filters are also available as stand-alone (free-standing) units. Some filters can remove gases such as SO_2 and volatile organic compounds, though these are uncommon and expensive. When designed and used appropriately, air filters can be economical and effective, especially since people spend most of their time indoors[13] and since filters reduce exposure to both indoor sources of air pollution (e.g., cooking, smoking, vacuuming) and outdoor pollution. *Indoor Air Filters* includes two recommendations summarized below. Please see Chapter 7 for the full set of activities and examples.

Enhanced filters are much more effective than standard furnace filters and can be installed in a building's heating, ventilating and air conditioning (HVAC) system; filters are also available as stand-alone units.

RECOMMENDATION 7-1:
Install, use and maintain enhanced filters in schools.

Schools are especially important since children represent a vulnerable population, many schools are near major roads, and filters can be easily and inexpensively installed in most schools' HVAC systems.

Activities to help schools use enhanced filters, especially schools located near major roads and industry, include: using a city-wide campaign to increase awareness about filter use and the linkage to academic achievement; creating school-community partnerships to coordinate air-quality improvement efforts; developing incentive programs to encourage appropriate

filter use and change-out (e.g., quarterly); and enacting laws and policies requiring filters and preventative maintenance in schools.

RECOMMENDATION 7-2:
Use filters in homes and businesses.

Activities to encourage residents and businesses to use filters include: promoting use of filters in homes and businesses through programs conducted by community organizations, city-wide campaign, telephone hotline or website; supporting and coordinating with current programming like Michigan's Weatherization Assistance Program, the Green and Healthy Homes Initiative, and Wayne Children's Healthcare Access Program; providing tax deductions for filters as a medical expense (e.g., reductions in asthma symptoms and hospitalization); creating tax credit exemptions for energy efficient and green buildings with enhanced filters; and requiring enhanced filters in public housing.

HEALTHY AIR STRATEGY 8: Buffers and Barriers

Buffers and barriers are setbacks, strips of land, vegetation and physical barriers (such as sound walls) that are located between sources of pollution (such as heavily trafficked roadways and industrial emissions sources) and sensitive land uses (such as residential areas, schools, day care centers, health care facilities and areas with high level of cumulative risk). Buffers reduce exposure to pollutants by absorbing, blocking or diluting some of the pollution, thus lowering concentrations. Buffers can help to reduce concentrations of O_3, PM, NO_X, SO_2, and CO,[14] especially at residences and schools near highways or industrial facilities. Buffers also can have important co-benefits, providing opportunities to improve surface water management, form linear parks with walking and bicycling paths, and reduce noise levels. *Buffers and Barriers* includes three recommendations summarized below. Please see Chapter 8 for the full set of activities and examples.

RECOMMENDATION 8-1:
Adopt regulations to create consistent and appropriate minimum setbacks between sensitive land uses and pollution sources.

Activities to promote adoption of setback regulations include: increasing knowledge and awareness of the benefits of buffers and setbacks around pollution sources; incorporating buffers in Community Benefits Agreements related to point or mobile pollution sources; forming partnerships between Detroit-based groups working to reduce air pollution to promote buffers; and using tax credits, financial incentives, incentive zoning and density bonuses to encourage developers to use buffers.

RECOMMENDATION 8-2:
Plant vegetative buffers and/or install sound walls where current minimum setbacks are not met.

Selected activities to implement this recommendation include: increasing knowledge and awareness of the benefits of vegetative buffers and sound walls; using CAPHE's *Vegetative Buffer Guide* for tree planting information; partnering with groups currently working with buffers; coordinating with the Michigan Department of Transportation to encourage use of vegetative buffers along major roads; using tax deferrals, tax credits and development incentive programs to create revenue for buffers; and requiring buffers between pollution emitting sources and sensitive land uses in the City of Detroit zoning code.

RECOMMENDATION 8-3:
Increase tree canopy throughout the City of Detroit.

Selected implementation activities include: increasing knowledge and awareness about the role of trees in absorbing pollutants; identifying high priority areas where trees would be most beneficial; engaging Detroit residents, schools, businesses and policy makers in tree planting efforts; using local and state funding sources to support planting trees; and integrating tree

Allen Park air quality monitoring site.

plant programs into a comprehensive open space plan.

HEALTHY AIR STRATEGY 9: Enhanced Compliance and Enforcement of Air Quality Rules

Federal, state and regional and local regulations play critical roles in air quality management. Most notably, these include: MDEQ's construction and operating permits that may include limits on emissions and requirements on the facility, process, fuel and/or feedstock to limit emissions and comply with ambient air quality standards and guidelines; reporting, disclosure and emergency planning requirements; and MDEQ's inspection, monitoring, analysis, and assistance programs. *Enhanced Compliance and Enforcement* includes three recommendations summarized below. Please see Chapter 9 for the full set of activities and examples.

RECOMMENDATION 9-1:

Increase the coverage, transparency, timeliness and stringency of facility inspections and enforcement activities, and assure compliance with existing permits and regulations.

This recommendation has many elements. Examples include: improving emissions inventory data and providing enhanced publically available databases; coordinating among MDEQ, the Michigan Attorney General's Office, and the US Department of Justice to provide annual reports/updates for the public regarding compliance and enforcement activities; increasing the capacity of and funding for MDEQ by revising Act 451, increasing funds through state budget, increasing fees for Renewable Operating Permits (ROPs), and instituting fees for Permit to Install applications; increasing fines; establishing priorities for inspection programs that focus on areas of high environmental burden or cumulative health impacts; setting goals for timely enforcement; and tracking actions related to compliance and enforcement on an expanded website.

RECOMMENDATION 9-2:

Require the use of qualitative and quantitative health impact assessments (HIAs) and cumulative impact assessments as part of the air quality management process, including enforcement actions, SIP development, and permitting.

HIAs are important because they refocus air quality management activities from being compliance-oriented to health-oriented. HIAs provide a more comprehensive and realistic assessment of health impacts than the screening approaches currently used by MDEQ, e.g., they better account for vulnerability and susceptibility factors described earlier.

Selected actions here, mostly addressed to MDEQ, include: educating MDEQ personnel and other stakeholders on the development and use of HIAs; coordinating across state agencies, non-governmental organizations, community groups, and potentially academic partners for the effective use of HIAs in air quality management; exploring opportunities to reduce costs; partnering with MDHHS, local health departments, SEMCOG, the Centers for Disease Control and Prevention (CDC), and EPA; and developing vetting and implementing a HIA program to assess health, vulnerability, susceptibility and inequality impacts across the air quality program.

Mobile and transportable air quality monitoring can provide opportunities to increase spatial coverage, provide mapping, increase the monitored parameters, and respond to possible hot-spots and community concerns.

RECOMMENDATION 9-3:
Increase public input in air quality management, including the development of regulations, permitting, and enforcement activities.

Actions to increase public input and engagement include: publicizing MDEQ's toll-free telephone number (800-662-9278), website and other mechanisms to report air pollution problems; creating opportunities for ongoing and bi-directional communication with representatives from affected communities; partnering between MDEQ, community and non-governmental organizations in affected areas; adopting policies that more heavily weight community feedback, health impacts and cumulative impacts in air quality management decisions; providing earlier notice of pending actions; and using evaluation tools and on-going improvement processes to improve public participation.

HEALTHY AIR STRATEGY 10: Enhanced Air Quality Monitoring

Air quality monitoring measures the concentration of pollutants in outdoor air in order to understand concentrations, exposures and health impacts. In addition, air quality monitoring determines compliance with ambient air quality standards, and monitoring can help identify culpable (or contributing) emission sources that require mitigation. Monitoring forms an essential element of air quality management, and provides the best data for community members to know what is in the air they breathe as well as track trends, assess the adequacy of controls, and evaluate the performance of the overall air quality management strategy. The Michigan Department of Environmental Quality (MDEQ) conducts most of the monitoring in the Detroit area, although several monitoring sites are operated by Marathon and other industries. The recent emergence of low cost air quality monitors provides opportunities for communities to actively monitor air quality themselves. *Enhanced Air Quality Monitoring* includes three recommendations summarized below. Please see Chapter 10 for the full set of activities and examples.

RECOMMENDATION 10-1:
Increase the number of monitoring sites, and utilize mobile and transportable monitors.

Currently, most monitoring is performed at permanent sites; mobile and transportable monitors provide opportunities to increase spatial coverage, provide mapping, increase the monitored parameters, and respond to possible "hot-spots" and community concerns.

Selected activities to help implement this recommendation include: creating educational opportunities for communities to learn about air monitoring technologies and monitoring sites; providing more opportunities for public engagement on air quality monitoring siting decisions by MDEQ; encouraging MDEQ and industry to collaborate and expand monitoring networks; expanding industry-operated monitoring to include fence-line, real-time, and multi-pollutant monitoring; expanding monitoring requirements as part of permit conditions; maintaining and ideally expanding financing of MDEQ's air quality monitoring program in Detroit.

RECOMMENDATION 10-2:
Identify and implement targeted air quality monitoring projects

Targeted projects are needed to investigate exposures, air quality trends, health risks, pollutant hot-spots, fugitive emissions, source apportionment, monitoring system adequacy, efficacy of controls, epidemiology, health impact analyses, health interventions, and/or other public health concerns.

Currently, air quality monitoring and data analyses performed by MDEQ are primarily oriented toward assuring compliance with standards and evaluating trends. These should continue. This recommendation call for, in addition, targeted air quality monitoring projects that address public health and community concerns. Two key and topical examples include traffic-related air pollutants, especially diesel exhaust, associated with the new international bridge crossing and freeway expansions (I-75 and I-94), and lead and asbestos exposures from Detroit's large scale demolition program, which has an unprecedented target of 5,000 buildings in 2017 alone.

The recommended targeted strategies can be supported by: creating a structured and scientifically-sound process with public engagement to identify and prioritize potential focal projects; incorporating advisory boards or steering committees that include the public, researchers, industry and government representatives; involving city, county, state and national organizations as well as community-based organizations, universities, industry and labor in monitoring and interpreting the targeted projects; and obtaining support for monitoring projects from government, foundations, and industry.

RECOMMENDATION 10-3:
Increase public engagement with air quality monitoring activities.

Selected activities to increase public engagement include: creating educational materials and workshops to share information about the need for and use of air quality monitoring (e.g., explaining how monitoring works and interpreting monitoring results); creating meaningful, bi-directional, and open communication between residents, community-based organizations, industry and regulators; increasing collaborations among regulatory agencies, community residents and organizations to build capacity and to enhance the quality and relevance of air quality monitoring data; and enhancing access to an understanding of monitoring data.

AN ONGOING PROCESS

Challenges and Opportunities

Multiple social, economic and political factors will affect progress towards CAPHE's recommendations to improve air quality and public health. The new administration in Washington has removed the Clean Power Plan rules that would have accelerated the shuttering of polluting coal-fired power plants, including several facilities that affect air quality in Detroit. The U.S. Environmental Protection Agency is facing substantial cuts in funding which, if realized, will adversely impact enforcement of the Clean Air Act, air quality monitoring programs, some MDEQ programs, and other important air quality activities. In November 2016, a proposal for a Regional Transit Authority was voted down by two of the four participating counties in southeast Michigan, delaying the coordination and expansion of transit options. Freeway and bridge expansion are proceeding without updated environmental impact assessments and with restricted public engagement. Disparities in health, housing, education and economics in Detroit, while evolving, remain very troubling for the majority of Detroit residents. Finally, air quality management has elements that are technical, complex and possibly obscure to many, creating challenges to effective public participation.

Despite these challenges, there have been positive developments that support efforts to improve air quality in the City of Detroit. The recent settlement with Volkswagen for violations of emissions controls in their vehicles will bring a substantial infusion of funds to Michigan, which should be used to mitigate diesel exhaust emissions. Environmental activities in the City of Detroit, with its new Office of Sustainability, and in the State of Michigan are receiving greater attention from government and increased visibility in the media due, in part, to the Flint disaster. Downtown and midtown areas of Detroit are undergoing a resurgence, with new developments and an increase in population. The nearly complete M1-rail project along a portion of Woodward Avenue will demonstrate transit's potential. These and other existing initiatives can improve air quality and public health, and build momentum toward the longer-range goal of a more sustainable and healthier Detroit.

Development of the *CAPHE Public Health Action Plan* has brought together an influential group of organizations committed to improving air quality. Continued education and outreach efforts by this group and others will increase public engagement and expand knowledge of the substantial health concerns associated with air pollution in Detroit, as well as practical and feasible actions that can be taken to improve air quality and health in the Detroit area. **Thus, the *CAPHE Public Health Action Plan* can help accelerate the transition to a cleaner and healthier Detroit.**

Next Steps

Following the launch of the *Public Health Action Plan* in 2017, CAPHE will work to support and encourage implementation of recommendations included in the plan. Many of these will be undertaken with leadership from a strong and committed core of Detroit- and Michigan-based organizations working to improve air quality and public health. Support from the CAPHE team for these activities will include:

Community meetings, town halls, and forums to share recommendations included in the *CAPHE Public Health Action Plan*.

These forums will bring together community organizations, institutions, and residents to share information about air pollution emissions, exposures, adverse health effects, and elements of the Public Health Action Plan. These forums will promote environmental health literacy, increase capacity to improve air quality and reduce adverse health effects, and encourage dialogue and coordinated action among community groups and institutions to promote improved air quality and public health.

Zug Island is a heavily industrialized island bordering Detroit with extensive air pollution sources, due to iron, steel and coke production.

Policy Advocacy Trainings.

CAPHE will be working with community groups and organizations to sponsor a series of community trainings designed to strengthen capacity of community organizations and residents to engage effectively with administrative and elected decision makers to promote clean air and public health. These trainings, which will be held in 2017 and 2018, will focus on improving effective engagement of community residents and organizations in decision making processes related to air quality. These trainings will incorporate a focus on policy recommendations included in the CAPHE Public Health Action Plan, including local (e.g. municipal), regional, state and federal level policies.

Youth Engagement and Capacity Building.

With leadership from CAPHE partner Detroit Hispanic Development Corporation, youth will be actively engaged in implementation of components of the *CAPHE Public Health Action Plan*, including raising awareness about air pollutants in the city, their implications for public health, and actions that can be taken to address these issues. A major objective of this effort is to strengthen capacity among local youth to be actively engaged in decisions that affect the environment and public health in Detroit.

Mini Grant Program.

CAPHE will implement a mini-grant program in 2017 and 2018 that will provide financial support for actions undertaken by Detroit residents and community groups that are consistent with recommendations included in the *CAPHE Public Health Action Plan*. Many of the recommendations included in the plan are actions that can be taken by local actors, and the mini-grants are designed to provide support for such actions. Examples include planting vegetative buffers between residential areas and heavily trafficked roadways, developing anti-idling campaigns, or installing filters in schools in areas with high levels of ambient air pollutants. The competitive mini-grant program will be launched in May 2017. Application materials, review criteria, and timeline are available on the CAPHE website at www.caphedetroit.sph.umich.edu.

Continued Partnership to Support Action.

CAPHE and its member organizations will continue to be actively engaged in ongoing efforts in Detroit and Michigan, including the Detroit Environmental Agenda, the Michigan Environmental Justice Coalition, MI Air MI Health, and other efforts to promote clean air, with a particular focus on vulnerable populations who experience high levels of exposure.

Resources to Support Action.

There are a number of resources available on the *CAPHE website* to support action to implement the recommendations included in the CAPHE Public Health Action Plan. These include: *Fact Sheets* about air pollutants and their impacts on health in Detroit; information about *Indoor Air Filters;* a *Vegetative Buffer Guide* that provides tips for designing and planting vegetative buffers; a *Buffer Audit* that evaluates state and local laws related to creation of buffers in Detroit; links to resources such as *EPA's AirNow,* providing up to date information about air quality across the state; and other resources for understanding air pollution in the Detroit metropolitan area and for reducing exposures and their adverse health effects. Please check the website regularly, as it is continuously updated with new materials.

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1 Point Source Controls

Point sources are industries, factories, and other facilities that emit air pollutants. Point sources in Detroit include power plants, incinerators, refineries, coke ovens, steel mills, waste water treatment plants, and vehicle assembly plants, among others. These sources emit a significant amount of criteria and toxic air pollutants (*See CAPHE Resource Manual Section 5).* Point source controls reduce air pollution before it reaches surrounding communities. Point source controls are especially important in Detroit for several reasons: (1) the number and size of pollutant sources in Detroit; (2) nearby densely populated neighborhoods; and (3) the age and characteristics of many industrial sources. Detroit contains many older facilities that do not utilize modern pollution controls. As examples, the Trenton Channel coal-fired power plant (originally built in 1924 and pictured in Figure 1) uses coal-fired boilers that date from 1950 and 1968; iron and steel making started on Zug Island in 1901; and present-day Carmeuse Lime, United States Steel Corporation, AK Steel and many other point sources utilize facilities that are decades old. In general, the applicable federal and state air quality emissions regulations that these facilities must uphold are ones issued at the time the facility was constructed. Air quality regulations, standards and control technologies have evolved over time with the effect of significantly lowering emission rates. Thus, many of the older facilities in Detroit would not meet current emission requirements. (This is called being "grandfathered" out of new requirements.)

FIGURE 1. *Example of point source: Trenton Channel Power Plant located at 4695 Jefferson Ave., W Trenton. This is a major source (greater than 100 tons/year) of SO 2 , NO x and PM 2.5 . From RACT Analysis SIP and Google Earth.*

Another type of emission source are the building demolitions occurring in Detroit as blight removal. These old buildings contain lead-based paint, and many also contain asbestos. The demolition and subsequent removal (load-out) of building materials can release so-called "fugitive" dust containing lead and asbestos, two hazardous air pollutants that can cause exposure and contaminate nearby areas. The magnitude of the demolition program in Detroit is unique: the City contains approximately 80,000 vacant buildings in very poor shape; the Detroit Land Bank has demolished approximately 3,000 buildings per year over the past several years; and the City plans to scale up the program to approximately 10,000 buildings per year. The Land Bank uses a protocol to minimize lead, asbestos and dust generation, and a task force is reviewing and improving the protocols. Some aspects of demolitions come under safety and air quality laws, e.g., asbestos removals are monitored and regulated by EPA and MDEQ. However, the magnitude of the program, the difficulty of controlling dust emissions, the proximity of demolitions to occupied buildings, and the toxicity of lead and asbestos exposure warrant continued and potentially enhanced monitoring, inspections and controls to minimize exposure and adverse health impacts.

Point source controls either (1) reduce the quantity of pollutants generated at the facility (called "pollution prevention" controls), or (2) reduce the quantity of pollutants emitted using emission control technology (called "end of pipe" controls). The controls appropriate for a facility depend on many factors, including the types and amounts of pollutants to be controlled, the processes used at the facility, its size, available space for control equipment, and regulatory requirements. Point source controls can reduce emissions of specific pollutants, such as SO_2, NO_x, VOCs, and particulate matter (PM, $PM_{2.5}$), and some controls can reduce or may affect multiple pollutants. Thus, it is generally best to consider the entire process or facility when selecting controls. While comprehensive evaluations are not required under current legal requirements, they would benefit sustainability and public health assessments.

Emission controls for gas phase pollutants include fuel switching, burner modification, absorption, adsorption, condensation, and combustion processes. Controls for particulate matter (PM) include cyclones, wet and dry scrubbers, filters (baghouses), and electrostatic precipitators. As mentioned, some controls can remove several pollutants simultaneously, for example, wet scrubbers can remove some gases and PM, and advanced catalytic filters with lime and carbon injection can remove SO_2, NO_x, PM, and mercury simultaneously. Site-specific information and applicable state and federal air

quality rules and regulations will affect which controls are necessary and feasible at a facility *(See CAPHE Resource Manual Section 5).*

Monitoring at point sources is used to: (1) measure emission rates; (2) verify that emission controls are working properly; and (3) ensure that emissions are within permit limits. Monitoring of some pollutants (or pollutant surrogates like opacity) is required for some point sources, typically the larger sources. For example, large coal-fired furnaces and boilers may be required to continuously monitor SO_2, NO_x, CO, opacity (related to $PM_{2.5}$), and mercury. Monitoring may be required in the permit, and exceeding permit conditions (based on monitoring data) may result in an air quality violation *(See CAPHE Resource Manual Section 4).*

PSC RECOMMENDATION 1: Improve emissions controls and emissions monitoring at point sources.

1.1.1 Education and Outreach

Communicating information about the many strategies that can be used to reduce emissions from point sources and the monitoring approaches that are used to document emissions and the effectiveness of point source controls can build public support for policy strategies. This information, along with information about the public health impacts of air pollution from point sources, should be shared with local and state officials, industry, and the public. Recommendations related to education and outreach for improving emissions controls and emissions monitoring include:

- Create a public education and outreach campaign to increase public awareness and understanding of the following: air quality regulations, the health effects of various pollutants, and the benefits of emission controls.
- Create hotlines to report air quality problems.
- Create and disseminate educational materials describing emissions controls to inform residents and decision makers about their benefits. (e.g., improvement of air quality (including criteria and toxic pollutants), reduction of illness and deaths, environmental benefits, and climate benefits (reductions in carbon emissions and climate change mitigation).
- Share information with industry, businesses, the City of Detroit, and the public about the rationale for emissions controls at specific facilities, and how to select, install, and use point source controls. This recommendation extends those preceding to address specific facilities or permits, providing information that describes the affected area (footprint), health and environmental effects of emissions, environmental justice concerns, and the cost effectiveness of controls. This information should be developed for the entire facility as well as the specific action or permit under consideration, utilize health impact assessment and environmental justice analyses noted in Recommendation 1.2, and be made available when an action is proposed.

Many pollution control measures can create jobs and investment. These economic benefits should be centered in the local community.

Many pollution control measures can create jobs and investment. These economic benefits should be centered in the local community. One way to maximize local benefits would be to establish an emissions control job training program in Detroit to provide high school and community college students with training in air pollution and the theory and practice of emission controls. Organizations in Detroit already providing "green" jobs training programs:

- Green Door Initiative's programs include workforce development that includes comprehensive job training for the green economy.[1]
- Focus HOPE[2,3] has operated a jobs training program since 1981 that includes a variety of training focus areas.
- Detroit Green Jobs Partnership, which involves Detroiters Working for Environmental Justice (DWEJ), the Detroit Regional Workforce Fund, and Wayne County Community College, has developed a training program on hazardous-substances.[4]

Michigan Department of Environmental Quality, and specifically, its Detroit district office, should expand its training and outreach programs to educate industry, policy makers, CBOs, and other local stakeholders on enforcement of the state's emissions control requirements. MDEQ has presentations on enforcement and other topics available on their web site; these (and others) might be updated and presented periodically (possibly using webinars) to targeted groups (e.g., industry, community organizations), possibly addressing specific topics.

Outreach to Detroit residents about energy-reducing options could lower emissions from coal-fired power plants. Easy to implement options include: replacing incandescent lamps with LEDs and compact fluorescent lamps (CFL); promoting alternatives to conventional air conditioning; encouraging the purchase of energy efficient appliances; and improving insulation in buildings. (Note that LEDs are preferred to CFLs as they do not contain mercury and are more efficient.) Outreach could take many forms, including providing information to residents and apartment managers and distributing energy efficiency kits. For example, an organization called Greenlight New Orleans in Louisiana distributes and installs CFLs to households and trains residents on energy efficient practices.[5] Michigan has several programs to promote residential energy efficiency.[6] Act 295, passed in 2008, requires energy utilities to provide energy-savings programs to customers. Information about services and grants available to consumers from their local utility can be found at: http://energy.gov/eere/femp/energy-incentive-programs-michigan.[7] Educational and outreach efforts could promote these existing programs.

1.1.2 Support and Coordination

Organizations concerned with emissions, air quality, health and point sources include governmental agencies (e.g., MDEQ, the Michigan Department of Health and Human Services, and the City of Detroit Health Department), universities, and non-profit and professional organizations (e.g. Sierra Club, American Lung Association, Zero Waste Detroit, DWEJ, and the Air & Waste Management Association). In addition, many industries have programs designed to reduce emissions, decrease air quality impacts, address community concerns, and promote sustainability and product stewardship.

Several recent actions provide some opportunity to promote and coordinate activities that can help to promote the installation and use of point source controls.

- The designation of portions of Detroit as non-attainment for SO_2 has focused attention on coal-fired utilities, steel making, coke facilities, cement and lime facilities. The proposed State Implementation Plan (SIP) for SO_2 calls for modest reductions in SO_2 emissions from these facilities.

- The pending designation of the seven counties in southeast Michigan as non-attainment for ozone will focus attention on NO_x and VOC emissions. Large point sources are major sources of NO_x, and no Detroit source is known to utilize advanced NO_x controls (e.g., selective catalytic reduction technology). Thus, the development of a SIP for O_3 will provide an opportunity to obtain NO_x reductions from point sources.
- Several point sources in Detroit have had numerous complaints and violations of air quality rules and some have been or are the focus of lawsuits, including the Detroit Renewable Power, US Steel, AK Steel, and Marathon Refinery, among others.
- EPA and MDEQ can require additional emission controls and monitoring at industrial facilities under current laws and rules where applicable. For example, fence line monitoring of benzene and other contaminants, and increased monitoring of flare efficiency are now required at refineries, and Marathon now monitors these contaminants at several monitoring sites.[8] It may be possible to strengthen and apply such requirements at other facilities.
- Attention and coordination with industrial facilities, including Marathon, EES Coke and others, on the elimination of flares and the improvement of flare efficiency should continue.
- The Clean Power Plan, along with DTE's plans to shutter several coal-fired utility plants, can help to increase attention on the remaining large industrial emitters.

Some communities have worked with industrial facilities to reduce emissions and increase monitoring, through "good neighbor agreements" (GNA), which are negotiated but generally non-binding agreements between a facility and local community organization that addresses community concerns. However, these efforts must be approached cautiously to avoid sham agreements with limited or negligible benefit to the community. As an example of a GNA, *Communities for a Better Environment* in Richmond, CA successfully negotiated several good neighbor agreements with refineries.[9] GNAs are relatively rare, require extensive organizing and effort, and require multiple years to navigate and implement, but when they work, GNAs can help to reduce environmental and public health burdens.[10]

Other coordination strategies should involve state and local agencies, and community-based organizations with environmental public health expertise and resources. Some strategies include:

- Creating opportunities and mechanisms for interagency cooperation to engage environmental agencies (e.g., MDEQ), other enforcement agencies (e.g., Office of Civil Rights, Department of Health and Human Services, public safety departments, first responders), and industry (e.g., Marathon) to facilitate emissions control enforcement, compliance, transparency, and communication. Some of this is performed under the Clean Air Act Emergency Response Planning coordinated by Wayne County.
- Promoting partnerships between the Detroit Health Department, Michigan Department of Health and Human Services, academia, community-based organizations, and MDEQ to facilitate performance and analysis of health impact assessments (HIAs). Michigan does not currently have legislation formalizing the requirement of HIAs in the environmental regulatory process. HIAs can help to promote environmental justice, and guidelines and efforts to mandate HIAs are available.[11, 12, 13]

Another way to ensure that compliance and enforcement efforts translate to an environmental health benefit would increase the use of supplemental environmental projects (SEPs).

- Developing a web-based map/application showing locations of odor and other air quality complaints, possibly in conjunction with MDEQ's call-in number and CBO participation.
- Expanding strategies and programming that reduce residential and commercial waste through the promotion of recycling, reuse, and reduction of waste.

1.1.3 Incentives and Funding

Incentives and funding can be very effective in increasing the use of point source controls. Michigan provides tax incentives for industries to install pollution control devices through the Air Pollution Control Facility Tax Exemption of Public Act 451 of 1994, which authorizes a 100% property and sales tax exemption for facilities primarily designed to control air pollution. Facilities seeking the tax exemption apply to the Michigan Treasury Department after the equipment has been installed (and not when the PTI application is submitted). The tax exemption is broad, covering baghouses, scrubbers, electrostatic precipitators, sprinkler systems, dust control enclosures, process changes or burner conversions, dust hoppers, waste conveyors, monitors, stacks, etc.[14] In addition, Michigan's tax code provides direct write-offs of any pollution control equipment purchased through the Capital Acquisition Deduction (CAD) of Michigan's Single Business Tax (SBT).[13]

Michigan's tax exemptions could be strengthened. Further tax exemptions could be coupled with environmental compliance. In 1990, Louisiana created a tiered tax incentive system, which based half of the incentive on environmental performance (calculated using a facilities violation record, and the ratio of emissions to number of employees). This approach lowered implementation costs and improved environmental performance.[15] (Previously, Louisiana had used a 100% tax exemption system similar to Michigan's.)

In Michigan, as in many other states, fines collected for violation of environmental regulations are placed in the state's general fund. Rather than funding all state activities, the state should transfer fines for permit violations to be used specifically for emissions reduction efforts or to mitigate adverse health effects of emissions.

Another way to ensure that compliance and enforcement efforts translate to an environmental health benefit would increase the use of supplemental environmental projects (SEPs), which are negotiated and binding agreements between community groups, industry and regulatory agencies. SEPs generally reduce the overall fine levied on a facility, but substitute a project that reduces pollution (using pollution controls). Examples include: installing monitors, or funding other programs to benefit the community like health clinics or filters in homes. Facilities may prefer SEPs to fines, in part because they can involve equipment purchases that can be tax exempt.[16]

Two other strategies to encourage emission reductions from industry include creating incentives to use renewable or clean energy *(See CAPHE Public Health Action Plan Section 2)* and to offer a state matching fund for qualified costs.

MDEQ's inspections, monitoring, enforcement, compliance and other activities must be strengthened to confirm and promote point source controls and emission reductions. This requires support for increased funding for MDEQ.

1.1.4 Planning and Regulations

Many policy and regulatory strategies are used to reduce point source emissions. All states or local agencies must implement regulations at least as stringent as those required by EPA, however, some create more protective rules. As examples, the Bay Area Air Quality Management District in California requires that refineries use real-time monitoring of flare efficiency to ensure maximum combustion,[17] decreasing the amount of flaring and emissions.[18] Similarly, a partnership between the Oregon Health Authority and the Oregon Department of Environmental Quality is developing a new regulatory system for managing air toxics.[19] More stringent state or local laws or regulations should be enacted that reduce emissions at point sources, these could include:

- Independent verification of emissions data using continuous emissions monitoring systems;
- Requirements for low NO_x burners on all combustors, and more advanced NO_x control on larger sources including power plants and gas fired turbines;
- Improved flare efficiency requirements and monitoring;
- Reliance on emission controls that reduce emissions, rather than on measures that increase dispersion of pollutants (e.g., increased stack height) as proposed in the recent SO_2 SIP;
- Use of health impact assessments when setting permit limits and appropriate controls. This will evaluate cumulative impacts, and impacts occurring at air pollution levels below the NAAQS (for criteria air pollutants — See Recommendation 2 in this section);
- Requiring flue gas desulfurization at all coal-burning and coking (coke oven gas) facilities. As noted, no coal-burning facility in the Detroit area (with the exception of DTE Monroe) uses advanced emission controls for SO_2 and NO_x (e.g., flue gas desulfurization and catalytic reduction). Also, Detroit is believed to have the only coke facility in the country (EES Coke LLC, a DTE Energy company) without such technology. Coal-burning sources are responsible for nearly all SO_2 emissions. (Coal contains a considerable amount of sulfur, and since flue gas desulfurization (FGD) is not used, essentially all of the sulfur in coal is emitted into the air as SO_2). Major coal users in Detroit include electrical generating units (DTE Trenton Channel, DTE River Rouge, other large boilers, Wyandotte Municipal Power, Guardian, and JR Whiting), steel producers (AK Steel, US Steel), a coke producer (EES Coke), and cement kilns (St. Marys). FGD systems are the most efficient technology to limit sulfur emissions, providing 90-98% efficiency.[20] DTE Monroe's installation of four FGD systems resulted in significant decreases in SO_2 emissions and an increase in jobs associated with installation of the systems.

In addition to requiring enhanced emission controls at point sources, Michigan should improve oversight and enforcement. Policies and strategies should include:

- Conducting more frequent inspections of industrial facilities, including establishing goals for inspection frequency for the next three years;
- Imposing stricter penalties for repeat violations (e.g., greater fines; withholding of tax incentives for violators; reparations to communities impacted by toxic emissions);
- Promoting the use of supplemental environmental projects (SEPs) over fines to provide local benefit;
- Developing emissions control transition plans for grandfathered facilities, by ranking facilities based on emissions, air impacts, and health impact analyses. (See Recommendation 1.2 below);
- Ensuring compliance with all EPA regulations, including EPA's 2015 change that removed start-up, shutdown and malfunction (SSM) exemptions from SIPs.[21] More generally, Michigan should regulate and enforce emission limits in all SSM events in all permits.

For related actions for monitoring, see *CAPHE Public Health Action Plan Section 10*, and for actions related to enforcement, see *CAPHE Public Health Action Plan Section 9.*

PSC RECOMMENDATION 2: Require quantitative and qualitative health impact and equity assessments when developing air quality management strategies.

MDEQ should adopt a policy to include health and inequality impacts in the development of control strategies, including the selection and prioritization of point sources for additional emissions controls using health impact assessment techniques. Health impact assessment (HIA) use a set of techniques to characterize the potential public health impacts

(both adverse impacts and health benefits) of proposed projects, policies, plans, or programs.[22] HIAs for air quality management use both quantitative and qualitative methods to examine impacts of point source control options. Quantitative HIAs use spatially-resolved information on ambient concentrations, baseline health rates, and at-risk populations, whereas qualitative HIAs require expertise in public engagement and qualitative research methods.[23]

1.2.1 Education and Outreach

Educating state air quality personnel and other stakeholders on the use of HIAs and their use in decision-making should be a priority. State environmental agencies have technically proficient engineers, air quality modelers, and risk assessors, but expertise in HIA is lacking. Several tools are available for interested parties to access data and conduct quantitative health impact assessments,[24] (e.g., US EPA's Benefits Mapping and Analysis Program (BenMAP) facilitates spatially resolved health and economic impacts). Training for state personnel and other stakeholders on these tools and other HIA methods is available from the EPA.[25] Additional methodological training will be required for more comprehensive assessments, e.g., those involving inequality metrics, since BenMAP and other readily available tools are often designed for screening purposes and do not include inequality or equity metrics. Training on qualitative HIA methods, including community engagement, should also be a focus of education efforts to ensure that public participation is prioritized. HIA training can be

obtained from Human Impact Partners[26] and other organizations.

HIAs also provide an opportunity to engage with Detroit residents, educate community members about the health and equity impacts of pollutant sources in their neighborhoods, and solicit feedback during air quality management activities, such as permitting. Because not all impacts from air pollution exposures can be quantified using BenMAP and other tools,[27, 28] it is important to engage with community partners to identify and understand the potential health, social, economic, cultural, and other impacts. Information collected during a health impact assessments should be informed by community priorities, discussed with the community while it is underway (e.g., sharing preliminary results for discussion), and communicated to relevant groups, including communities most affected, once the assessment is complete.

Including HIAs as part of the air quality management processes will require coordination across state agencies, non-governmental organizations, community groups, and potentially academic partners.

1.2.2 Support and Coordination

Including HIAs as part of the air quality management processes will require coordination across state agencies, non-governmental organizations, community groups, and potentially academic partners. Impact assessments that incorporate quantitative health and equality metrics must draw from several information sources across varying levels of government: environmental and emissions data (e.g., air monitoring data, emissions inventories, and meteorological data) are typically housed within MDEQ; and baseline health rates, population, and socioeconomic variables are housed within the Michigan Department of Health and Human Services (MDHHS), the US Census Bureau, and/or local health departments. Additional data regarding social impacts may be collected directly from the community, engaging community leaders and residents in the process. Bringing together these data sources, and utilizing the most current and appropriate data will require cooperation between different governmental and non-governmental organizations, and possibly require formal agreements for data sharing and collaboration. Strategies for facilitating coordination of HIAs in Detroit include:

- Creating opportunities and mechanisms for interagency cooperation to engage environmental agencies (e.g., MDEQ), other enforcement agencies (e.g., Office of Civil Rights, MDHHS, public safety departments, first responders), and industry to facilitate emissions control enforcement, compliance, transparency, and communication. Some of this is performed under the Clean Air Act Emergency Response Planning coordinated by Wayne County.
- Promoting partnerships between Detroit Health Department, MDHHS, academia, and MDEQ to facilitate performance, analysis and best practices for HIAs. Michigan does not currently have legislation requiring HIAs in the environmental regulatory process. HIAs can help to promote environmental justice, and guidelines and efforts to mandate HIAs are available.[29, 30, 31]
- Partnering with existing community organizations, e.g., Detroit Hispanic Development Corporation, Green Door Initiative, Detroiters Working for Environmental Justice, and Data Driven Detroit, that have expertise in conducing HIAs in the city of Detroit.[32]

1.2.3 Incentives and Funding

Michigan currently does not have legislation requiring HIAs as part of the environmental regulatory process. Because HIAs can be time consuming and resource intensive, funding at the state level should be made available for MDEQ to include these assessments as part of the decision-making process.[33] The effort required for HIAs will decrease as Detroit area databases are assembled that can be used for multiple assessments.

Foundation (e.g., Erb, and Pew) and governmental funding (e.g., CDC) could bolster the use of HIAs in Detroit.

1.2.4 Planning and Regulations

MDEQ should develop, vet and implement a program to assess health and equity impacts for point sources, including both new and existing sources, when permits are issued (Permits to Install) and up for renewal (Renewable Operating Permits), which occurs every 5 years). Currently, MDEQ evaluates source controls in several circumstances: (1) as part of the Permit to Install (PTI) process for new sources; (2) as part of the Maximum Achievable Control Technology (MACT) process for existing and new sources of toxic air pollutants; (3) as part of Reasonably Available Control Technology (RACT) analyses performed for SIPs, which takes place when the National Ambient Air Quality is exceeded; and (4) possibly after an air pollution complaint, inspection, or permit violation. Currently, PTI, RACT, MACT and other analyses evaluate ambient concentrations resulting from emissions of particular sources. However, they are limited in several ways: evaluations generally use maximum allowable emissions, which may not be reflective of actual emissions; only a subset of emitting facilities are considered; only a single pollutant is considered at time; and, most significantly, health and equity impacts are not considered.

As an example of the use of health and equity impact evaluations, we consider the MDEQ proposed SIP aimed at addressing SO_2 non-attainment in the Detroit area. In the proposed SIP, allowable emissions are slightly lowered at three of the larger emitters (DTE River Rouge, DTE Trenton Channel, US Steel), and the stack height is raised at a fourth facility (EES Coke, without changing allowable emissions). No other changes are proposed for other SO_2 emission sources in the area. Following EPA policy, the SIP evaluated SO_2 concentrations in the non-attainment area;[34] neither health impacts nor the distribution of health impacts were considered. The health and inequality impacts of the SIP strategy, as well as several alternative strategies, were compared in a recent analysis.[35] Several of the alternatives were designed to reduce health burdens and

inequality in the distribution of health burdens. Key findings include:

- SO_2 contributes to the environmental health burden experienced by Detroit area residents, even in areas outside the non-attainment zone, mostly by children with asthma;
- While actions in the proposed SIP will provide a modest reduction in health burdens, the SIP neither directly considers health impacts nor addresses the inequality in health burden, an important environmental justice consideration;
- For the largest SO_2 sources (e.g., DTE Monroe, DTE Trenton Channel), ambient concentration and health impacts are widely dispersed, but the inequality in the burden of disease resulting from emissions at these facilities is relatively low;
- Smaller SO_2 sources (e.g., Carmeuse Lime, Dearborn Industrial Generation) cause more localized impacts, but can have higher health impacts per ton of pollutant emitted and increase inequality in health burdens because they disproportionately affect vulnerable populations, and thus may warrant emissions controls and attention in the SIP;
- Strategies that consider both large and small facilities will most efficiently reduce both health burdens and the inequality of the health impacts.

Policies incorporating health and inequality impacts, which would be more stringent than current EPA requirements, would require site-specific analyses that are within the reach of current tools. In general, these policies would target sources that are close to populations and that have dispersion characteristics that increase local impacts. Historically, these sources have not received much attention in air quality analyses. Some of these sources may be relatively small, and costs per ton of pollutant removed may appear high. However, these sources should be considered for additional emissions controls, following the evaluation and prioritization proposed.

PSC RECOMMENDATION 3: Improve safety and awareness of industrial facilities and air emissions.

While reducing emissions is the primary strategy for minimizing exposure and improving health near industrial facilities, other strategies can be used to improve overall health and safety.

1.3.1 Education and Outreach

Safety training programs for workers at industrial facilities should be improved. These might include emissions control safety training programs (e.g., to address upsets, malfunctions). Training programs would be most effective if developed in conjunction with local union chapters. For example, the United Automobile Workers (UAW) union provides health and safety training with support from the National Institute of Environmental Health Sciences, the Occupational Safety and Health Administration, and the Michigan Department of Labor and Economic Growth.[36] These trainings are free and are conducted by UAW staff and peer safety trainers. Similar programs could be developed with unions, e.g., education and outreach for diesel equipment.

Emergency response education and information should be provided to workers and the general public to ensure awareness of the emissions, risks, and state regulations on emissions, and to minimize impacts during emergencies. Signs (in multiple languages, i.e. Spanish and Arabic) should be posted near point sources, schools and residential communities. Education, outreach and response procedures for workers and the public should be developed, practiced and implemented to prepare for industrial accidents; this should complement the Risk Management Plans at county and state levels. As an example, California's Interagency Working Group on Refinery Safety has provided recommendations for emergency response protocols aimed at alerting workers and community members in emergencies.[37]

Collaborations with government agencies across all levels with expertise on industrial safety are recommended.

1.3.2 Support and Coordination

It is important to work with industrial facilities to improve safety measures that reduce or eliminate accidental air emissions, and to partner with trade organizations and unions who represent workers and who may have conducted campaigns to improve worker safety. For example, the United Steel Workers (USW) union, which represents workers in the chemical, oil, manufacturing and other industries, regularly advocates for policy to strengthen worker safety and publishes guidance on improving safety programs at industrial facilities. The US Chemical Safety Board also publishes guidance on improving safety at industrial facilities. Efforts to improve worker health should be coordinated with industry and unions, and should build from existing work.

Collaborations with government agencies across all levels with expertise on industrial safety are recommended. For example, in 2013, CalEPA commissioned an Interagency Task Force of Refinery Safety, which included members from U.S. EPA, local and state agencies, to provide policy recommendations.[38] Similar task forces should be established in Michigan to support refinery and worker safety.

The Michigan Voluntary Protection Program (MVPP) maintained by the Michigan Occupational Safety and Health Administration (MIOSHA) incentivizes health and safety protection at industrial facilities by evaluating health and safety programs and awarding designations for protections above MIOSHA standards. Designated "star companies" can mentor other companies to improve their health and safety programs; and "rising star" companies express interest in improving their programs.[39] Such programs can be expanded and promoted.

1.3.3 Incentives and Funding

Funding and incentives help motivate companies to implement improvements at their facilities. The state should create a variety of strategies to incentivize improved health and safety programs, including:

- Providing tax incentives to industries that participate in advanced safety training programs;
- Offering grants and matching funding to industries that use enhanced approaches to prevent leaks and technology malfunctions;
- Imposing stricter penalties for repeated safety violations.

1.3.4 Planning and Regulations

While some industries may choose voluntarily to improve their health and safety programs, statewide regulations requiring improved occupational safety would ensure that more workers would be covered. Regulatory strategies to improve health and safety at industrial facilities could include:

- Improving protocols for handling upsets and emergencies that result in pollutant releases. California's Interagency Working Group on Refinery Safety has published recommendations to improve safety programs and emergency response protocols at industrial facilities in their document,[40] which could be used as a template;

- Banning open storage and material transfer processes that can result in fugitive emissions and leaks;
- Increasing the frequency of safety inspections of industrial facilities, and providing recommendations that reduce risks;
- Requiring the use of modern approaches to detect, quantify and inventory unregulated process releases. Unregulated process leaks (e.g., at pipe connections, valves or corroded pipes) can represent a significant proportion of emissions at industrial facilities. While leak detection and repair (LDAR) programs are required under federal statutes, the EPA has found widespread noncompliance with these regulations, specifically at refineries. EPA also provides guidance on best practices for LDAR programs.[41] The Chemical Management Safety Board has cited inadequate preventative maintenance as a primary root cause of chemical accidents, and routinely recommends more robust preventative maintenance procedures, LDAR practices.[42]

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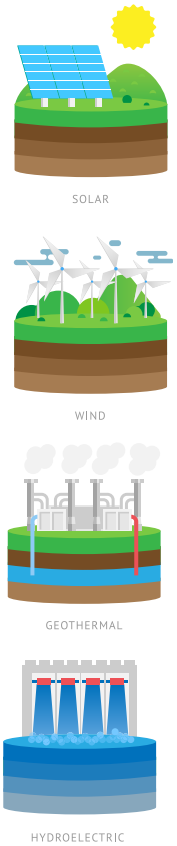
2 Renewable Energy

Renewable energy sources include solar, wind, geothermal and hydropower energy sources that are naturally replenished on a human time scale. They have low emissions of toxic pollutants and greenhouse gases, and much lower environmental impacts than fossil fuels.[1] Use of renewable energy can displace "dirty" sources of energy, including coal, oil, diesel, gasoline and other fossil fuels. Renewable energy sources include:

- Solar energy, which comes directly from the sun and may be harnessed using photovoltaic (PV) cells, concentrated solar power (CSP), and passive solar heating.
- Wind energy that is produced using wind turbines which use rotating blades to power a generator and produce electricity. Wind farms can be combined with other land uses, including agriculture, because the turbine towers have small footprints.[2] Smaller turbines can be used on rooftops.
- Geothermal energy that uses heat generated and stored in the earth arising from the hot core of the earth and from radioactive decay. Examples include geysers and hot springs that heat groundwater.[3]
- Hydropower, which is derived from moving water, typically using hydroelectric dams where water spins a turbine attached to a generator to produce electricity.[4]
- Biomass (and biogas), which is derived from plant and animal matter. Energy can be derived from wood (and wood products), sewage sludge, solid waste (organic fraction), and other materials. However, current processes for deriving energy from biomass and biogas, most of which use combustion or pyrolysis, are associated with emissions of air pollution; moreover, the production of the biomass/gas feed stocks may not be sustainable or may involve other environmental problems. For these reasons, while we recognize the potential of biomass energy, our recommendations de-emphasize biomass.



Solar energy is considered one of the cleanest and most abundant forms of renewable energy.[5] PV panels, which generate

electricity cost-effectively, can be installed on buildings (especially rooftops), and on open land, including brownfields. PV installations in Detroit could utilize tracts of vacant land, abandoned industrial properties, brownfields and spatial buffers, making such land productive and valuable. Early adoption of large scale PV installations could be transformative for Detroit's energy future, and could reduce air pollution emissions associated with fossil fuel combustion conventionally used to generate electricity and thermal energy.

Energy-related emissions also can be reduced by improving energy efficiency. This is often the most-effective short-term strategy to reduce energy consumption.

RE RECOMMENDATION 1: Increase the use of renewable energy sources and transition away from polluting sources.

2.1.1 Education and Outreach

Building awareness about renewable energy sources, practices and technologies is a key component of increasing the use of renewable energy. Education and outreach campaigns have the potential to galvanize Detroit community members, city leaders, local businesses, and other key stakeholders; expand the City's renewable energy agenda; and promote renewable energy standards in Detroit and Michigan.

Community-based organizations and environmental groups should conduct education and outreach to Detroit residents, businesses, and local decision makers to enhance awareness of the benefits of switching from traditional power sources to renewable energy sources. This could include consumer education programs for residents and businesses. For example, the Consumer Education Program for Residential Energy Efficiency from Cornell University and the New York State Energy Research and Development Authority offered workshops for participants from low-income households to learn how to implement no-cost and low-cost measures that reduced energy expenditures.

Local environmental groups could also conduct education and outreach that promotes use of consumer owned electricity generation, e.g., energy co-ops are investor/member owned utility companies that select their energy sources. Co-ops can own the power producing equipment, or purchase it from existing producers at a wholesale cost. For example, Wolverine Power Cooperative in Cadillac, Michigan, Wolverine sells its members a slightly more environmentally-favorable mix of power.

The City of Detroit, local environmental groups, and renewable energy companies could develop public-private partnerships to educate residents and businesses about transitioning to renewable energy. As examples, Solar Now!

in Portland, OR provides free workshops, advertising campaigns, educational brochures, a website, a call center, and daily emails; and Solar Knoxville was started by the City of Knoxville in 2008 to educate residents and businesses through free workshops tailored to residents, businesses, and utilities, etc.

Local educational institutions or community colleges, in partnership with institutions such as the City of Detroit, the International Brotherhood of Electrical Workers (IBEW), and Midwest Renewable Energy Association (MREA) could increase their renewable energy vocational training and education for employees of the energy sector who want to learn more about renewable energy. The *Ecotech Institute* in Aurora, Colorado offers degrees and certificates in renewable energy, sustainability, and energy efficiency.[6] Such programs could have economic benefits as well as reducing emissions and energy costs.

Several major cities, including Grand Rapids, MI, have already committed to a transition to renewable energy.

At the city scale, the City of Detroit could partner with local environmental groups to launch a public awareness campaign that highlights the environmental and economic benefits of renewable energy, and, ultimately, to influence renewable energy policy. There are many examples of such programs. The *New Yorkers for Clean Power* campaign, for example, uses education, advocacy, and organizing efforts to engage the public, local governments, and businesses and advance renewable energy, energy efficiency and clean transportation solutions.[7] The *Philadelphia Energy Campaign,* which integrates job creation into their energy and carbon emissions reduction campaign, will create an estimated 10,000 jobs and $200 million in local cost savings using a 10-year neighborhood-driven job creation platform, leveraging public and private investment in energy efficiency and clean energy at municipal buildings, K-12 schools, low-income residences, and small business.[8] The *A2energy* program is an outreach and education campaign aimed at residents and businesses in Ann Arbor.[9] The Sierra Club Foundation in Los Angeles has proposed a public education campaign *The Future is Bright!* that supports the development of education materials, creates activities to engage residents and other stakeholders in a city-wide discussion of the city's energy future, and uses social media to help launch a conversation about the role of renewable energy.[10] The City of Detroit could use this experience in developing outreach and education campaigns, and encourage engagement of homeowners, businesses, landlords, renters and others to increase renewable energy use.

Detroit should also consider joining national renewable energy campaigns, such as Sierra Club's *Ready for 100%*, to mobilize the city around the idea of adopting 100% renewable energy by a set date. Several major cities, including Grand Rapids, MI, have already committed to a transition to renewable energy.

Detroit can leverage the support gained from the outreach and educational campaigns to develop comprehensive plans aimed at persuading DTE and other Detroit-based power generators and energy consuming/producing industries to transition to renewable energy. This could include public relations and economic rationales, goals, objectives, timelines, and other element; it could be participatory, providing industries with outreach materials and opportunities to offer input/feedback.

The City of Detroit could pursue renewable energy directly through the Public Lighting

Department, which has the authority under City Charter to furnish and sell light, heat, and power to any person, firm, division, or corporation within or outside of the city.[11]

While industry may be responsive to pressure from the public, city and state to become more socially responsible, potentially the most effective way to transition to renewable energy is through new renewable energy policy and standards. Educating the public on various regulatory actions that can encourage renewable energy use (e.g., net metering) and building the public's capacity for engaging in renewable energy policy advocacy (e.g., through action events, policy training, and advocacy instruction, such as that offered by the University of Michigan's Detroit Community-Academic Urban Research Center), Detroit citizens can become more engaged in the political and regulatory process.

2.1.2 Support and Coordination

Partnerships and collaborations among a broad and diverse set of stakeholders are critical to increase the use of renewable energy and transition away from polluting sources. A number of Detroit area organizations are already working to promote the adoption of renewable energy sources, including:

- Detroiters Working for Environmental Justice (DWEJ), an advocacy organization that empowers individuals, communities, and organizations in Southeast Michigan.[12]
- The Detroit Climate Action Collaborative, working since 2011 to reduce greenhouse gas emissions in Detroit by advocating for increased efficiency for Detroit buildings, and renewable energy investment.[13] The Detroit Climate Action Plan suggests that the city can increase the renewable energy portfolio to 35% by 2030 (see Planning & Regulation Section for more details).
- The American Lung Association, which has advocated for clean air and worked to hold polluters accountable.
- Detroit Environmental Agenda, a coalition of non-profit, environmental, and environmental justice organizations, is developing a citywide Environmental Agenda on the state of the environment and its impact on quality of life, and to build consensus on policy initiatives and to empower citizens to advocate for environmental solutions.
- Sierra Club Detroit, and its *Beyond-Coal Campaign*, which focuses on replacing coal with clean energy sources by mobilizing activists to advocate for the retirement of coal plants, and to prevent new plants.
- Detroit Area Clean Cities, a project of the *Clean Energy Coalition*, works with vehicle fleets, fuel providers, community leaders, and other stakeholders to reduce petroleum use in transportation.
- EcoWorks, which provides services at the intersection of community development and sustainability, including building affordable, energy efficient residential housing and commercial buildings.[14]
- Green Door Initiative, an organization that provides job training to prepare Detroit residents to participate in the green economy, and strengthens community capacity to engage in land use and policy decisions related to environmental health.

These and other organizations can coordinate efforts to develop renewable energy programs

and support renewable energy rules and regulations, e.g., EPA's Clean Power Plan.[15] This can include a coordinated public campaign to pressure DTE, other industries and the state of Michigan to remove financial and regulatory barriers impeding renewable energy. The *Corporate Sourcing of Renewables Campaign* from Clean Energy Ministerial aims to get more companies to commit to using renewables, by deploying tools and resources.[16] Such a campaign in Detroit can make the business case that renewable energy can drive the market, boost the economy, and offer long term cost savings.

At the same time, the City of Detroit should work with industries in the region to help transition the City's major industries, businesses, and power generators to renewable energy sources. In particular, supportive public policies and programs are critical to ensuring that companies have easily accessible, financially feasible options for obtaining renewable energy. The City of Detroit, in partnership with other energy and environmental groups, could consider developing a policy toolkit or other resources to encourage adoption of renewable energy.

In particular, supportive public policies and programs are critical to ensuring that companies have easily accessible, financially feasible options for obtaining renewable energy.

The City could partner with DTE to promote renewable energy. Installation of solar and other renewable facilities at brownfields and other open space not suitable for recreation/natural space or agriculture can promote large scale efforts and make energy more affordable for communities.

The City of Detroit could coordinate with other Michigan cities (e.g., Grand Rapids, Lansing, Ann Arbor) to develop appropriate renewable energy benchmarks (see "Planning and Regulation" below). The City could also partner with local community groups to develop best practices for ensuring a responsible transition from current energy to renewable energy sources (e.g. considering land and energy use in plans).

Detroit Public Schools should promote the use of renewable energy sources, and be a partner in renewable energy campaigns, as children are particularly vulnerable to the adverse health effects of air pollution. Local school groups (including parents, teachers, and students) and activists could launch renewable energy campaigns to help protect young people, and specifically target schools that have unreliable, inefficient systems. For example, in Charlotte and Durham North Carolina, the R*epower Our Schools* campaign asks school boards to use 100% renewable energy.[17] A K-12 renewable energy school curriculum could be developed and implemented to teach students about renewable energy; models exist at *EnergyWorks* at the Ecology Center in Ann Arbor. The Massachusetts Department of Energy and Environmental Affairs is using renewable energy as an integrating framework for STEM education in public schools.[18] The NAACP has published a guide to teaching Environmental Justice in the classroom, which lists classroom resources and lesson plans that could be used to teach children about Environmental Justice issues surrounding renewable energy.[19] Detroit Public Schools and nonprofit organizations serving youth in the City could also consider developing after school programs or service learning projects to help youth become renewable energy advocates. For example, *Solar Youth's* after school program in New Haven, CT offers environmental education, community service, and leadership development to empower youth of all ages to tackle environmental problems.[20]

Partnering with the public health sector, such as Detroit Health Department and Wayne County Health and Human Services, can help to promote use of renewable energy. Public health organizations have the skills and expertise to evaluate the local health effects of different energy sources. Presenting evidence of the public health benefits of renewable energy can support regulations and incentives for renewable energy.

Detroit should also consider supporting communities working to establish energy co-ops by promoting cost-efficient energy models that decentralize electricity production and centralize heat through cooperative ownership of renewable energy.[21] Detroit could help new co-ops by applying for and distributing financial support, connecting them with state and national funding programs, and/or serving as an informational resource.

Coordination with other air pollution strategies, like installing solar panels in spatial buffers designed to reduce pollutant exposure and on noise walls along freeways could provide significant co-benefits.

2.1.3 Incentives and Funding

The price of solar panel installations has fallen dramatically in recent years and these systems are often very competitive to other energy systems. Once installed, solar panels have low maintenance and low operating costs. Michigan solar potential is about 4 kWh/m2/day[22], which exceeds most of Germany, the world's leader in solar deployment.[23] Still, incentive and funding mechanisms are needed to promote adoption of renewable energy sources. The following sources provide information on renewable energy incentives and funding programs (including rebates, tax credits, loans, and grants):

- The Database of State Incentives for Renewable Energy, which provides a comprehensive source of information for state, local, utility and federal incentives and policies regarding renewable energy and energy efficiency.[24]
- The Clean Energy Authority lists clean energy rebates and incentives available to Michigan residents and businesses.[25]
- The U.S. Department of Energy's resource guide of government programs that support the development of clean energy projects in the U.S. and abroad.[26]

Local incentive and funding programs include:

- DTE Energy's *Solar Currents Program,* which provides incentives to offset the installation costs of PV for its electricity customers.[27]
- The Economic Development Corporation of the City of Detroit provides loans and financial assistance to commercial, institutional and public buildings in Detroit that install energy efficient and renewable energy technologies.[28]
- The Ecology Center, which supports K-12 school energy efficiency projects and improvements in classroom environments.[29] , in partnership with the Michigan School Business Officials, Michigan Saves, and the C.S. Mott Foundation.

State level incentive and funding programs include:

- The Michigan Energy Office, which funds renewable energy and energy efficiency

activities, (e.g. providing education/outreach and technical assistance to communities and businesses on renewable energy and energy efficiency topics, feasibility studies, utility bill analysis and Energy Star benchmarking, energy evaluations and audits, demonstrations of commercially available renewable energy and energy efficiency technologies, and/or other activities that promote renewable energy and energy efficiency as an affordable, reliable, adaptable, and environmentally protective energy solution).[30]

- Michigan Saves green bank, a nonprofit dedicated to making energy improvements easier for all Michigan energy consumers. This bank makes financing and incentives available through grants and partnerships with private sector lenders and energy providers.[31]
- DEQ Pollution Prevention Loans, which provide loans to businesses that eliminate or reduce waste at the business location, resulting in environmentally sound reuse and recycling of generated wastes or conservation of energy or water.[32]

National level incentives and funding programs include:

- The Federal Business Energy Investment Tax Credit, which offers financial incentives to commercial and industrial sectors for installing renewable energy technologies.[33]
- The Residential Renewable Energy Tax Credit, which offers financial incentives to residents who install renewable energy technologies in their homes.
- The U.S. Department of Energy Loan Guarantee Program, which provides tax deductions for expenses incurred for energy efficient building modifications made by a commercial building owner. Loans are issued for projects with high technology risks that "avoid, reduce or sequester air pollutants or anthropogenic emissions of greenhouse gases; and employ new or significantly improved technologies."[34]

Continued federal tax incentives and incentive financing can help businesses participate in DTE's *Solar Currents Program.* DTE has easement rights to locate PV arrays on suitable property in southeastern Michigan.[35] Examples of PV projects include: Ikea Solar Energy in Canton, MI with over 4900 solar panels;[36] *1-800-LAW-FIRM Southfield, MI* (near Lodge and Lahser) with 550 solar panels; and four wind turbines, a project that received incentive financing from Detroit and federal tax credits ($300,000).[37]

Despite the existing programs that incentivize and fund renewable energy, more could be done at the city and state level. Detroit could offer low-interest loans to homeowners to add solar to their homes. *Milwaukee Shines* is an example of one such program that uses a comprehensive and citywide approach with the goal of creating cleaner air for Milwaukee residents and reducing energy costs.[38] Detroit also could expand and certify green pricing programs that allow utility customers to volunteer to pay a small price premium in order

By 2015 all but three of Michigan's 72 utilities were on track to meet the target using wind, solar, biomass and biogas.

to receive greater percentages of their power from renewable resources.

The City could encourage greater participation in green pricing options by using the Center for Resource Solutions' guide, *Best Practices in Marketing Green Pricing Programs.*[39] The City may also wish to offer small grants or funding programs to lower income residents who are interested in joining DTE's *Green Currents* or other green pricing programs, but cannot afford it. The *Green Currents* program enrolls about 23,000 customers annually, with several options (e.g., you can pay an additional $0.02 per kilowatt hour to get 100% of your power from renewable sources).[40]

Expanding funding for entrepreneurs and universities engaged in renewable energy research and development might impact the use of renewable energy. Such funding could provide an economic boost for the city, and potentially improve air quality and reduce energy costs.

Community Benefits Agreements negotiated from projects or developments in Detroit could also be targeted to renewable energy projects within the community, including incentivizing use of renewable energy.

2.1.4 Planning and Regulations

Legislative action at local, city, state and federal levels would have significant impact in transitioning to renewable energy. This could include new energy legislation, ordinances and additional incentives. At the federal level, the *Clean Power Plan* is under stay, pending judicial review, and was expected to be considered by the D.C. circuit court by the end of 2016.[41] If the *Clean Power Plan* becomes law, the Michigan Department of Energy will hold stakeholder meetings and create a compliance plan for Michigan. This plan should include significant investment in renewable energy sources, rather than investments in natural gas, nuclear and biomass sources. Expanding and strengthening state level renewable energy requirements will also ensure that Michigan complies with the EPA's Clean Power Plan.

At the state level, Michigan is restructuring its clean energy legislation. Nearly half (46.4%) of Michigan's electricity is generated by burning coal.[42] Because most of the coal-fired power plants are old and do not have modern emission controls, Michigan's electricity is a particularly "dirty" source of energy. PA 295, passed into law in 2008, required 10% of Michigan's energy to come from renewable sources by 2015. By 2015 all but three of Michigan's 72 utilities were on track to meet the target using wind, solar, biomass and biogas.[43] (As noted, however, forms of biomass and biogas are not necessarily low polluting fuels.) On November 10, 2016, the Michigan Legislature passed a plan to overhaul state energy policy, with a 15% renewable requirement by 2021.[44] Even noting these changes, Michigan should promote a more aggressive renewable portfolio standard, e.g., 25% renewable portfolio by 2025 (compared to the new 15% standard), which would significantly increase the fraction of renewable energy. Other states have used standards up to 50% by 2030.[45] The Legislature has also discussed redefining "renewable energy" as "clean" energy, which will encompass natural gas. While producing less NO_X and CO_2 than typical coal or oil use, gas extraction (e.g., fracking) is associated with other environmental issues, and NO_X emissions are associated with ambient O_3 pollution, a current problem.

At the city level, less than 3% of Detroit's energy is derived from renewable energy sources.[46] Detroit is currently considering a climate ordinance that examines the City's energy mix,

and will lower greenhouse gas emissions. The Detroit Climate Action Plan suggests that the City of Detroit has the ability to exceed statewide renewable energy portfolio standards to 35% by 2030.[47] Detroit should set a more aggressive renewable energy goal to increase the use of renewable energy. Many cities have made commitments to renewable energy, including Denver, Salt Lake City, Builder, San Diego, and San Francisco. The city council of Los Angeles, for example, approved a plan to replace 100% of the city's energy sources, which currently rely on fossil fuels, with renewable energy.[48]

Detroit should work to commit DTE and other power generators to transition rapidly to renewable energy. Recently, DTE announced plans to shutter eight units at three old coal-fired power plants (River Rouge, St. Clair and Trenton coal-fired power plants) with target dates of 2020-2023. Accelerating the phase-out would produce health benefits due to lower emissions and exposures of SO_2, NO_x, PM and other pollutants. However, DTE does not intend to shutter its largest plant, at Monroe, which has been recently upgraded with new emission controls.[49] Currently, DTE is behind its originally proposed timeline.

The City and other government agencies (schools, county buildings, etc.) should require that new buildings meet high performance/low energy standards, e.g., LEED standards. For example, in 2008, Kent County initiated a plan to reduce energy use in county facilities and buildings, and decreased energy usage at these facilities by 45%.[50]

The Greater Detroit Resource Recovery Plant should utilize state-of-the-art pollution controls, or should be phased out to cleaner technology. This waste-to-energy (WTE) plant burns materials such as plastics (made from petroleum) that are not renewable. Burning these materials to generate electricity creates a demand for "waste" and discourages efforts to conserve resources, reduce packaging and waste, and encourage recycling and composting. More than 90% of materials currently disposed of in incinerators and landfills can be reused, recycled and composted.[51] WTE facilities have high operating and maintenance costs, recover relatively small amounts of energy, and require sophisticated emission controls. Further, the Detroit facility is a major air pollution source that has been the focus of air pollution complaints and violations.

Regulatory and financial barriers impeding renewable energy in Detroit should be removed. This includes reforming utility approaches and Public Service Commission rules regarding purchase agreements for renewable energy, and further support of the current net-metering regulations using wholesale prices (not market prices as current legislation seeks).

RE RECOMMENDATION 2: Use renewable energy and green/sustainable practices for new and renovated buildings and infrastructure.

2.2.1 Education and Outreach

To encourage builders and developers to use renewable energy and green or sustainable construction practices, they must understand the environmental, public health, economic, consumer value, and consumer relations benefits of these practices. Education and outreach efforts are needed for construction companies, architecture firms, engineers, urban planners, developers, banks, real estate professionals, and others.

The City of Detroit and local environmental groups should offer energy and energy efficiency education and outreach seminars/workshops to share best practices, information on available resources, market trends, energy efficiency and renewable energy options, financing models, and examples of ways to incorporate renewable energy and green construction practices.[52] Model houses, tours and demonstrations may help.

Local groups working on reducing greenhouse gas emissions in Detroit could promote renewable energy and green construction advocacy, and could reach out to the architectural and business communities currently constructing developments and other infrastructure in Detroit. *Build It Green,* a nonprofit membership organization, helps local governments and communities develop greener, cleaner homes using model city codes, climate action plans, and policies, training staff on best practices, and coordinating efforts of planners, building inspectors, contractors, and organizers.[53] Groups could consider tapping into *Build It Green's* knowledge and resources. In addition, the *Detroit Climate Action Collaborative,* which currently advocates for increased efficiency for Detroit buildings and increased investment in renewables, could also engage in outreach and education targeted at developers to promote renewable energy and green construction practices.[54]

> Education and outreach efforts are needed for construction companies, architecture firms, engineers, urban planners, developers, banks, real estate professionals, and others.

2.2.2 Support and Coordination

Partnerships and collaborations are critical to expanding the use of renewable energy and green construction practices. Organizations that could be involved include:

- The City of Detroit
- Detroit Climate Action Collaborative
- US Green Building Council, including the Detroit Chapter
- Michigan Businesses for Clean Energy
- NextEnergy
- Detroit Economic Growth Corporation
- DTE Energy
- Clean Energy Coalition
- EcoWorks
- Detroit Public Schools

Detroit should coordinate with collaborative efforts, e.g., the Detroit Climate Action Collaborative, to promote renewable energy (e.g., PV installations) in new construction and renovations. Other cities have been successful in setting goals and developing partnerships to accomplish those goals. For example, Denver promoted solar panel installation in new developments by legislative activity, outreach, and changing city codes. Detroit should consider partnering to create goals and develop a plan for promoting the

renewable energy and green practices in both new construction and renovations.

Detroit could create a green building taskforce that provides guidance on policies and strategies. This task force could be appointed by the city council and include stakeholders with a range of perspectives on environmental and policy issues.[56] As an example, in 2004, Boston convened such a taskforce and subsequently become a national leader in this field,[57] and the first city in the nation to require a green building standard through municipal zoning requirements.[58]

2.2.3 Incentives and Funding

Detroit can encourage the construction of renewable energy buildings and green/sustainable infrastructure by pursuing local, state, and national incentive and funding programs. Many such programs exist to support renewable energy for the design and development of new construction. These programs include:

- *Smartbuildings Detroit Green Fund Loan*, a loan program offered by City of Detroit's Economic Development Corporation.[59]
- Michigan Rebates and Incentives for Clean Energy: A statewide rebate and incentive program available to residents and businesses.[60]
- The US EPA C*lean Energy Incentive Program,* which encourages the use of zero-emitting wind or solar power projects.[61]

2.2.4 Planning and Regulations

Detroit can best support renewable energy and green/sustainable practices for new developments by implementing policies and regulations that remove barriers and increase the financially feasibility. As examples:

- Zoning policies should consider site orientation to allow for PV installation;
- New construction and major renovations should be required to utilize renewable energy and/or green/sustainable building practices, possibly using building certification systems such as LEED;
- Green building ordinances could be adopted that promote economic and environmental health while reducing operating expenses through decreased energy and water bills.

These programs could be required or incentivized, and apply to governmental, school, residential, and/or other types of buildings. San Francisco was the first US city to require solar panels in new construction. Grand Rapids, MI requires that all new municipal construction and major renovations meet LEED standards,[62] as does the University of Michigan. West Hollywood, CA has a Mandatory Green Building Ordinance requiring that city-owned facilities be certified as LEED buildings and new developments meet the City's green building point system.[63] More modest actions might only require that city-owned facilities implement green practices or meet LEED-type standards; more aggressive actions might specify energy targets or footprints, as "radical" as net-zero buildings which essentially generate all the energy required.

Footnotes

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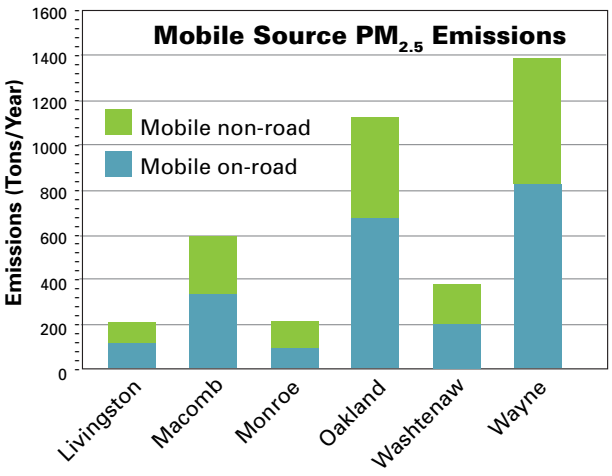
3 Retrofitting Diesel Engines

Diesel engine retrofitting involves installing more modern and effective emission controls on older diesel engines, or replacing older diesel engines with new cleaner ones. Diesel retrofits can be used on trucks, buses, off-road construction vehicles (e.g., dump trucks, cranes), diesel-powered equipment (e.g., generators, pumps), ships and trains. Retrofits can significantly reduce emissions and can be more cost-effective than vehicle replacement.[1] This is important since diesel engines have long lives, thousands of older vehicles and engines remain in use today, and diesel particulate traps and other emission control technology required after 2007 for new on-road heavy duty diesel vehicles can substantially reduce emissions. Older diesel engines and engines without these controls emit considerable amounts of particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_x) and other pollutants. Retrofitting these engines can substantially reduce air pollutants emitted.

Diesel exhaust accounts for 20% of $PM_{2.5}$ concentrations at monitoring sites in Detroit and a larger amount where there are large numbers of diesel-powered vehicles.[2] The fraction of $PM_{2.5}$ concentrations due to vehicle emissions has increased over time.[3] Both on-road and non-road vehicles (e.g., construction equipment) are important emission sources. Figure 3-1 shows the most recent estimates of mobile source $PM_{2.5}$ emissions by country in southeast Michigan. Most of these emissions come from diesel engines, and most from on-road sources. In Wayne County, for example, about 68% of diesel emissions are emitted by highway (on-road) traffic, and about 22% from non-road vehicles.[4] Considerable emissions

FIGURE 3-1. *Mobile source emissions by county for on-road and off-road sources. Includes exhaust emissions and excludes road dust. From 2014 National Emission Inventory (NEI).*



come from the 70,000 to 90,000 trucks that travel on major corridors (I-75, I-94, I-96, M10 and M39) in Detroit daily,[5] as well as the International Bridge, which has about 6,900 trucks per day (2.5 million annually).[6] The Michigan Department of Transportation (MDOT) estimates that truck traffic will grow at a rate of 2.5% per year, and will more than double over the next 30 years after the Gordie Howe International Bridge is built.[7]

Diesel exhaust is associated with many serious adverse cardiovascular and respiratory health impacts,[8] and diesel $PM_{2.5}$ is considered to cause cancer.[9] The number of people that would benefit from diesel retrofits depends on how many engines are modified or replaced. Those who would benefit most are those who live, work, and spend time near major freeways, sites with heavy diesel truck traffic, and construction and industrial sites using diesel engines. Two groups of individuals who have high exposure to diesel exhaust would particularly benefit from diesel retrofits: children riding on diesel school buses, especially since about 70% of Detroit's bus fleet is diesel,[10] and truck drivers, who can have high occupational exposure to diesel exhaust.

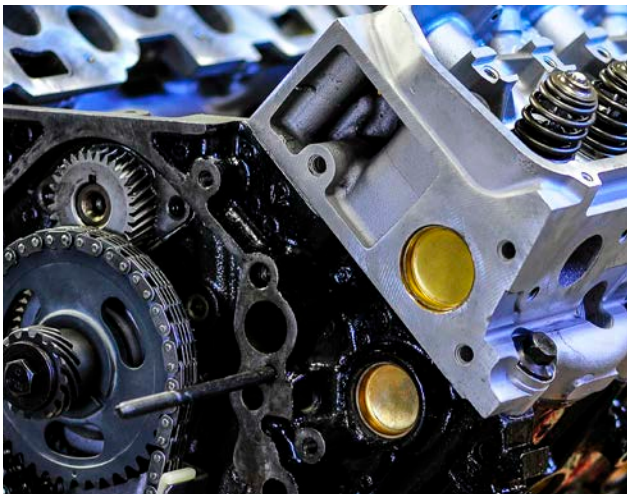
RETROFITTING RECOMMENDATION 1: Expand diesel retrofit programs and fleet and engine replacements.

3.1.1 Education and Outreach

Education and outreach are critical components of expanding diesel retrofitting programs and encouraging fleet and engine replacements. Target audiences for outreach and education efforts include residents, school bussing companies, trucking companies and owner/operators, and policymakers. Education and outreach materials should enhance awareness of the need for, and the benefits of, retrofitting and replacement, and should also identify affected neighborhoods and schools, the health effects of diesel emissions, and co-benefits of retrofitting.

Components of an education and outreach plan in Detroit should include:

- Education and outreach materials for truck owner/operators, trucking businesses, trucking unions, industrial facilities, and construction companies about why and how to reduce diesel emissions. This should include information about the health effects of diesel exposure, the best available retrofitting technologies, and possible financing options. Materials should also emphasize the economic benefits of early replacement, along with fuel savings.
- Surveys of truck owners/operators to measure drivers' willingness to finance retrofits, and their attitudes toward different truck replacement scenarios, which would help provide information that could be used to create and implement targeted strategies for retrofitting.
- Hotlines, smartphone apps and/or web-based tools to enable truckers and trucking businesses, construction firms, and other industries to learn more about the health effects of diesel emissions. There tools could also provide information about funding for retrofitting and replacement, and best available technologies. The EPA provides cost estimates and pollutant reduction estimates for several retrofit options.[11]
- A guide for policymakers on best practices for retrofit and replacement programs (e.g., the International Council on Clean Transportation guide for retrofitting, replacement and repowering).[12]



- Materials on the health, economic, and environmental benefits of diesel retrofits for community groups to use during Community Benefits Agreement negotiations. CBAs can include the use of low-pollution construction equipment during demolition, construction, and maintenance phases of projects.

3.1.2 Support and Coordination

Southwest Detroit Environmental Vision (SDEV) has worked on retrofitting trucks for several years in the City of Detroit. Their *Clean Diesel Program* is a successful public-private partnership that has reduced diesel pollution in southwest Detroit, south Dearborn, and surrounding areas. This program is funded by the Michigan Department of Environmental Quality (MDEQ), the Michigan Department of Transportation (MDOT), the Environmental Protection Agency (US EPA) and local business partners.[13]

Efforts to expand the diesel retrofit program should build on the extensive work of SDEV and its private-public partnership. Further support and coordination for retrofitting efforts in the City of Detroit could include:

- Creating and/or expanding local partnerships (e.g., involving local trucking companies, the Detroit Climate Action Collaborative, Transit Riders United, Detroit Greenways Coalition) to promote current programs, advocate for additional funding (see Section 3.1.3), and develop new initiatives.
- Coordinating with national level partnerships, like the Moving Forward Network to share and promote best practices.
- Creating regional and state level partnerships (e.g., involving the Michigan Department of Environmental Quality, the Michigan Department of Transportation, U.S. EPA SmartWay Transport, Southeast Michigan Council of Governments, neighboring city governments) to promote current programs, advocate for additional funding, and develop new initiatives.
- Recruiting additional volunteers and team leaders to expand trucking surveys.

- Coordinating retrofitting with anti-idling and clean fuels initiatives.
- Coordinating workforce development programs with opportunities to provide training for retrofitting.

3.1.3 Incentives and Funding

Installing control technologies on existing diesel engines requires potentially substantial financial investments from the owners/operators. Costs vary widely, from about $1000 for an oxidation catalyst, $10,000 or more for a particulate matter filters,[14] and much more to replace a large diesel engine. Incentives and funding are necessary to increase the feasibility of expanded diesel retrofit programs. Options for generating incentives and funding include:

- Developing a state-level public recognition incentive program for businesses that are taking steps towards a clean fleet by burning less fuel, cleaner fuel, or using advanced technology to reduce emissions (i.e., using retrofits). Such programs could highlight companies and organizations committed to reducing environmental impacts. Examples include the Midwest Clean Diesel Initiative, sponsored by US EPA,[15] and *"2016 Top 50 Green Fleets"* from TruckingInfo.com, a leading trucking industry website with over 300,000 hits a month.[16]
- Incentivizing turnover of older trucks by subsidizing replacement with cleaner technologies (e.g. grants, voucher and scrap programs), as replacing vehicles can be more effective than promoting alternative transport

Conversion of the remaining 70% of the DPS bus fleet to propane gas would extend these cost savings.

modes or using other truck restrictions. A study of the I-710 Freeway in the San Pedro Bay Ports area in California found that fleet replacement with cleaner (especially zero-emission) trucks yielded greater emissions reductions compared to alternative transport modes and truck restriction lanes.[17]

- Encouraging the Detroit School District to apply to the EPA's School Bus Rebate Program to fund retrofits and replace diesel buses.
- Increasing use of federal and state funds for retrofit and replacement programs.
- Increasing state-level match funding for the Diesel Emission Reduction Act (DERA) funds to capitalize on additional federal-level incentive funding.

3.1.4 Planning and Regulations

Increasing the number of diesel retrofits will require involvement from multiple parties, including private trucking, industry, and construction organizations, state, local and federal governments, and community members. The City of Detroit could implement several planning and regulatory changes to increase the use of retrofits. Options include:

- Requiring low-emission vehicles and best available technologies in city contracts and requests for proposals.
- Requiring a mandatory checklist and resources of all partners (e.g. project owner/sponsor, construction manager, and contractor) involved in clean diesel construction projects in Detroit.
- Prioritizing city owned or operated fleets, and those contracted by the city to be low emission or retrofitted vehicles. Prioritization could target high visibility fleets (e.g., transit buses and garbage trucks) and vehicles operating in SW Detroit. For example, in 2015 Boston issued an ordinance requiring all pre-2007 city-owned vehicles to have retrofits or other technology to reduce emissions.[18]
- Replacing transit and school buses in Detroit with propane gas-fueled buses. In 2015, Detroit Public Schools (DPS) acquired 35 propane gas-fueled buses, which are cleaner and cost about 50% less to operate than diesel-fueled buses.[19] Conversion of the remaining 70% of the DPS bus fleet to propane gas would extend these cost savings.

Specific regulatory changes could also increase retrofits. Options include:

- Creating laws and/or ordinances at the local, state and/or federal level that require a cut-off date for diesel truck retrofitting, effectively forcing the retirement of older trucks. For example, to accelerate fleet turnover, in 2006 the Ports of Los Angeles and Long Beach, followed by the state of California in 2008, established regulations that required post-2007 emission controls, which decreased the average fleet age from 12.7 years in 2008 to 2.5 years in 2010. The new trucks use diesel particle filters and other technologies to substantially lower emissions of CO (by 30%), NO_x (48%) and $PM_{2.5}$ (54%).[20]
- Enacting a state-level bill requiring all heavy duty vehicles contracted in Michigan using state or federal funds to be equipped with modern pollution control devices. As an example, Rhode Island created a state-level *Clean Construction Diesel Retrofit Program* in 2010 requiring all heavy-duty vehicles contracted by the state with federal funds to be equipped with modern pollution control devices, adhere to the state's anti-idling law, limit idling to 5 minutes, and use clean burning ultra-low sulfur diesel fuel.[21] The law imposes relatively low costs on companies, and vehicle emissions were lowered by 20-90%.[22]

Footnotes

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4 Idling Controls

Idling controls reduce or eliminate pollutant emissions from cars, trucks, buses and construction equipment when vehicles are not in motion. These controls can be implemented using technological approaches, e.g., installing on-board auxiliary power units, energy recovery systems, and automatic turn-off and alert systems,[1] or by using institutional approaches, e.g., enacting and enforcing regulations that prohibit idling. For heavy duty trucks, idling reductions can be encouraged by truck stop electrification (TSE) that provides heating, air conditioning and power for truck appliances. Idling restrictions often target commercial trucks and buses, but emissions can also be reduced when anti-idling controls are used on other sources (e.g., construction equipment). Idling also occurs on congested roads when vehicles are stopped in traffic. Measures that reduce such congestion, including public transit, carpooling, walking, and cycling and other transportation controls that reduce peak use of roads can reduce congestion and emissions. These transportation control measures are addressed in a separate section *(See CAPHE Public Health Action Plan Section 6).*

Truck idling is a significant concern in Southwest Detroit. A 2013 survey indicated that truck pollution was one of the top concerns of residents in City Council District 6 (which includes Southwest Detroit).[2] In 2015, about 2.5 million trucks crossed the Ambassador Bridge, about 6900 trucks each day.[3] Many of these trucks idle at the bridge, tunnel and terminal areas in Detroit, and emissions from idling at such areas can be substantial. Across the U.S., idling truck engines emit an estimated 11 million tons of carbon dioxide (CO_2), 200,000 tons of oxides of nitrogen (NO_x), and 5,000 tons of particulate matter ($PM_{2.5}$) each year.[4] CO_2 emissions contribute to climate change.[5] Exposure to NO_x and $PM_{2.5}$ can cause a wide range of serious adverse health effects, including respiratory (e.g., asthma) and cardiovascular disease (e.g., hypertension).[6] PM from diesel

exhaust is considered a human carcinogen,[7] and NO_x emissions also form ozone (O_3), another widespread air pollutant with adverse health effects.[8] Idling controls would contribute to reductions in respiratory and cardiovascular diseases. Restrictions on idling are particularly important to reduce emissions, improve air quality and reduce adverse health effects in high traffic and congested urban areas.

IDLING RECOMMENDATION 1: Increase awareness of existing anti-idling efforts through an education and outreach campaign.

4.1.1 Education and Outreach

Education and outreach are critical elements for creating and implementing an integrated, city-wide campaign that builds awareness and commitment to anti-idling efforts. Focal audiences should include community residents, trucking companies, owner/operators, and decision makers. Education and outreach efforts should focus on increasing resident and owner/operator engagement with anti-idling efforts. *Green Dallas* is an example of a successful campaign, which included a sign program (requesting companies and organizations to post anti-idling signs), an educational component (featuring a website where people could learn more about the ordinance), and outreach to trucking companies (including brochures distributed at truck stops and trucking businesses).[9]

Components of an education and outreach campaign in Detroit should include:

- Outreach and education for community residents using multilingual materials (Arabic, English and Spanish) that provide information about the health effects of diesel exhaust, the benefits of reducing idling, information about Detroit's current anti-idling ordinance, reporting options, alternatives to idling, and anti-idling hot spots in the city and surrounding areas.
- Outreach and education to trucking companies, owner/operators and bus drivers using multilingual materials that provide information about the adverse health effects of idling, wear and tear on equipment, Detroit's anti-idling ordinance (e.g., violation fees and consequences), available anti-idling technologies (e.g. auxiliary power units), and the benefits of reduced idling, (e.g., reduced fuel costs, lower exposures for drivers/operators, and less frequent equipment maintenance).[10]
- Utilization of the U.S. Department of Energy's Idle Box Toolkit for idling reduction projects. This toolkit can inform drivers, fleet managers, and policymakers about the benefits of and strategies for reducing idling.[11] Washtenaw County has developed presentations, newsletters, videos, handouts, logos and signs that could be applied to campaigns in Detroit.[12]
- Outreach to local decision makers to enhance awareness of the need for and benefits of reducing idling. These materials could identify the number and location of sites where trucks consistently idle, health effects associated with air pollutants, and strategies and opportunities for developing and enforcing effective anti-idling policies and practices.
- Outreach and education focused on "hotspots," e.g., the new Gordie Howe Bridge, intermodal facilities, and other locations with high truck volumes, to build awareness and support for anti-idling campaigns among residents and decision makers. Increased anti-idling signage in idling "hot spots," e.g.,

Restrictions on idling are particularly important to reduce emissions, improve air quality and reduce adverse health effects in high traffic and congested urban areas.

using "No Idling Zone" signs and graphics placed in appropriate locations. Aspen's program, for example, used fliers placed on windshields, signs, and a small incentive program to encourage residents to report idling trucks in their neighborhoods.[13]

- Outreach to international trucking companies to increase awareness of city and state laws and ordinances. Because of the high volume of international truck traffic between Detroit and Windsor, it will be important to extend outreach to trucking companies based outside of the U.S. to assure awareness of, and compliance with, anti-idling restrictions in Detroit.

4.1.2 Support and Coordination

Organizations currently working on anti-idling efforts in Detroit include *Southwest Detroit Environmental Vision* (SDEV), *Mom's Clean Air Task Force, MI Air MI Health*, the *Detroit Asthma Coalition*, and the *Southeast Michigan Council of Governments* (SEMCOG). Supporting existing efforts and coordinating across organizations to promote education about and enforcement of anti-idling restrictions can help build a critical mass to reduce and/or regulate idling. New initiatives should also build off of previous anti-idling efforts in the City of Detroit, for example, working with restaurants and businesses that have already agreed to be 'anti-idling' establishments.

Support and coordination across groups could include:

- Supporting the anti-idling campaign plan developed by SDEV, including information dissemination and hosting of community events to raise awareness and share strategies for action.
- Collaborating with schools to combine anti-idling messaging with educational programming on student bike-riding programs, Safe Routes to Schools, and other programs. The Safe Routes to School Detroit Partnership, whose mission is to promote student safety and reduce negative health

outcomes,[14] uses volunteer vehicle patrols that monitor a 2 mile radius around schools and "walking school buses" that have children walk together with a supervisor. This program is coordinated with Complete Streets efforts to increase availability of safe biking and walking routes, and to reduce traffic and idling near schools. *Detroit Greenways Coalition* is also helping to create a network of bike and walk trails including projects at the Inner Circle Greenway and the Dequindre Cut.[15]

- Working with Complete Streets proponents to increase the number of safe biking and walking routes to school and to reduce traffic and idling near schools.
- Promoting initiatives between the City of Detroit Health Department, Authority Health, the Institute for Population Health, Southwest Solutions, Insurance Companies, Teamsters, and others.
- Coordination with schools, hospitals, and clinics to create anti-idling zones.

4.1.3 Incentives and Funding

Several sources could fund anti-idling education and outreach campaigns, especially if linked to the priorities of the funders, including:

- The Community Foundation for Southeast Michigan, which works with organizations and projects that focus on Wayne, Oakland, Macomb, Monroe, Washtenaw, St. Clair, and Livingston Counties. These projects should create solutions that make positive impacts through arts and culture, to the environment, and to health and human services.[16]

- The W.K.Kellogg Foundation, which promotes the welfare, comfort, health, education, feeding, clothing, sheltering, and safeguarding of children and youth. Topics encompass educating kids, healthy kids, secure families, community and civic engagement, and racial equity.
- The Kresge Foundation, whose mission is to invigorate city neighborhoods as envisioned in the Detroit Future City Strategic Framework Plan by funding projects that build on Detroit's physical, social, cultural, economic assets to promote quality of life in green, healthy, active neighborhoods.[17]
- The Herbert H. and Grace A. Dow Foundation, which aims to improve the educational, religious, economic and cultural lives of Michigan's people. Grant making priorities are flexible.[18]
- The Skillman Foundation, which provides grants to organizations that aim to make social impacts with stable financial practices with the goal of directly benefiting children, improving educational outcomes, and strengthening neighborhoods.[19]
- DTE Energy, which provides grants to organizations that focus on environment, leadership, K-12 and higher education, development and diversity.[20]
- The Hudson Webber Foundation, which strives to improve the quality of Detroit by focusing on physical revitalization, economic development, safe communities and the arts.[21]
- McGregor Fund, whose mission is to promote programs in areas of human services, education, health care, arts and culture, and public benefit, with a focus mostly on Detroit and the tri-county area.[22]
- The Daniel & Pamella DeVos Foundation, which allocates grants to organizations that aim to make the community more livable and sustainable for everyone, and that give people the capacity to improve their lives.

4.1.4 Planning and Regulations

Detroit's anti-idling ordinance was passed in 2010, however it is not widely enforced. Anti-idling campaigns should use education and outreach (See Section 4.1.1) as a tool to increase enforcement of this existing regulation (See Section 4.2).

In addition, education and awareness may focus on drawing attention to the limits of existing legislation and raising awareness of the potential to strengthen it through, for example, encompassing idling due to slowly moving vehicles in lines at industrial facilities or at international bridge crossings.

IDLING RECOMMENDATION 2: Increase enforcement of existing anti-idling ordinances.

4.2.1 Education and Outreach

Increasing anti-idling enforcement goes hand in hand with implementing a city-wide anti-idling campaign. The measures outlined in the Education and Outreach Section 4.1.1 describe the components of a successful campaign, which could help lead to increased enforcement. Targeted materials should also be created to educate trucking company owners and operators about the current ordinance. These materials should include information about the health effects of idling, the wear and tear this creates on equipment, the benefits of reduced idling (e.g., fuel savings, health of operators), and idling reduction technologies, which include: automatic engine shut down/start up systems, auxiliary power units, battery-operated heaters, and electrification systems that allow drivers to run some vehicle systems (e.g., heater and air conditioner) without operating the engine.

Other important education and outreach components include:

- Outreach to local decision makers to enhance awareness of the need for, and the benefits of, continued anti-idling enforcement (e.g. the number and location of local sites where trucks consistently idle;

operator and community health effects of exposure to diesel pollution) and strategies for developing and enforcing effective anti-idling policies and practices.

- Outreach and education to the Detroit Police Department (especially the 4th Precinct, which covers the area near the Ambassador Bridge and site of the Gordie Howe Bridge) on the anti-idling ordinance (e.g. health effects of idling, common hotspots, violation consequences, enforcement options).
- Increasing community-led monitoring and enforcement of truck traffic (i.e. truck surveys and hand-held monitoring). Information gathered systematically through these efforts can be used to raise awareness of violations and support calls for increased enforcement.
- Developing anti-idling hotlines, smartphone apps and/or web-based tools that enhance citizen engagement in reporting violations, aggregate time frames and locations of idling trucks, and send the information to the local police precinct. The reporting system developed by Philadelphia, PA to help implement anti-idling laws passed in 2008 serves as an example for the city of Detroit. Philadelphia's air pollution control agency, Air Management Services, is responsible for monitoring air pollutants and enforcing air quality standards. Residents can report idling violations in their neighborhood using a telephone hotline or a web-based mapping tool called IdleFreePhilly.org and clicking on the map where the idling issue is occurring.[23] This information is reported to Air Management Services, and the city's Clean Air Agency can issue a ticket if enough information is provided. In addition, the collected data allows the city to identify and address idling hot spots where additional enforcement efforts may be warranted.[24] A similar tool in Detroit would allow residents and others impacted by idling to report violations in real time to the Detroit police department and other enforcement entities.

To utilize resources effectively, enforcement should target specific areas, including privately-owned, state-owned, and federally-owned areas frequented by trucks.

4.2.2 Support and Coordination

Organizations currently working on anti-idling efforts in Detroit include *Southwest Detroit Environmental Vision* (SDEV), *Mom's Clean Air Task Force, MI Air MI Health*, the *Detroit Asthma Coalition*, and the *Southeast Michigan Council of Governments* (SEMCOG). In the early 2010s, several of these organizations, and others, partnered with the *City Council's Green Task Force* and the *Detroit Police Department* to form an *Anti-Idling Workgroup* to raise awareness about the Detroit ordinance and encourage more rigorous enforcement.

Further coordination with industry, trucking unions and transit could play an important role in enforcing the current ordinance, and could be combined with the education and outreach outlined in Section 4.1.1.

To utilize resources effectively, enforcement should target specific areas, including privately-owned, state-owned, and federally-owned areas frequented by trucks. These include the Ambassador Bridge and other areas with high truck traffic.

Coordinating with surrounding cities, particularly Dearborn, to pass anti-idling ordinances and/or working to pass state level anti-idling regulation could also be important strategies to decrease idling.

4.2.3 Incentives and Funding

Anti-idling ticket revenue could help fund enforcement by the Detroit Police Department (DPD). For example, a first offender ticket has a $150 fine: Issuing 4-6 such tickets each day would yield $219,000 to $328,000 annually.[25] Revenue would increase substantially with proper enforcement of repeat offenders (see Section 4.2.4).

4.2.4 Planning and Regulation

Detroit's anti-idling ordinance, passed in 2010, is enforced by the Detroit Police Department Traffic Enforcement Division.[26] This ordinance regulates commercial trucks >8,500 pounds and includes a five minute consecutive idling limit in any 60-minute period, a written warning for a first offence, and a fine of $150 for the operator and $500 to the owner for a second offense. Exemptions include non-commercial vehicles, those <8,500 pounds, when traffic conditions do not allow, when a truck is motionless for more than 2 hours and temperatures are below 25 degrees F, when trucks undergo state inspections, mining vehicles, and during hybrid vehicle recharging. Idling restrictions do not apply to power auxiliary equipment, emergency vehicles, and electric, hydrogen or natural gas powered vehicles.[27] This ordinance could be strengthened by:

- Developing a system to document prior violations, allowing police to ticket at an appropriate level;
- Enabling multi-agency enforcement, e.g., by the parking department, the health department, customs officials, and the Department of Transportation. For example, Chicago's 2009 anti-idling ordinance is enforceable by Department of Public Health (CDPH) inspectors, traffic control aides, parking enforcement aides, and police officers. Enabling multiple agencies to enforce anti-idling ordinances can help to alleviate enforcement issues faced by cities like Detroit.[28]
- Creating state-level anti-idling restrictions that enable enforcement by state and federal agencies. Anti-idling regulations are incorporated into State Implementation Plans (used to assure compliance with the National Ambient Air Quality Standards) in Connecticut, Massachusetts and Rhode Island, where EPA has taken enforcement actions against trucking fleets for alleged violations of anti-idling regulations.[29] Other examples of state anti-idling regulations have been compiled by EPA.[30]
- Creating a violation registry for drivers, which would allow enforcement agencies to track repeat offenders, and potentially increase their fines.
- Encompassing idling due to slowly moving vehicles in lines at industrial facilities or at international bridge crossings, especially when these areas are surrounded by neighborhoods.

In addition to strengthening the existing anti-idling ordinance, local decision makers should consider regulation and planning strategies that reroute trucks from densely populated areas or areas with sensitive land uses, e.g., schools and daycare facilities. Such policies require identifying truck routes and idling locations near these areas, which can be facilitated by partnering with Community Based Organizations, stakeholders and volunteers. Once current routes are identified, alternative routes can be designated, publicized and enforced.[31] Anti-idling ordinances would still need to be enforced along these new truck routes.

IDLING RECOMMENDATION 3: Encourage and incentivize trucking, delivery and bus companies and their drivers to minimize idling.

4.3.1 Education and Outreach

Education and outreach materials tailored to trucking and bus companies, truck and bus drivers, and others could raise awareness regarding idling, air quality, health, economic, and environmental effects. These materials could be coupled with the outreach and education campaign described in Section 4.1.1. The materials should be multilingual and provide information about the adverse health effects of idling, wear and tear on equipment, Detroit's anti-idling ordinance (e.g., violation fees and consequences), available anti-idling technologies (e.g. auxiliary power units), and the benefits of reduced idling, e.g., reduced fuel costs, lower exposures for drivers/operators, and less frequent equipment maintenance.[32]

For trucking companies, awareness could be increased using the EPA's outreach materials on *SmartWay Partnerships,* which are voluntary and individualized collaborations between the EPA and the freight industry that aim to conserve fuel, lower emissions and improve transportation efficiency.[33] One such partner is Gemini Transport of Dearborn. Creating positive publicity for trucking companies working to reduce idling, and sharing their procedures could be used to establish *best practices*. These best practices could be shared with others in the trucking community and combined with a list of companies who frequently violate the anti-idling ordinance. This type of publicity could help create public pressure to decrease idling, and provide positive examples for how to do so. The *Utah Clean Cities Coalition* publicizes involvement in such initiatives and uses designations of 'bronze', 'silver', 'gold' or 'platinum' corporate partners.[34]

At schools, education and outreach could include posting 'no-idling' signs at school pick-up locations to encourage bus drivers and parents to turn off their engines when parked. Community organizations could also host idling reduction and clean school bus workshops for school bus drivers and school officials. The *Utah Clean Cities Program, National Energy Foundation,* and *Environmental and Energy Study Institute* partnered to create curricula and methods for providing signage at schools.[35] Materials from the EPA available to help reduce school bus idling include a sample school bus idling policy, information about starting a *Clean School Bus Idle Reduction Campaign*, and information about clean school buses.[36]

4.3.2 Support and Coordination

Anti-idling campaigns can partner with industry, trucking unions and transit (e.g. Gemini) to create new and innovative models. Several resources can be shared with these organizations to support best practices and to improve worker and community health, (e.g., the *Best Fleet Practices* and other EPA resources that promote cleaner technologies with industry, unions and transit authorities.)[37]

Encouraging trucking companies and sites where trucks commonly idle to build drivers lounges and advocate for the use of idling reduction technologies (e.g. queuing systems)

Designating places where trucks can idle that are distant from residential areas, schools, hospitals or residential facilities, can be used to reduce air pollution exposures, especially during special events.

at terminals and hotspots, (e.g. customs plaza at the Gordie Howe Bridge and MDOT-owned rest areas) could also play a role in idle reduction. For example, the Northwest Council of Governments created areas where drivers can relax while their trucks are being loaded or unloaded, reducing their need to idle vehicles. Lounges can offer amenities like internet, cable TV, and food and beverages to encourage their use.[38] Additionally, companies should participate in the EPA's SmartWay Partnership, mentioned in Section 4.3.1. Coordination with workforce and educational training programs for truckers, like that of Southwest Solutions, could also help inform truckers about current idling issues. Community organizations, schools and parent groups, like the Detroit Parent Network, can also form partnerships to reduce idling at schools.

4.3.3 Incentives and Funding

Given the substantial economic benefits of reduced idling (e.g., reduced fuel costs and lower maintenance costs), trucking companies should create incentives for drivers to reduce idling, such as cash bonuses, points programs for truckers using electric plug-ins, points on fleet cards, designated lounges with refreshments, free Wi-Fi, and exercise equipment to encourage truckers to turn off cabs and take breaks, rather than idling trucks to keep cabs warm.

Other potential sources of incentives and funding include:

- Creating incentives to use truck stop electrification (TSE), a network of electric power set-ups that provide heating, air conditioning and power for appliances without requiring engine power. Single-system electrification provides these functions as a stand-alone system; Dual-system electrification requires both on- and off-board equipment.[39]
- Applying to the *Vehicle Technologies Office* for grants to support idle reduction technologies, such as plug-in electric drive vehicle programs.
- Establishing reward programs for bus drivers that successfully reduce idling. Businesses, non-profits working on clean air, and parent-teacher organizations can donate gift certificates and other items for these programs.[40]
- Incorporating anti-idling incentives into Detroit RFP process, for example, by prioritizing organizations who participate in the *EPA's SmartWay Program* for subcontract selection.

The EPA *Diesel Emissions Reductions Projects* (DERA) offer grants and rebates for projects that reduce diesel emissions. Organizations may apply through federal or state-led programs. Eligible projects include: certified emission control technologies (e.g., exhaust controls, engine upgrades, verified idle reduction technologies, verified aerodynamic technologies and low rolling resistance tires), and certified engine configurations (e.g., engine repowers and vehicle or equipment replacement).[41] Heavy-duty highway vehicles, locomotive engines, marine engines and non-road engines, equipment or vehicles used in construction, handling of cargo, agriculture, mining or energy production could benefit.[42] Both the federal program and the *Michigan Clean Diesel Program* issue yearly requests for proposals.[43]

4.3.4 Planning and Regulation

Designating places where trucks can idle that are distant from residential areas, schools, hospitals or residential facilities, can be used to reduce air pollution exposures, especially during special events like the Auto Show.

However, it is preferable to simply reduce idling using strategies such as:

- Electronic Management systems at custom stations that facilitate traffic flow and reduce backups at border crossings;
- Plug-ins at truck stops that allow refrigerated trucks to remain cool without idling;
- No-car zones at schools to reduce exposure of children during school pick up and drop off periods.

For schools, an anti-idling policy for buses and other vehicles could be developed and implemented throughout the Detroit Public School District. For buses, the policy might include: (1) turning off engines as soon as possible after arriving at loading or unloading areas; (2) restarting engines only when ready to depart; (3) requiring that buses be moving whenever the engine is on; and (4) limiting idling time during early morning warm up to no more than 5 minutes.[44]

State programs could reduce idling across the region. These could be incorporated into State Implementation Plans (SIP; *See the CAPHE Resource Manual Section 4*, which details policies and programs designed to achieve compliance with National Ambient Air Quality Standards). An important opportunity to use SIPs for this purpose will come with the proposed ozone non-attainment status for southeast Michigan.[45] Idling emissions include ozone precursors, e.g., VOCs and NO_x, which will likely be targets for proposed controls in the SIP. The SIP could require infrastructure to support reduced idling, e.g., plug in stations at truck stops and other measures.

Footnotes

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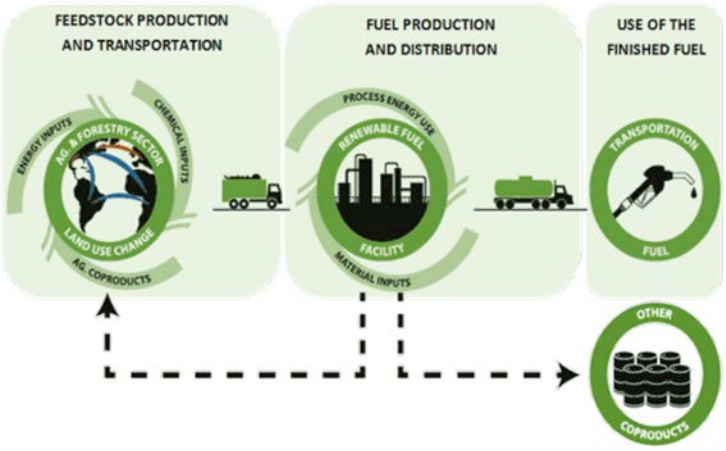
5 Clean Fuels

"Clean fuels" that have low emissions of air pollutants can be used to power cars, trucks, buses and other on-road vehicles, as well as non-road vehicles and equipment such as construction vehicles, cranes and pumps. Examples of clean fuels include most types of ethanol, biodiesel, natural gas, biogas, electricity, propane and hydrogen.[1] Some of these fuels can be substituted directly for conventional fuels, while others require special equipment or retrofits.

Clean fuels produce less pollution throughout their *life cycle* than conventional petroleum fuels like gasoline and diesel. The life cycle encompasses production, transport, storage and use (Figure 7-1). The Clean Air Act requires that clean fuels have lower life cycle greenhouse gas emissions (e.g., at least 20% lower than "conventional renewable" fuels like corn ethanol, and 60% lower for cellulosic biofuels) relative to a 2005 petroleum-based fuels baseline.[2] Biofuels sold for on-road use must be certified and meet licensing requirements.

FIGURE 7-1: *Conceptual model of a life cycle assessment for a clean fuel alternative to conventional, petroleum-based fuels. Taken from: US EPA, https://www.epa.gov/renewable-fuel-standard-program/lifecycle-analysis-greenhouse-gas-emissions-under-renewable-fuel*



Each day, the US consumes 375 million gallons of gasoline and 195 million gallons of diesel, jet, and other fuel for trucks, air travel, rail and transit.[3] While modern vehicles incorporate many pollution control technologies, the transportation sector accounts for the largest share of many pollutants in urban areas, including $PM_{2.5}$, nitrogen oxides (NO and NO_2), and volatile organic compound (VOC) emissions, which cause hundreds of billions of dollars per year of adverse health and

environmental impacts.[4, 5] In Wayne County, on-road truck traffic produces about 752 tons/year of diesel exhaust $PM_{2.5}$,[6] and the transportation sector produces about 30% of all greenhouse gas emissions in Detroit.[7] Replacing conventional fuels with cleaner alternatives can reduce emissions of these pollutants.

There are many types of clean fuels.

- Ethanol is the most widely used clean fuel. Currently, it replaces 10 to 15% of petroleum-based gasoline throughout most of the US. Vehicles year 2010 and later can use E15 (15% ethanol blend) and "flex fuel" vehicles can use E85 (85% ethanol).[8] Currently, most ethanol comes from corn (some from sugarcane and soybeans), and the Midwest is the largest US producer.[9] Ethanol production uses extensive resources (water, fertilizer, agricultural land) and corn-based ethanol production is limited to 15 billion gallons per year.[10] Ethanol from cellulosic feedstocks (e.g., switchgrass and crop residue) is preferred for environmental reasons, but production is more difficult.[11] Research is being conducted to lower costs and improve the energy efficiency of ethanol production.[12]

- Biodiesel is commonly used to replace petroleum-based diesel. Biodiesel is typically sold as a blend (e.g., B20 is a 20% biodiesel blend). Most biodiesel is made from soybean oil, though other feedstocks (e.g., used cooking oil and animal fats) are used.[13] Blends up to B20 can be used in existing engines without modification. Higher blends have lower energy content and can gel when cold, thus, their use requires engine and fuel system modifications.[14] As of October 2016, Michigan had two large biodiesel facilities producing 10 million gallons of biodiesel fuel per year.[15]
- Hydrogen is used in fuel cells, which produce electricity without harmful emissions. This fuel has the potential of being much more efficient than conventional vehicles,[16] however, producing hydrogen is currently energy intensive, and gaps in transportation, distribution and storage systems preclude its use.
- Propane can be used in light, medium, and heavy-duty vehicles, and existing gasoline-powered vehicles can be retrofitted to run on propane. Propane can be less expensive than conventional gasoline, but cost savings can be offset by reduced fuel efficiency.[17]
- Natural gas as compressed natural gas (CNG) and liquefied natural gas (LNG) is generally cleaner than gasoline or diesel alternatives. However, most natural gas is produced from conventional wells or hydraulic fracturing. Renewable natural gas (RNG) produced from landfills and other sources is chemically identical to natural gas, and can be used in natural gas engines without modifications or special equipment.[18]
- Electricity is increasingly used to power vehicles. Most are light duty vehicles, but a few medium and heavy duty vehicles are available. Hybrid electric vehicles (HEV, e.g., the Toyota Prius) use conventional (or some clean) fuels. Plug-in hybrid electric vehicles (PHEV, e.g., the Chevrolet Volt) and all-electric vehicles (EV, e.g., the Nissan Leaf) use electricity from the grid or other source. All of these vehicles have lower tailpipe emissions

than conventionally-fueled vehicles.[19] While costing more than conventional vehicles (partially offset by some federal and state incentives),[20] operating costs may be lower due to their higher efficiency. The fuel life cycle must be considered when evaluating the impacts of these vehicles. In Michigan, much of the electricity required to run PHEVs and EVs comes from coal (46%),[21] thus the use of these vehicles shifts emissions from the tailpipe to the smoke stacks of power plants. Increased electrification of the transportation sector should be accompanied by the increased use of renewable energy and cleaner alternatives than coal *(see CAPHE PHAP Renewable Energy Chapter 2, Recommendation 2.1)*. Other considerations for electric vehicles include the manufacture and disposal of batteries and the availability of charging stations that allow use of these vehicles over long distances.

CLEAN FUELS RECOMMENDATION 1: Increase use of the clean fuels best suited for Detroit and Michigan.

This recommendation has three elements: (1a) Increase use of clean fuels in vehicles (e.g., cars, buses, trucks, ships), construction equipment, and industry (e.g., pumps, generators, cranes); (1b) Convert transit vehicles operated by DDOT, SMART, QLINE and schools to clean fuels[22]; (1c) Improve the electric vehicle and clean fuels infrastructure (e.g., install charging and CNG stations).

5.1.1 Education and Outreach

Education and outreach that informs industry, small businesses, municipalities and citizens about the benefits of clean fuels is a first step in increasing their use. Many of the practical, economic and health benefits of using clean fuels are not widely known. Materials should be developed and disseminated that describe what clean fuels are, how they are used, how they differ from traditional fuels, and why

they are important. To increase clean fuel use, local groups and organizations could create a forum for businesses using clean fuels and technologies to share experiences and best practices. Companies considering converting to clean fuels could learn about the benefits of cleaner fuels, tax incentives, and return on investment (ROI). Partnerships to promote education are mutually beneficial and can improve air quality while creating positive press for companies using clean fuels. In Detroit, *Southwest Detroit Environmental Vision* (SDEV) works with local companies to reduce diesel emissions and to expand educational and outreach opportunities for clean fuels.

Environmental advocacy groups, unions and others should implement educational campaigns that reach local fleets, truck drivers and industries. Campaigns can highlight the health impacts for drivers who operate vehicles using conventional fuels and the health benefits of cleaner fuels. For example, the *Fuel What Matters* public education awareness campaign administered by the North Carolina Clean Energy Technology Center and sponsored by the state's Department of Transportation connects residents with clean fuel technologies and practices to improve air quality, save money, and reduce dependence on foreign oil.[23] An interactive website provides users (e.g., parents, students, fleet operators) with tailored content, including information, resources,

and action steps for converting to clean fuels. The awareness campaign also uses billboard, radio, and TV advertising. Another example of an educational campaign is *Drive Clean Chicago,* funded by the Chicago Department of Transportation and federal Congestion Mitigation and Air Quality Improvement Program, which aims to accelerate adoption of alternative fuel vehicles. Its *Drive Clean Trucks* initiative offers financial incentives to fleet owners to shift diesel fleets to zero and low emission vehicles.[24]

A clean fuels website for Detroit would share information about the economics of driving a hybrid, electric, or cleaner fuel vehicle, focusing on the return on investment (ROI) for individual drivers, businesses, and fleet owners/operators. The City of San Francisco, for example, has web sites for clean fuels as well as Sustainable Commuting, which describe mobility options to help decrease congestion and emissions.[25]

Education and outreach efforts must also reach decision makers for transit (QLINE, RTA, DDOT, SMART), school systems, and constituent stakeholders (e.g., students, parents, commuters, local businesses and residents) and inform them on the economic, environmental and health benefits of clean fuels.

5.1.2 Support and Coordination

Detroit should build and expand partnerships with local environmental groups to develop programs aimed at promoting clean fuels across different sectors and areas of the city. For example, the *Clean Energy Coalition's Green Fleets Program* awarded $5.4 million to DTE Energy to convert 170 gasoline-powered utility vehicles to natural gas, construct two natural gas fueling stations and refurbish 13 others across Michigan. This program will save about 250,000 gallons of gasoline each year.[26] As part of Detroit's *Clean Cities Program*, Metro Cars partnered with the *Clean Energy Coalition* in 2010 to purchase cars that operate on propane gas. Most of Metro Cars fleet (approximately 300) operating at the Detroit Metropolitan Airport and other Michigan sites, is now operated on propane.[27]

Creating partnerships between government, education and nonprofit organizations can promote clean fuels policies. For example, *Wisconsin Clean City* partnered with the State Energy Office and the Wisconsin State Technical College System to create *Forwarding Wisconsin's Fuel Choice*, a two-year program designed to implement policy, reduce barriers and provide training and educational initiatives to expand alternative fuels market.[28]

Employers and government agencies can coordinate activities to provide more clean fuel infrastructure, including electric vehicle charging stations (See Section 5.1.3). Currently, *Google's "plugshare" website* highlights the location and availability of public and private electric vehicle (EV) charging stations.[29] Several charging stations are currently available in Detroit, including sites at: Wayne State University, Henry Ford Health System, General Motors Headquarters, and the Detroit Medical Center. Placing these sites in prime parking areas increases their visibility and desirability.[30]

The Obama administration also created a partnership between the Department of Transportation (DOT), the Air Force and the Army, and the Environmental Protection

Education and outreach efforts must also reach decision makers for transit (QLINE, RTA, DDOT, SMART), school systems, and constituent stakeholders (e.g., students, parents, commuters, local businesses and residents…)

Agency geared towards creating electric vehicle charging infrastructure.[31] Detroit might partner with the federal government to procure electric vehicle fleets at a discounted value.

Supporting and showcasing businesses transitioning to clean fuels can help to demonstrate the benefit of clean fuels to other businesses. Detroit could announce and recognize local organizations that have adopted clean fuels. The Louisville, CO *Green Business Recognition Program* works with *Partners for a Clean Environment* to recognize businesses for sustainable and environmentally-friendly practices, providing three levels of recognition by the City Council, decals, a press release highlight, and an invitation to a year-end celebration.[32]

Collaborative networks and coalitions of businesses already using clean fuels should be created and expanded to help spur new ideas and innovations that increase the benefits of using clean fuels and that serve as a resource to others considering clean fuels and technologies. These collaborations are relatively common at both state and local levels.[33] For example, *Clean Fuels Michigan* is a collaboration of 30 companies and organizations focused on growing a high-tech, clean transportation industry in Michigan.[34] A second example is the T*riangle Clean Cities Coalition* in Durham NC, which was founded in 1999 to improve air quality and reduce dependence on petroleum by promoting alternative transportation fuels. This coalition brings together fleet managers, local and state government officials, fuel and vehicle providers, and interested citizen groups.[35] The *Clean Energy Coalition* or other Detroit-based organizations could expand to include a broad, diverse range of stakeholders and decision-makers (e.g., residents, businesses and non-profit groups), and then organize and host workshops describing clean fuel options, benefits, best practices, and economics.

Partnering with events around Detroit could raise awareness of clean fuels. For example, the annual *Advanced Clean Technology Expo* brings together transportation and logistics companies from across the US in a 4-day meeting about clean transportation. Major sponsors include Bloomfield Township-based *Penske Corporation*.[36] This expo might be an excellent forum to disseminate information about clean fuels. Virginia Clean Cities co-hosted an Alternative Fuels Workshop with the national trade associations of the alternative fuels industry to share information about alternative fuels, incentives and next steps.[37]

Coordination with local organizations, including Transit Riders United (TRU), Motor City Freedom Riders, Southwest Detroit Environmental Vision (SDEV), Teamsters (bus drivers' union), school districts, parent-teacher organizations, and others to promote education and advocacy activities related to transit (see previous

section) can help extend the effectiveness of these efforts in promoting awareness of clean fuel options and their benefits.

5.1.3 Incentives and Funding

Although some clean fuel options are economical in the short run, others require investments to purchase fuel conversion systems, charging stations, or other equipment, which increases payback. Detroit and/or Michigan could develop and implement incentive programs that encourage the use of zero-emission vehicles. Delaware's *Clean Transportation Incentive Program*, for example, promotes wider use and acceptance of electric and clean fuel vehicles, and seeks to boost investment in clean fuel infrastructure using a clean vehicle rebate program, heavy-duty vehicle rebate program, electric vehicle charging infrastructure rebate program, alternative fueling infrastructure grants, and innovative transportation greenhouse gas reduction grants.[38]

Detroit's contracting and Request for Proposal (RFP) point system could be amended to include points for companies that operate cleaner fuel vehicles and equipment. The *Detroit Environmental Agenda* is developing a sustainability checklist, which the City Council plans to use to rate RFPs according to sustainability goals. Use of clean fuels could gain points for sustainability, increasing the likelihood of selection under the checklist.

Detroit's contracting and Request for Proposal (RFP) point system could be amended to include points for companies that operate cleaner fuel vehicles and equipment

Use of clean fuels can be encouraged by federal, state and local grants or matching funds that support investments such as:

- Tax incentives for individuals, businesses and truck fleet owners that use clean fuels. These can include promotion and expansion of Michigan's current clean fuels incentives.[39]
- State and federal grants that support clean fuels and fleet upgrades. For example, Texas has obtained approximately $38 million from federal, state and local sources to replace 700 aging buses and retrofit 7000 buses (average contribution of $30,113 per replaced bus and $2,589 per retrofitted bus).[40] In 2015, *Detroit Public Schools* (DPS) acquired 35 propane gas-fueled buses, which are cleaner and cost about 50% less to operate than diesel-fueled buses.[41] Conversion of the remaining 70% of the DPS bus fleet to propane gas would further extend these cost savings. Bus fleets operated by the DDOT and SMART could request grant support for clean fuels and upgrades.
- Grant-writing assistance to organizations (e.g., industry, government, community organizations and other interested in applying for clean fuel funds. For example, *Clean Fuels Ohio* partners with clients to develop competitive grant proposals.[42]
- Incentive programs that encourage fleet owners, drivers and companies to replace or upgrade polluting vehicles with clean fuels and technologies, including discounts for purchasing cleaner engines. Examples include: Michigan's *Clean Diesel Grants,* which has a partnership with Southwest Detroit Environmental Vision (SDEV) and reduced an estimated 508 tons of CO_2, 155 tons of NO_X, and 49 tons of CO in the past three years;[43] EPA's Clean Diesel National Grants used for aerodynamic technologies, engine replacements, and clean diesel technologies;[44] and Federal Highway Administration's *Congestion Mitigation and Air Quality Improvement* (CMAQ) *Program*, which channels money to state and local transportation projects to help meet requirements of the Clean Air Act, including remediating nonattainment areas.[45] With the pending designation of Southeast Michigan

as a non-attainment area for ozone, Detroit and other governments can apply for these funds.

- Incentive programs to businesses to encourage employees to buy clean fuel vehicles or use zip cars, public transit or non-motorized transportation. Incentives can be provided in the form of energy tax credits awarded to businesses.
- Awards and recognition programs for businesses that invest in clean fuels and low emission vehicles. For example, Oregon's Department of Environmental Quality's Fleet Forward Program acknowledges companies that use clean fuels, install advanced exhaust controls, and/or conserve fuel; these firms receive public recognition of their leadership, information about their transportation footprint, website stories, vehicle decals, and an improved chance of qualifying for contracts calling for cleaner fleet.[46]

Incentives for individuals to use clean fuels and vehicles include:

- Offering commuter tax benefits to workers who commute using transit or clean fuels.
- Offering rebates to purchase or lease clean fuel vehicles and/or charging stations as in Delaware's *Clean Transportation Incentive Program*.[47]
- Placing electric vehicle charging stations close to business entrances.
- Offering a cash incentive to owners who retire older and more polluting cars as in California's *Cash for Clunkers Program*.[48]

5.1.4 Planning and Regulations

Regulations and ordinances should require government contractors to use clean fuels and/or upgrade their fleets. Such regulations vary in terms of their restrictions and penalties for non-compliance. For example, the University of Michigan requires that diesel equipment utilized on project sites (except delivery trucks) use biodiesel B20. New York City Local Law 77 (enacted in 2004) requires the use of ultra-low sulfur diesel fuel (ULSD) and "best available technology" (BAT) for reducing emissions from non-road equipment used on city construction projects.[49] (This fuel is now commonplace.) Chicago's *Clean Diesel Construction Ordinance* in 2014 banned high polluting diesel equipment and created a *Clean Fleet Score* for equipment and vehicles used by potential contractors.[50] Detroit could require the use of clean fuels and/or fuel-efficient vehicles in all City contracts; this could also be incentivized through the RFP point system discussed in the previous section.

Detroit could require that all new and renovated buildings include electric charging stations for vehicles. For example, Vancouver, Canada requires that 20% of the parking stalls in new apartment buildings, condos, townhouses, and other buildings with a minimum of three homes include a receptacle for charging cars.[51] The city might adopt elements of the LEED Standards for buildings that encourage low energy and transit options.

Detroit could require that companies reduce

their carbon pollution. Oregon's *Clean Fuels Program,* for example, requires oil companies to reduce carbon pollution from fuel by 10% by 2025 by blending low-carbon biofuels or purchasing credits that support electric vehicles, natural gas, propane and other clean fuels.[52] *(See CAPHE PHAP Renewable Energy Chapter 2.)*

Investments by Detroit and/or Michigan in long-term infrastructure, such as electric vehicle recharging stations, is critical to support the use of alternative fuels and technologies. For example, in 2014 California announced it was installing 475 electric vehicle chargers throughout the state, worth millions of dollars.[53] Such efforts should be complemented with programs that increase the amount of electricity generated from renewable sources.

Two other regulatory programs may be worth considering, although their effectiveness and acceptability may be controversial:

- Emissions testing could be used to identify vehicles that are poorly maintained or with malfunctioning emission controls. Many states charge a fee for emissions testing, which discourages testing and burdens low-income families. A free model, as offered by Illinois, would be more favorable.[54]
- Low emission zones (LEZ) could be created in Detroit to improve air pollution by banning vehicles with higher emissions from entering certain areas of the city and/or requiring that higher polluting vehicles pay more if they enter low emission zones.[55] LEZs have been used in London, Berlin, Lisbon and other European cities.[56] Vehicles burning clean fuels would be exempt from these higher fees *(See CAPHE Resource Manual Section 7.9).*

CLEAN FUELS RECOMMENDATION 2: Increase local production of second generation clean fuels, particularly advanced biofuels and biodiesel from waste oil.

Local production of clean fuels can help reduce emissions associated with transporting fuels, increase availability of clean fuels, provide employment, positively impact the local economy, and recycle waste materials. Importantly, benefits of local production must outweigh economic and environmental costs. Thus, local production should utilize second generation biofuels, which are produced from sources other than food crops. In addition to utilizing appropriate feedstocks, production facilities should employ equipment and practices that minimize pollutant emissions, and produce high quality fuel that produces low emissions with negligible odors. Finally, local production facilities must be located in areas where truck traffic and any local emissions are acceptable to the community.

5.2.1 Education and Outreach

Educating city residents and particularly young people about the benefits of clean fuel, potential careers and other opportunities in clean fuel production could help to improve air quality and make Detroit a leader in clean fuel technologies.

Local educational institutions could work with the City of Detroit to develop educational programs, courses, workshops and certificates to offer to Detroit residents, including youth and small business owners interested in clean diesel production. For example, the University of Loyola Chicago's *Biodiesel Program* offers

continuing education courses on small-scale biodiesel production. The program partnered with the Chicago Park District to launch a pilot biodiesel plant that will help fuel their vehicle fleet. The program serves as a resource for high schools, universities, small businesses, and municipalities across the US interested in making biodiesel.[57]

Local biodiesel producers should offer tours and open houses to community groups, small businesses, schools and others who want to learn about clean fuels and to increase awareness of its benefits and possible careers. This could apply to Detroit Grease, a firm that recovers cooking grease and converts it into off-road diesel fuel,[58] and which recently moved from Ann Arbor to Detroit.

5.2.2 Support and Coordination

Establish a Detroit-based program to collect used cooking grease to produce biodiesel that fuels the city's vehicles. The City of San Francisco's *Water Pollution Prevention Program* offers a free fat, oil and grease (FOG) collection service to restaurants as part of a citywide effort to divert FOG from the sewers and turn it into biofuel to power San Francisco fleets.[59] Detroit could establish FOG drop-off sites, offer residents the opportunity to safely dispose of their kitchen waste, and provide an additional raw material (feedstock) for biodiesel production. Detroit could consider partnering with existing businesses (e.g., Detroit Grease) to expand services and/or support others interested in creating clean fuel businesses.

Biodiesel cooperatives could be created to facilitate used grease pick-up and biofuel production. Cooperatives among grease collection services, biofuel producers, and environmental organizations can provide biodiesel fuel to members for use in their vehicles, generators and furnaces. Feedstock typically uses waste grease or local sources of high quality plant oils (e.g., palm, rapeseed or canola, coconut). Produced fuels can be distributed at a dispensary or delivered, based on customer demand. An example is *Piedmont Biofuels*, a small cooperative in North Carolina that collects used cooking to produce clean fuel for coop members.

The City of Detroit could also support and coordinate with Detroit businesses (e.g., Detroit Grease) to produce clean fuels that can be used in city fleets. Because acquiring the license to produce on-road biodiesel can be difficult, grease collected locally is often processed and sold out-of-state. Local production and use is environmentally and economically beneficial. (See Section 5.2.4)

5.2.3 Incentives and Funding

Incentive and funding mechanisms to build infrastructure and capacity to produce and use clean fuels include:

- Biofuels Infrastructure Grant Program that funds public service stations to install or convert fuel delivery systems to high blend ethanol E85 and/or biodiesel blends of B20 or higher.
- Michigan Biomass Energy Program - Workshop and Event Funding, which provides up to $2,500 for workshops or events to promote the production, commercialization, and use of biomass in Michigan.
- Alternative Fuel Development Property Tax Exemption, which applies to industrial property used for, among other purposes, high-technology activities or the creation or synthesis of biodiesel fuel.
- The Michigan Public Service Commission's Low-Income and Energy Efficiency Fund that supports the implementation of energy

efficiency and renewable energy projects in the state.

- The USDA's Bio-refinery Assistance Program, which offers loan guarantees for the development, construction, and retrofitting of commercial-scale bio refineries.

Individuals, businesses and community groups could advocate for more state funding to support clean fuel production by promoting its economic benefits (e.g. "pro-business," financially profitable, job creating), as well as its environmental benefits.

5.2.4 Planning and Regulations

Regulations and licensing requirements apply to local production and sales of fuels. Revised regulations could help make local production more feasible and economically and environmentally sustainable. Detroit could create and support regulations that encourage local production while maintaining safeguards for residents and the environment. Portland, OR has used an array of tools and incentives to promote a robust local biofuels market, and city leaders believe that biofuels offer local and regional economic development opportunities, improved air quality, reduced greenhouse gas emissions, and decreased dependence on volatile oil supplies.[60]

Detroit could invest in local biofuel production to reduce fossil fuel use, reduce emissions, save money, and power the city's fleets. In addition to the San Francisco example described earlier (Section 5.2.2), Raleigh, NC has a fully operational mobile biofuel processor, housed within a trailer (see photo) and is pursuing the development of an on-site oilseed processing facility.[61]

Clean fuels production can be encouraged using a carbon tax or requirements that the clean fuel production is carbon neutral or lower emitting than conventional production. For example, in 2006, Boulder instituted a carbon tax on the use of electricity generated from fossil fuels — the first policy of its kind in the U.S.[62]

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6 Transportation Control Measures

Transportation control measures (TCMs) are strategies that reduce transportation-related air pollution, greenhouse gas (GHG) emissions, and fuel use by reducing vehicle-miles-travelled (VMT) and improving roadway operations and efficiency. TCMs make transportation more efficient by managing and/or improving the transportation system, including improving public transit, increasing the capacity of existing roadways, and making improvements to the built environment.[1] TCMs improve air quality by removing vehicles from the road, reducing VMT, and "smoothing" traffic flow, since vehicles tend to have higher pollutant emissions in stop-and-start driving, (e.g., when transitioning between free-flow and congested conditions).[2] Additional and important co-benefits of TCMs can include decreased congestion, increased access and mobility, and increased opportunities for physical activity. TCMs have focused on on-road vehicles and in particular passenger vehicles, although they can apply to trucks and other commercial vehicles.

The transportation sector is responsible for a substantial fraction of ozone (O_3) precursor emissions, including volatile organic compounds (VOCs) and oxides of nitrogen (NO_x). In addition, this sector emits most (75%) of the carbon monoxide (CO) in the USA, about a third of greenhouse gas emissions (e.g., carbon dioxide, CO_2), particulate matter (PM_{10} and $PM_{2.5}$), and many toxic air pollutants.[3] A large part of these emissions is due to light-duty vehicles (cars, sport utility vehicles, pickup trucks and minivans). Greenhouse gas emissions in the transportation sector have increased by 16% since 1990;[4] emissions of CO, NO_x, and VOCs have tended to decrease; trends for $PM_{2.5}$ have been partly offset by increased VMT and additional diesel vehicles. In Detroit, on-road vehicle emissions represent over 50% of CO emissions, over 50% of NO_x emissions (20% from gasoline cars and trucks,[5] 27%

of VOC emissions, about 15 to 30% of $PM_{2.5}$ emissions, and a small fraction (0.4%) of SO_2 emissions *(see CAPHE Resource Manual Section 5.3).* If replacement transit uses clean fuels, emissions can be further reduced.[6] While TCMs reduce emissions without changing the vehicle fleet or fuels, TCM recommendations are complemented by recommendations for diesel engine retrofits (see CAPHE Public Health Action Plan Section 3), idling controls (see CAPHE Public Health Action Plan Section 4) , and clean fuels (see CAPHE Public Health Action Plan Section 5).

TCMs implemented in southeast Michigan could lower air pollution emissions, concentrations, and adverse health impacts associated with traffic-associated air pollutants.[7] The impact and number of people affected depends on the type and scale of the selected mitigation strategies. TCMs could be a focus for regional transportation planners and environmental agencies in the coming months and years given the pending ozone non-attainment designation for the seven county southeast Michigan area.[8, 9] Given the importance of mobile source emissions, the transportation sector likely will be targeted for controls under the required State Implementation Plan (SIP) that will follow US EPA's acceptance of MDEQ's recommendation.

TCM RECOMMENDATION 1: Increase public transit ridership by improving regional transit systems and incentivizing their use across southeast Michigan.

Making public transportation faster, affordable, convenient and reliable can encourage people to utilize transit and reduce car use, which in turn can help improve air quality. Effective public transit-related TCMs include improving public transit systems (particularly regional improvements), increasing access to bus rapid transit (BRT), providing commuter choices, creating incentives to use public transit, and improving the interconnectivity and scale of the transportation network.

6.1.1 Education and Outreach

Education and outreach can promote the use of public transit. Education and outreach materials should be provided in multiple languages and should provide information about commuter choices and associated costs and savings. In the Detroit region, communities not currently participating in the Suburban Mobility Authority for Regional Transportation (SMART) should be educated on its benefits (e.g., connectivity of bus lines, improved air quality, etc.). SMART is Michigan's regional public transportation provider for Macomb, Oakland and Wayne Counties. Funded by local, state and federal sources, SMART provides local and regional bus service in these counties, although 51 communities opted out, which limits funding and presents significant access and mobility gaps.[10] SMART's fleet consists of biodiesel and hybrid buses equipped with bike racks to facilitate active transit.[11]

Outreach is needed to encourage Detroit and nearby communities to work together to create a better integrated and more efficient regional public transit system. Efforts to engage with suburban communities should be prioritized as residents in these areas are most likely to commute into Detroit using personal automobiles. Census data show that only 38% of people who work in Detroit live in Detroit, and thousands of commuters from across southeast Michigan drive into the city each day (Figure 6-1), especially from Southfield, Warren, Dearborn, Sterling Heights, Farmington Hills and Livonia. These and other cities could be connected to Detroit with improved regional transit. (The Regional Transit Authority is described in Section 6.1.2.)

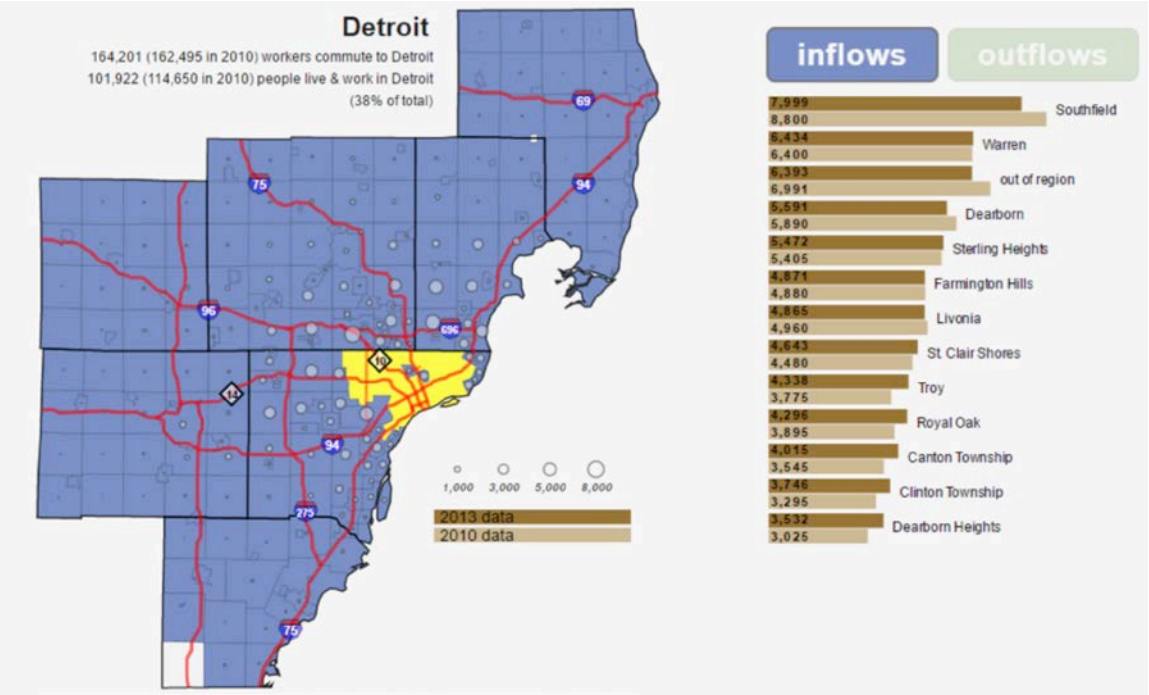

FIGURE 6-1. *Commuting patterns for southeast Michigan. The table shows daily flows from regional communities into Detroit (highlighted in yellow) using 2010 and 2013 data. Source: SEMCOG*[12]

Results of health impact assessments (HIAs) that document the impacts of traffic-related air pollutants could be used in education and outreach initiatives. We estimate that due to $PM_{2.5}$ alone, on-road mobile sources in Detroit contribute 4,000 days of respiratory symptoms for children with asthma, 8,000 days of restricted activity or lost work, and 11 premature deaths each year. Individuals living near major roads have the highest exposures *(See CAPHE Resource Manual Section 5.5.4)*. HIAs can quantify health impacts due to traffic and be used in comparative analyses of TCMs and other actions to reduce air pollutants.

6.1.2 Support and Coordination

Existing transit services in the Detroit area include the Ann Arbor Area Transit Authority (AAATA), the Detroit Department of Transportation (DDOT), the Detroit Transportation Corporation/Detroit People Mover (DTC), Suburban Mobility Authority for Regional Transportation (SMART), and Q-LINE (light rail along a stretch of Woodward Avenue). Together, these systems operate 103 transit routes and serve over 140,000 passengers each weekday.[13] The Regional Transit Authority (RTA) was formed in 2012 by Public Act No. 387 to coordinate public transportation between Wayne, Oakland, Macomb, and Washtenaw counties.[14] Activities of the RTA include:

- Developing the RTA Master Plan, which calls for expanded rapid bus transit lines across the 4-county area, regional rail service to connect Ann Arbor and Detroit, increases in local bus service, better transit to Detroit Metro Airport, and improved paratransit and mobility management programs;
- Studies of the Gratiot Avenue and Michigan Avenue corridors to understand transit challenges and identify alternatives for public transit in these regions; and
- The Woodward Avenue Transit Study, which evaluated the impacts of the Woodward Avenue bus rapid transit line, including noise, traffic, and environmental justice concerns, and developed prototype transit station designs.

Coordination between the RTA and organizations within its member counties should be strengthened to better serve the region. To encourage public engagement with the public transportation system, increase ridership, and facilitate dialog with riders and

non-riders, public transit authorities should release transport-related data to the public that enables third-party developers to create new commercial and social good products. Examples of products and services that could be developed or improved with increased access to transit data include:

- Smart phone apps that allow users to track buses and trains in real time, plan transit routes based on starting locations and destinations, purchase tickets or fare passes, or access alternative modes of transportation, e.g., car shares. For example, AATA, DDOT and the University of Michigan bus systems have apps that allow riders to track buses and estimate arrival times. However, these apps are limited to the individual systems: Expanding to allow riders to estimate times across systems would further strengthen these apps.
- Two-way communication between riders and transit providers to share information regarding delays, schedule changes, and special events that may affect regular transit patters, and alternative routes.
- Improving "first and last mile" connectivity, i.e., helping riders identify methods and routes to get from home to the transit system and back. Such gaps in connectivity can discourage or challenge users and identifying effective strategies to address them can be important in supporting use.[15]
- Ride-sharing services that organize commuters based on origin and destination that includes public transit options. SEMCOG has a free carpool program that links carpoolers based on ZIP codes.[16]
- Access to "guaranteed ride home" services for transit users who may encounter an emergency or who may travel to or from their destinations after regular transit hours.

6.1.3 Incentives and Funding

Incentives can increase ridership on public transit. For example, Ann Arbor provides incentives that include free fares to University of Michigan (UM) students and employees on AAATA buses, and free *Park-and-Ride* lots for commuters to take transit from parking lots on the periphery of the city.[17] UM sponsors the free *Detroit Connector* bus/van, which makes several trips from Ann Arbor to Detroit on several days of the week. UM also provides discounted fares on *ExpressRide* commuter buses, which connect Ann Arbor to Canton and Chelsea. Offering free WiFi and other services on public transit can also promote use. Pleasanton, CA has a similar program, which offers $2.00 per day to city employees who leave their car at home and use alternative transit. The program has been estimated to avoid 20,000 trips per year, equal to 12,000 gallons of fuel, or more than 109 tons of CO_2 emissions.[18]

6.1.4 Planning and Regulations

Detroit and nearby communities should create an integrated transit plan and implement an efficient, reliable and widely used regional public transit system. The RTA recently released a transit plan and 20-year vision to expand and improve transit in southeast Michigan, which includes the use of bus rapid transit, cross-county connectors, local buses, regional rail, commuter express lines, airport express service, streetcars, and paratransit and mobility management programs. The 2-year property tax assessment on owners in Macomb, Oakland, Washtenaw, and Wayne counties, part of the RTA plan, was included on the November 8, 2016 ballot but did not receive enough support to pass.[19] The tax, which would have cost homeowners on average $95 to $120 each year, was approved in Wayne and

Detroit and nearby communities should create an integrated transit plan and implement and efficient, reliable and widely used regional public transit system.

Washtenaw Counties, but not in Oakland and Macomb Counties. The RTA board expects the plan will be on the ballot again in 2018.[20] Cooperation and support by the four counties, and voter support through organizing, outreach, education and incentives, should be priorities. In particular, support and engagement on RTA-related activities by SEMCOG and Oakland and Macomb Counties should be strengthened. This can occur through organizing, public participation at hearings, and nominations to boards and commissions to these organizations.

TCM RECOMMENDATION 2: Encourage higher vehicle occupancy, increase existing road capacity, and improve traffic flow.

TCMs that increase vehicle occupancy, increase existing road capacity, and improve traffic flow can reduce air pollutant emissions. Examples include high occupancy vehicle lanes (HOVs) and/or high occupancy toll lanes (HOT), EZ permits and passes to collect tolls for express lanes, continuous flow metering on highway on-ramps (e.g., traffic signals that control the rate at which cars enter the highway), congestion pricing (e.g., higher prices for use of roads or tolls during periods of high congestion), restricted driving days (e.g., allowing cars with odd numbered plates to drive every other day, and even numbered plates on alternate days), low emissions zones, and increased work place flexibility (e.g., telecommuting), and carpooling. Other than limited carpooling and telecommuting, these options have not been used in the Detroit area.

6.2.1 Education and Outreach

Education and outreach that encourages commuters to reduce individual car trips can help improve traffic flows and can have the same effect on reducing congestion and emissions as increasing roadway capacity, but without costly infrastructure investments. Effective communication about available transportation choices is critical. Much of this outreach effort should target large employers who can create incentive or disincentive programs for their employees. Creating and/or distributing a 'best practices' handbook of employer-based commuter incentive programs could increase awareness of options. These outreach efforts should include information on the economic benefits, including decreased need to provide parking, and better employee recruitment and retention.[21] This best practice handbook should address:

- Facilitating car-pooling. SEMCOG offers a web-based service for ride sharing.
- Promoting alternative commuter programs, e.g., SEMCOG's rideshare and MDOT's MichiVan program.
- Creating disincentives to driving. Disincentives can be triggered through limited and/or expensive parking and high insurance costs. For example, UM-Ann Arbor provides high cost parking passes with limited availability to employees and students.[22] Along with UM's public transportation incentives, personal car use is lowered and the use of public transit is increased.

- Creating work place flexibility programs that allow employees to telecommute and create schedules that avoid congestion.[23] As examples: Health Management Systems of America in Detroit allows employees to work from home one day per week and/or to work compressed workweeks; and the Michigan Occupational Safety and Health Administration uses flexible scheduling program for employees in which 80% of staff

participate with options of working four 10-hour days, reduced hours, varying starting and stopping times and telecommuting.[24]

- Creating commuter benefits programs. In 2012 the Bay Area Management District and the Metropolitan Transportation Commission created the *Bay Area Commuter Benefits Program* to reduce greenhouse gas emissions and traffic congestion by using the federal tax code to encourage commuting via alternatives to driving alone. Employers with 50 or more full time employees must provide one of the following benefits: (1) pre-tax benefit that allows employees to exclude up to $130 of transit or vanpooling expenses each month from taxable income; (2) employer-provided subsidy that reduces or covers employees' transit or vanpool costs up to $75 per month; (3) employer-provided transit that provides a free or low-cost transit service for employees, e.g., bus, shuttle or vanpool service; or (4) an alternative commuter benefit that is as effective in reducing single-occupancy trips as options 1, 2 or 3.[25]

Commuters are unlikely to shift to public transit using employer-sponsored incentives or disincentives if the local and regional systems are not improved.

Commuters are unlikely to shift to public transit using employer-sponsored incentives or disincentives if the local and regional systems are not improved. Thus, to improve the effectiveness of employer-based incentive programs, outreach efforts must focus on the need to adopt and implement a comprehensive regional transit plan (Section 6.1.4). Businesses with a vested financial and workforce interest in an efficient, reliable transit system can become important partners in developing and promoting a comprehensive regional transit plan.

Education and outreach efforts should target residents interested in reducing health and environmental impacts from air pollution in the region. Educational materials should include information on the health and environmental impacts of traffic-related air pollutants, ozone formation that result from NO_x and VOC precursor emissions, the (likely pending) non-attainment designation, and strategies for reducing ozone precursor emissions. Designation as a non-attainment area will require the development of a SIP for the purpose of achieving the ozone standard, which requires MDEQ to solicit public comment on the proposed attainment plan. Thus, outreach and education efforts regarding TCMs and impacts on ozone formation would be timely, and community members would be better prepared to offer their support for TCMs in the SIP.

6.2.2 Support and Coordination

Support and coordination between public transit, environmental and other advocates and agencies working on these issues is critical to implementing TCMs that increase vehicle occupancy, reduce VMT and improve traffic flow. Key planning and decision-making groups include the Southeast Michigan Council of Governments (SEMCOG), Michigan Department of Transportation (MDOT), Michigan Complete Streets Coalition, the Detroit Greenways Coalition, Transportation Riders United, the Regional Transit Authority (RTA), among others. Support and coordination activities undertaken by the City of Detroit should include:

- Developing criteria to prioritize Congestion Mitigation and Air Quality (CMAQ) in partnership with state transportation agencies and environmental agencies to ensure projects have multiple benefits.
- Coordinating with MDOT to implement high occupancy vehicle (HOV) and high occupancy toll (HOT) lanes as alternatives

to widening or as a part of widening major roads. MDOT recently began a 20-year project that will widen and repair portions of I-94 over a 6.7 mile section in Detroit (I-94/I-96 interchange to Conner Avenue). The project includes repairs to 67 bridges and railroad overpasses, modernization of on and off ramps, elimination of left-hand exits and entrances, and has the potential to add lanes.[26] Encouraging implementation of HOV and HOT lanes along I-94 has the potential to reduce costs of this effort.

- Using electronic tolls and passes at the International Bridge and Tunnel. "Smart" tolls and passes can reduce congestion and idling at tollbooths, and reduce air pollution in the surrounding communities.

6.2.3 Incentives and Funding

Incentives and funding to increase road capacity could include the following:

- Encouraging companies to offer incentives for alternative transit, e.g., pre-tax benefits, subsidized vanpools, free bus passes, ridesharing programs, and covered bicycle spaces and showers (See 'best practices' information in Section 6.2.1)
- Creating a citywide alternative commuter incentive program, e.g., use monthly or annual prizes and/or commuter challenges.
- Value pricing for high occupancy vehicle (HOV) lanes using "pay as you drive" tolls or congestion pricing that increases costs during high volume periods. Value pricing can be applied to parking, insurance, and sometimes fuel (as gas taxes).[27] These pricing schemes help drivers incorporate cost considerations into their transportation decisions. Examples include: HOV lanes in Washington, DC that display variable pricing on signs that change through the day and that is collected automatically using electronic fare passes; toll lanes in Houston, TX that increase fees for vehicles with only one passenger ($2 toll and a $2.50 monthly fee);[28] and reversible express lanes on I-15 near San Diego, CA that charge a variable toll to single occupancy vehicles.[29] (Reversible roadways are best suited where there are clear patterns of traffic, e.g., flows into a city during the morning and back to the suburbs in the evening.) Funds generated from the use of HOV and other express lanes can be funneled back into transit- and TCM-related projects. Because value pricing may disproportionately affect low-income drivers, further research is needed to design appropriate and equitable policies.

6.2.4 Planning and Regulations

The City of Detroit could implement planning and regulatory changes to increase the current road capacity:

- Upgrade existing public transit systems to increase frequency, improve interconnectivity, and expand the transportation networks (see Recommendation 6.1).
- Use a Bus on Shoulder System (BOSS) that makes bus travel faster and more efficient by allowing transit buses with trained drivers to operate on the shoulders of selected freeways at low speeds during congested periods, thus bypassing traffic and maintaining schedules. This low-cost option can provide immediate benefits with moderate to heavy degrees of congestion.
- Require use of high occupancy vehicle (HOV) and high occupancy toll (HOT) lanes where feasible on heavily congested freeways to encourage carpooling and improve speed and efficiency. HOV lanes, sometimes called "carpool lanes," are restricted at peak times for the exclusive use of buses, carpools

and/or vanpools. HOV lanes target traffic congestion, and can improve air quality by encouraging carpooling and reducing the number of vehicles and VMT. HOV lanes can be most effective when carpool and bus riders are picked up within walking distance of their homes.[31] In California, HOV lanes reduce pollutant emissions per lane and per passenger compared to adjacent standard freeway lanes.[32] However, a Washington, DC study suggested that HOV lanes increased CO_2 emissions,[33] thus further analysis is needed to better understand when HOV lanes can best reduce pollutants. HOT lanes allow lower occupancy vehicles access by paying a toll with the goal of optimize allocation of lanes.[34]

TCM RECOMMENDATION 3: Encourage active transit (walking and cycling) and mixed-use ("20-minute") neighborhoods by improving planning and the built environment.

TCMs related to the built environment include: use of "complete streets" design principles that combine TCMs, "smart growth" strategies, and design elements like road diets, refuge islands, and curb extensions; and developing multi-modal transportation systems that increase transportation options and create incentives for using alternative transit forms including cycling, walking and public transit.

Complete streets principles embody a transportation corridor design philosophy that emphasizes safe use for all users, including drivers, transit riders, bicyclists, and pedestrians.[35,36] Recognizing that no single design will work everywhere, the complete streets approach considers current transportation uses and future transportation use goals. Complete streets design elements include: sidewalks that are wide and free from hazards, (e.g., raised concrete slabs or extreme cracks); designated bike lanes, separated medians, or wide,

paved shoulders that facilitate safe bike use; separated bus lanes that remove buses from the flow of traffic; comfortable and accessible public transportation stops; frequent and safe street crossing opportunities, including median islands for wide streets, signals that allowing sufficient time to cross streets, and curb extensions, gateways or pinch points that separate pedestrians from motor vehicle traffic, shorten crossing distances, and signal road use changes (i.e., moving from commercial to residential areas); narrower travel lanes or roundabouts that slow the flow of traffic in sensitive areas; and road "diets" that reduce the number of lanes for motor vehicle traffic, especially where traffic demand has decreased.[37] Streetscapes can also help mitigate both air pollution and storm water run-off by incorporating vegetative buffers, rain gardens, and other features into the design *(see CAPHE PHAP Buffers and Barriers Chapter 8)*

Detroit mayor Mike Duggan announced his "20 minute neighborhood" plan for Detroit in 2016,[38] which would allow residents to access the day-to-day services they need within a 20-minute trip from their homes, thus encouraging non-motorized transportation. Such neighborhoods require a walkable environment, basic amenities such as grocery stores and banks, and sufficient population density. Four neighborhoods are slated to be revitalized under the mayor's plan, including: the West Vernor corridor in Southwest Detroit; the Grand River corridor in northwest Detroit; Islandview along the riverfront; and the Rosa

Parks-Clairmount neighborhood near the historic Boston-Edison area of town.[39]

6.3.1 Education and Outreach

Conducting education and outreach to community residents and local decision makers to enhance awareness of the need for, and the benefits of, public transportation, biking, and walking are critical to garner public support for complete streets approaches.

Schools, parent groups, and parent-teacher associations (PTAs) should be a focus of education and outreach efforts related to the built environment. Complete streets design elements can play a strong role in facilitating Safe Routes to Schools (SRTS) programs by providing safe environments for children to walk and bike to and from school.[40] Complete streets design elements that would foster SRTS programs include wide sidewalks, median islands, and curb extensions, among others. Education materials should include examples of successful complete streets designs that improve routes to school. Education and outreach to school communities can help build much needed support for complete streets and SRTS programs in Detroit.

Other outreach efforts should focus on non-motorized transit users (e.g., walkers and bicyclists). It is likely these groups are already familiar with the need for improved infrastructure that supports safe non-motorized and public transit use. Outreach efforts for these groups should focus on providing information on the economic, environmental, and health benefits of increased active transportation[41] and information on key decision makers and on-going city planning projects, e.g., the Choice Neighborhoods project.[42]

Lastly, residents living in the four areas slated for improvements under Mayor Duggan's "20-minute neighborhoods" plan should be a part of ongoing built environment education and outreach efforts. Educational materials in multiple languages should be provided that detail the benefits of complete streets elements, e.g., safe sidewalks, greenbelts, and curb extensions, that could be incorporated into neighborhood revitalization projects. Outreach materials should emphasize successful complete streets and 20-minute neighborhoods projects elsewhere, e.g. Portland, OR and Minneapolis, MN. The social, health, and environmental benefits of these designs should be emphasized, and residents should be encouraged to reach out to decision makers to comment on proposed plans. Such outreach efforts also provide an opportunity to engage with community residents on important topics such as gentrification and increased living costs. As with non-motorized transit users, education and outreach in these targeted communities can help build support for the implementation of complete streets and other efforts to increase neighborhood walkability and access to important services.

6.3.2 Support and Coordination

Support and coordination with public transit, environmental and other advocates and agencies working to improve the built environment is necessary to facilitate TCMs. Key planning and decision-making groups include the Southeast Michigan Council of Governments (SEMCOG), Michigan Department of Transportation (MDOT), Detroit Planning Department (DPD), Michigan Complete Streets Coalition, and the Detroit Greenways Coalition, among others. Further support and coordination between these agencies and organizations could include:

At least 50% of National Highway System funding and up to 50% of Interstate Maintenance funds can be shifted to the Surface Transportation Program, which provides safety improvements for motorists, pedestrians, and bicyclists.

- Developing criteria to prioritize Congestion Mitigation and Air Quality (CMAQ) with state transportation agencies and environmental agencies to ensure that projects have multiple benefits.
- Creating a coordinated transportation improvement program partnership between the MDOT, DDOT, Detroit Planning Commission, SEMCOG and the City of Detroit to efficiently and appropriately integrate projects and utilize transportation funding.
- Integrating complete streets design principles within existing projects, minimizing costs. As an example, a New Orleans partnership integrated these principles into a resurfacing of Esplanade Avenue in 2013, reducing the four lanes to two, lowering the posted speed limit, adding accessible curb ramps, shared-lane markings, and 32 dedicated bicycle lanes with signage.[43]

6.3.3 Incentives and Funding

Improvements related to the built environment can be funded by:

- Federal Transit Administration FAST Act, which allows states, urban areas, and metropolitan planning organizations programs to apply for project-specific funding including replacements for aging fleets or facilities, and other capital investments.[44]
- Congestion Mitigation and Air Quality (CMAQ) Program funding, which is available through SEMCOG for transportation projects that contribute to attainment maintenance of the National Ambient Air Quality Standards; eligible projects include diesel retrofit projects, bike lanes, and many others.[45]
- Transportation Economic Development Fund, which aims to support Michigan' highway needs related to economic development and applications are open to state, county, and city road agencies.[46]
- Michigan Transportation Alternatives Program (TAP), which uses federal funds to support intermodal transportation system and provide safe alternative options.[47]
- Michigan Economic Development Corporation (MEDC), which offers grants and loans to redevelop Michigan's downtowns and to foster historical preservation. MEDC will support a mixture of land use and walkable urban areas that help reduce sprawl.[48]
- Michigan Community Revitalization Program (MSF), which promotes community revitalization that focuses on revitalizing facilities, historic resources, blighted areas, and property adjacent to those improved that is at risk of increase in taxes.[49]

Another funding strategy is to reallocate federal transportation funding for non-highway projects. At least 50% of National Highway System funding and up to 50% of Interstate Maintenance funds can be shifted to the Surface Transportation Program, which provides safety improvements for motorists, pedestrians, and bicyclists.[50, 51]

6.3.4 Planning and Regulations

The City of Detroit is working to design and implement their '20-minute neighborhoods' plan, intended to create neighborhoods that have all essentials (i.e., grocery stores, banks, parks, and other day-to-day amenities) within a 20-minute walk or bike ride.[52] The following elements should be incorporated in these plans:

- Bicycle-friendly neighborhoods with bicycle lanes on major streets, bicycle parking at popular locations, and bike-friendly signals at street crossings. As an example, the MDOT and Detroit Greenways Coalition have worked to add bicycle lanes, parking and repair stations throughout Detroit. Such projects can also include street improvements and increased security through the installation of cameras.[53]

- Connecting neighborhoods and businesses by developing new trails and connecting existing trail segments.
- Utilizing pedestrian-oriented design approaches that consider sidewalks, curb ramps, transit stops, marked crosswalks and other enhancements.
- Using smart growth and complete street principles in all City master plans.
- Improving street conditions and safety for bicyclists and pedestrians. Car-pedestrian and car-bicycle crashes should be minimized and not offset the health benefits of active transit.[54]
- Enforcing truck route restrictions to improve safety in residential areas. As an example, a 2009 study in Barrio Logan in San Diego, a residential area near the port facility, found that rerouting trucks reduced emissions in residential areas and improved air quality. In the affected corridor, diesel particulate matter (DPM) emissions were reduced by 99% and diesel truck VMT was reduced by 87%, however, regional emissions and VMT increased due to longer truck routes that bypassed residential areas.[55]
- Working with city council representatives to pass a Detroit complete streets ordinance. Efforts on this are underway.

Footnotes

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7 Filters

Indoor air filters are devices that remove certain air pollutants from air that is passed through them. Most filters remove particles, including: dust, small particles (including much $PM_{2.5}$), pollen, allergens, animal dander and fibers. Typical styles of filters are shown in Figure 1-1. Some filters can remove gases, such as sulfur dioxide (SO_2), odors, and volatile organic compounds (VOCs). When designed and used appropriately, filters reduce indoor exposure to $PM_{2.5}$ and PM_{10}, and potentially other harmful air pollutants. Removal of these air pollutants can reduce the incidence of asthma, decrease respiratory inflammation and irritation, and lessen nose, throat, and lung irritation. In addition, lower $PM_{2.5}$ levels are associated with fewer premature deaths, lower rates of heart attacks and hypertension, and lower risks of adverse birth outcomes and cancer.[1]

Most people spend over 90% of their time indoors.[2] Air pollution found indoors arises from indoor sources, such as cooking, smoking

FIGURE 1-1. *Examples of filters used in forced air heating/cooling systems and in commercial heating, ventilating and air conditioning (HVAC) systems. Left: extended area filters in three depths with ratings from MIRV7 to 13 (high efficiency). Center: Secondary "bag" or "pocket" filter used in commercial HVAC systems. Right: Low cost and inefficient filters often used as furnace filters in homes. Sources: left and right: http://www.qualityfurnacefilters.com/are-pleated-furnace-filters-really-better-than-disposable-fiberglass-filters/ Center: http://www.filtrationgroup.com/WFS/FGCBusiness/en_US/-/USD/HVAC/hvac-pocket-filters;*

and vacuuming, as well as outdoor sources, such as traffic and power plants. Outdoor pollutants enter a building through the ventilation system, windows, doors, and other openings. Using indoor filters is advantageous in that they reduce levels of pollutants that arise from both indoor and outdoor sources. Filters must be selected to match building and HVAC characteristics, and regular maintenance, including filter replacement, is essential. Filters can also help mitigate pollution exposures in homes, schools and residences that are located near major roads and industry, which is common in Detroit.

Significant improvements in indoor air quality can be realized by upgrading existing filters with more efficient filters, for example, by replacing low efficiency furnace filters with extended area filters (often rated as MIRV 11 to 13 or higher). In buildings without forced air systems, stand-alone or portable air filters can be installed to improve indoor air quality (Figure 1-2).

FIGURE 1-2: *Example of a portable air filter, Whirlpool Whispure Air Purifier.*

FILTER RECOMMENDATION 1: Install, use and maintain enhanced filters in schools

Indoor air quality (IAQ) is important in schools since children spend much of their day during the school week inside classrooms. Many of Detroit's schools are older buildings with mold, ventilation, heating and cooling, and other problems.[3] Additionally, 58 schools in the Detroit Public School (DPS) system are within 200 meters of high traffic roads (interstates and state highways), where PM exposures are

about 20% higher than most other locations and diesel exhaust is common. In addition, Detroit children have high rates of asthma, which can be exacerbated by poor IAQ in schools. Asthma is a leading cause of school absenteeism for both students and teachers. [4, 5]

Using filters in all schools could reduce the asthma-related health burden of $PM_{2.5}$ exposures in schools by an estimated 40-80%, depending on the type of filter used *(See CAPHE Resource Manual Section 7.2)*. For example, upgrading inefficient filters to MERV 8 filters in all schools in the area would have significant health benefits for students in these schools that include eliminating more than 13,000 asthma symptom days (defined as days with a cough) annually. Other benefits include fewer emergency department visits for asthma. The total health benefit from using MERV 8 filters in all schools in the area represents a monetized value of $0.73 million annually. Using filters in schools would also reduce absenteeism, and improve cardiovascular and respiratory health among teachers and staff. Filter installation could be prioritized in schools near major roads or industry in the City of Detroit.

The most effective types of filters and the feasibility of filter installation will depend on school building characteristics, including its mechanical systems. Schools could utilize the U.S. Environmental Protection Agency's *Indoor Air Quality Tools for Schools* for guidance on selecting and using filters.[6]

7.1.1 Education and Outreach

While profoundly concerned with the educational environment and student academic achievement, few school principals and administrators are aware of the links between the school environment and health and learning.[7] Outreach and education activities should be used to promote awareness (including those suggested in the Tools for Schools manual noted earlier). These include:

- Collecting and displaying aggregated student attendance data to track and show the success of prevention measures, and also raise awareness.
- Using a filter management program or filter committee in schools to install, replace and maintain current filters, and to minimize future maintenance issues.
- Creating training programs for teachers about how to effectively utilize and maintain individual room filters.
- Educating residents, schools, businesses, and policymakers.
- Creating a city-wide outreach campaign, which could help increase awareness and could focus on making sure people understand the importance of installing and maintaining filters (potentially as part of a possible Detroit Office of Sustainability). Specific neighborhoods and schools in vulnerable areas could be targeted.
- Encouraging people to make behavioral changes to improve air quality using posters, newspaper ads, websites, petitions, and social media.[8, 9] *(See CAPHE Resource Manual Section 1.1)*
- Creating a telephone hotline or website, which allows residents to share concerns and to learn more about IAQ, filter usage, funding support, and incentives for filter installation.
- Engaging Detroit-area (and other) science teachers to promote awareness and knowledge. Educational workshops organized for teachers could promote the understanding of air quality, its health effects, and how to incorporate air quality lessons into the learning curriculum. Educators can use EPA's *AirNow website*, which offers curriculum resources for grades K-12,[10] and the American Lung Association School Flag Program, which promotes awareness of air quality and which has a K-8 curriculum.[11]
- Disseminating guides on effective filter types and usage to provide important information to residents and others. The EPA's *Guide to Air Cleaners in the Home* details air cleaning technologies and the pollutants they control.[12] *Consumer Reports* has a guide to air purifiers on the market.
- Actively involving parents and the larger community, making clear the links between health and student performance (i.e. a healthy study environment can positively impact student performance).
- Creating Continuing Education Credit Classes and Workshops for school engineers and staff.

7.1.2 Support and Coordination

Detroit has many government offices, non-profit organizations, and parent groups working to create a better learning environment for students and educators. School-community partnerships should be formed that can help these organizations coordinate efforts to improve IAQ. These partnerships could collaborate and/or prioritize schools that are currently upgrading their HVAC systems. As an example, public schools in Hartford, Connecticut created a district-wide wellness program to address rising rates of asthma. School teams and health

Few school principles and administrators are aware of the links between the school environment and health and learning. Outreach and education activities should be used to promote awareness.

and environmental organizations used the Indoor *Air Quality Tools for Schools*[14] material to engage and train teachers, staff and parents on IAQ, health risks, and responses. The district saw a decrease in asthma-related visits to school-based care providers.[15] As a second example, a Canadian school district used an air filter management program to bring together an air filter company, school officials, and school personnel (from purchasing, maintenance, and health and safety departments) for quarterly meetings to monitor filter change schedules and to troubleshoot problems, resulting in improved maintenance and IAQ in the schools.[16]

Potential partners for a Detroit multi-stakeholder "school environmental quality" committee might include the Michigan Department of Education and Detroit based groups working on education. Smaller subcommittees on topics such as "filters" or "green cleaning" might oversee

specific environmental improvements. Charter school representatives should be involved in a district-wide program. Other organizations potentially engaged in a school-community partnership could include:

- Excellent Schools Detroit (ESD), a coalition of Detroit leaders dedicated to improving the educational performance of Detroit public and charter schools. Although ESD's educational plan is focused on competency-based standards, IAQ should be a top concern given its impact on student learning and achievement, as well as staff functioning.[17]
- The Detroit Parent Network (DPN), which has a public policy agenda that calls on Michigan to provide school maintenance and funding for repairs. DPN could promote the enactment of IAQ standards for schools.[18]
- The Detroit Hispanic Development Corporation (DHDC), a non-profit organization in Southwest Detroit. DHDC's Parent Institute is a policy advocacy and community organizing group that advocates for educational reform. Leveraging the Parent Institute and the other parent groups at DHDC could help reach parents often left out of PTO groups, such as non-English speaking Latino parents.[19]
- The Detroit Federation of Teachers (DFT) and/or the American Federation of Teachers (AFT) and Maintenance Unions. These unions could help to engage lawmakers around this issue, they could also advocate to have filters used through their contracts.

IAQ policy advocacy work should coordinate with the Michigan Education Association (MEA), which represents teachers and education employees throughout the state. MEA's preamble states that its priorities include advancing its members' welfare by improving working conditions for all school employees.[20]

Additional support and resources may be available via the US Green Building Council (which administers the LEED building standards), and other environmental and health organizations, such as the American Lung Association. Coordinating with school engineers and maintenance staff could also help increase the efficacy of school filter use.

7.1.3 Incentives and Funding

Incentive programs can be a fun and easy way to promote healthy school environments. Schools can be rewarded for improving the health and wellness of students and staff, constructing green infrastructure, or implementing innovative school health efforts. The Detroit Public Schools Foundation and health-related foundations, such as the Blue Cross Blue Shield of Michigan Foundation,

could partner and provide modest funding to continue or expand these efforts. The Colorado Education Initiative's *Healthy School Champions Program,* for example, recognizes Colorado schools for creating a healthy school environment and implementing effective school health efforts: winners receive $300 to $7,500 per school.[21] Such incentive programs can use the Colorado or the U.S. Department of Education Green Ribbon Schools program as models.[22]

> Incentive programs can be a fun and easy way to promote healthy school environments. Schools can be rewarded for improving the health and wellness of students and staff, constructing green infrastructure, or implementing innovative school health efforts.

Currently, there is no state or national funding for air filters. Michigan does not provide grants to school districts for building projects. To create more equitable funding, Michigan should designate grant funding to school districts for IAQ and filters, potentially based on a facility assessment and the district's relative wealth. Innovative examples elsewhere include Wyoming's School Facilities Commission (SFC), which provide non-matching grants to local school districts for approved capital projects; funding uses a prioritized needs index that identifies the most critical projects (based on facility condition, educational functionality, and capacity). Connecticut's Department of Education provides matching grants to school districts with the state's share (20 to 80%) determined by relative district wealth ranking.[23] 'Sinking funds' could be used to support the use and maintenance of effective filters when capital improvements are made to school buildings. In Michigan, these funds are funded through a property tax mileage.[24] Michigan's sinking funds currently allow for the purchase of real estate for school building sites, the construction of schools buildings, and the repair of school buildings.[25] Detroit Public Schools and other districts could pursue sinking funds and use a portion of them to improve, install, or repair filtration systems.

Schools can have liability exposure due to poorly performing buildings. If Michigan or the Detroit School District does not respond to petitions requesting air filters, related funding, or IAQ, then school staff or students could file legal claims against these or possibly other liable parties for IAQ-related injuries. Michigan law provides that governmental agencies are liable 'for bodily injury and property damage resulting from a dangerous or defective condition of a public building if the governmental agency had actual or constructive knowledge.[26] *The Government Tort Liability Act* (MCL 691.1401) gives an exception to immunity for public school buildings and any fixtures/structures attached to the building and integral to its use (e.g., playground or courtyard) in which "[t]he governmental entity's sole duty under the statute is to repair and maintain its public buildings."[27] In tort cases, plaintiffs must show sufficient burden of proof to show injury. These cases are generally settled out of court and may involve monetary or non-monetary relief (e.g., correcting IAQ problems). Information on school district liability is provided by the Environmental Law Institute.[28]

7.1.4 Planning and Regulations

Many planning and regulation strategies can be used to improve indoor environmental quality. The most common strategies use comprehensive preventive maintenance policies and programs for facilities and maintenance staff at the district level. As examples, Philadelphia's maintenance policy takes a preventive approach

using monthly building inspections, a standard checklist, a physical inspection by the building principal and head maintenance person, and a written report returned to the Superintendent, who then creates an improvement plan that is shared with the school board.[29] Hartford's preventive maintenance program includes quarterly cleaning and filter change-out, roof leak repairs, a comprehensive "Green Clean" janitorial cleaning program with environmentally-friendly material, and renovation guidelines for construction projects (e.g., controlling emissions during construction and using low emitting materials).[30]

Coordinate preventive maintenance and wellness programs. The Oakland California Unified School District integrated IAQ into the school wellness program to decrease absenteeism and improve student and staff health, and limit liability.[31] This program uses school walkthrough inspections to identify and fix common IAQ issues, as well as other periodic inspections and improvement plans. In Detroit, coordinating maintenance plans may require contract amendments since service providers are often contract employees. Service providers are contracted through the Office of Procurement and Logistics (public schools)[32] or through individual school boards (charter schools).[33]

Michigan should enact a law to require IAQ, filter, and preventive maintenance programs in schools. Connecticut, for example, enacted Public Act No. 03-220 in 2003 that required districts to adopt and implement an IAQ program that required ongoing maintenance and facility reviews to maintain and improve indoor air. It also allows boards of education to establish an IAQ committee to increase staff and student awareness.[34]

Facility upgrades should be prioritized to identify improvements with the greatest impact. Older schools without ventilation systems or with poorly operating HVAC systems should be a top priority, as these systems affect air quality throughout the building.

School district policy should require that new construction or major renovations improve IAQ using enhanced filters, low emission materials,[35] and other measures. Recognized "green design" rating programs for buildings address some IAQ concerns.[36] The Leadership in Energy and Environmental Design, known as LEED, certification provides independent verification of a building or neighborhood's green features and promotes the design, construction, operation, and maintenance of resource-efficient, high-performing, healthy, cost-effective buildings.[37] Green Globes provides personalized assistance to project teams on new construction and renovation projects using a third-party assessment and a scoring system.[38] Both certifications are helpful, but not sufficient, to ensure that high performance filters are installed and maintained.

FILTER RECOMMENDATION 2: Use Filters in Homes and Businesses

IAQ is important in homes and businesses, as people spend most of their day indoors. Both homes and businesses could benefit from improved IAQ, especially at locations within about 200 meters of interstates and highways and near industry or other pollution sources.

Filters in homes can substantially reduce $PM_{2.5}$ exposure. The extent of the reduction depends on the home and filter characteristics; we estimate that the typical reduction would be about 25% (*See CAPHE Resource Manual Section 7.2)*. Based on a study that considered using filters in the estimated 254,000 occupied housing units in Detroit,[39] this 25% reduction would eliminate about 33,000 asthma symptom days per year (defined as days with cough) among children in the Detroit area. Other benefits include reduced visits to the emergency department or hospitalizations for asthma. The health benefits for children of using filters in homes represent a total monetized value of $2.4 million per year. Using filtration in homes will also reduce morbidity and mortality related to cardiovascular and respiratory disease among Detroit adults. The monetized value of health benefits to adults would greatly exceed those for children due to the high cost associated with hospitalizations and premature mortality.

In businesses, appropriate filter types and the feasibility of using filters depend on the building and HVAC configuration and other factors. Easy-to-use guidance is available for filter installation, maintenance, operation and financial evaluation.[40] Additional information on preventing and resolving IAQ issues in offices is given by the U.S. EPA's *Building Air Quality: A Guide for Building Owners and Facility Managers*.[41]

7.2.1 Education and Outreach

Most people and businesses are unaware of the importance of IAQ and the potential benefits of filters. Many outreach and education activities can be used to promote awareness:

- Community organizations can help educate residents, schools, businesses and policy-makers.
- A city-wide outreach campaign could help increase awareness (potentially as part of a possible Detroit Office of Sustainability). Specific neighborhoods and schools in vulnerable areas could be emphasized.
- Posters, newspaper ads, websites, petitions, and social media can encourage people to make behavioral changes that positively impact on air quality.[42, 43] *(See CAPHE Resource Manual Section 1.1)*.
- A telephone hotline or website would allow residents to share concerns and to learn more about IAQ, filter usage, funding support, and incentives for filter installation.
- Dissemination of guides on effective filter types and usage would provide important information to residents and businesses. The EPA's *Guide to Air Cleaners in the Home* details types of air cleaning technologies and the pollutants they control.[44] *Consumer Reports* offers a guide to air purifiers on the market.[45] *Lungs at Work: A Toolkit for Improving Indoor Air Quality in Office Workplaces* provides best practices and case studies relevant to offices.[46]
- Businesses can create employee green teams and use best practices to improve IAQ, such as replacing carpet and installing filtration systems.
- To encourage filter use and maintenance (including replacement), related Michigan businesses might create and distribute informational pamphlets on best practices. This could draw on the seven air filter companies operating in Michigan, e.g., D-Mark, Inc., in Chesterfield, MI.[47]
- City, state or other organizations could provide free or reduced-cost training to businesses on IAQ and filters. For example, the New South

Wales government offers free half-day energy efficiency HVAC training modules to businesses.[48] In southeast Michigan, professional associations, including the *Air and Waste Management Association,* the *American Institute of Architects,* and associations for building engineers (e.g., *ASHRAE*) could provide such training.

- Engaging Detroit-area business leaders would be valuable. In coordination with the Detroit Regional Chamber and industry experts, workshops could be organized to offer business leaders a better understanding of IAQ and air filters. The Detroit Regional Chamber could help distribute information via email, their website or other means, similar to the U.S. Small Business Administration.[49]
- Creating awareness of the benefits of filters among the medical and public health community.
- Develop programming for Continuing Medical Education credits for physicians and medical staff so they are aware of the importance of filter use.

7.2.2 Support and Coordination

Weatherization assistance programs and home-health initiatives could integrate air filter recommendations into their programming for homes. Filter use in areas with high cumulative risk could be emphasized. Organizations that could be engaged in air filter education and distribution include:

- Michigan's Weatherization Assistance Program, which provides free home energy conservation services to low-income Michigan homeowners and renters to reduce energy use and lower utility bills.[50]
- Green & Healthy Homes Initiative in Detroit-Wayne County, which offers services to families with children who live in dwellings with poor health and safety conditions. Programming includes an in-home visit, repair services, education, and free or low-cost health and safety products.[51]
- Wayne Children's Healthcare Access Program, which has an asthma education program that includes personalized health plans and home visits.[52]

The Detroit Health Department (DHD) could offer information on IAQ, filter usage, available toolkits, and resources, possibly using brochures and its website. For example, Wisconsin's Department of Health Services has a website page describing air filters (including how they work and how to choose one).[53] Currently, DHD does not have IAQ or asthma home health initiatives.

Insurance providers have a vested interest in providing incentives to improve IAQ given its link to asthma exacerbations.

Additional support and resources may be possible via the US Green Building Council, which administers the LEED building standards, and other environmental and health organizations, such as the American Lung Association.

7.2.3 Incentives and Funding

Insurance providers have a vested interest in providing incentives to improve IAQ given its link to asthma exacerbations. Air filters are a tax deductible medical expense if a family's medical expenses exceed 3% of the family income or $2,028.[54]

Detroit's Plan Review Division could implement an expedited permitting process for green developments applicable to developers and owners *(See CAPHE Resource Manual Chapter 7).* Green developments typically prioritize energy efficiency and lower CO_2 emissions; improvements in outdoor and indoor air quality can also be accommodated. Chicago's *Green Permit Program* shortens the permitting process to less than 30 business days, and in

some cases, less than 15 days (depending on the number of green building elements, LEED certification level, and the project complexity).[55]

If existing heating and cooling (HVAC) systems in a building can accommodate enhanced filters, costs of effective filters may be low. However, if existing HVAC systems require modification or new HVAC systems must be installed, or if a large number of stand-alone filters are required, costs may be high, and possibly prohibitive for some homeowners, tenants, and small businesses. Air filter installation and maintenance can be a part of energy efficiency projects, such as replacing HVAC systems, which are supported by several local, state, and federal loan and tax deductions programs:

- The Economic Development Corporation of the City of Detroit and the Detroit Development Fund offer energy efficiency loans for commercial properties in Detroit.[56]
- The Property Assessed Clean Energy (PACE) program in southeast Michigan allows property owners to finance energy efficiency and renewable energy projects using long-term loans repaid as voluntary property assessments.[57]
- DTE has a home performance rebate program that offers rebates for HVAC equipment.[58]
- Michigan Saves is a non-profit organization that offers financing for energy efficiency and renewable energy to businesses, the public sector, multifamily homes, and homeowners.[59]
- The federal Energy-Efficient Commercial Building Tax Deduction provides a tax deduction of $0.30 to $1.80 per square foot to building owners or tenants who install heating, cooling, ventilation, or hot water systems that reduce a new or renovated building's energy and power cost.[60] Additional federal income tax credits for energy efficiency are described on the EnergyStar website.[61]

The City of Detroit could increase funding for green construction and energy efficiency projects using Detroit Community Development Block Grant funds *(See CAPHE Resource Manual Chapter 7).*

Michigan should create a tax credit or exemption for energy efficient and green buildings and filter use in homes and businesses. Currently, none are offered. Such approaches are used elsewhere, e.g., in Maryland, owners or tenants receive an income tax credit equal to 8% of allowable costs ($120 per square foot of the base building; $60 per square foot of tenant space) for green developments (defined using USGBC criteria)."[62]

7.2.4 Planning and Regulations

Planning and regulatory strategies that can improve indoor environmental quality include green building regulations, comprehensive inspection systems, and required filter installation.

Green building regulations should specify that the construction and renovation of all buildings

funded by taxpayers should meet environmental criteria, including enhanced filters, low emission materials,[63] and other measures. Recognized "green design" rating programs for buildings address some IAQ concerns.[64] The Leadership in Energy and Environmental Design or LEED certification provides independent verification of a building or neighborhood's green features, promoting the design, construction, operation and maintenance of resource-efficient, high-performing, healthy, cost-effective buildings.[65] Green Globes provides personalized assistance to project teams on new construction and renovation projects using a third-party assessment and a scoring system.[66] These certifications are helpful, but currently not sufficient, to ensure that high performance filters are installed and maintained.

Detroit's Buildings, Safety Engineering, and Environmental Department should develop a comprehensive inspection program for residential inspections. Because Detroit City Council repealed required home inspections in 2014, this would require reinstatement of required home inspections, and then incorporation of filter inspections into the overall inspection. Other cities regularly inspect housing, e.g., Hayward, CA uses a *Residential Rental Inspection Program* to inspect rental housing with the goal of inspecting units in high density areas every 3.5 years, and less frequently in other areas, unless complaints are received. Fees and penalties are charged for violations and lack of timely correction.[67]

Air filters should be requested in Community Benefits Agreements associated with projects that can affect air quality, e.g., transportation and industrial developments. Such agreements should be developed before construction to ensure that residents and businesses are protected. For example, in Washington D.C., air filters were distributed to all homes near a soccer stadium while under construction.[68, 69]

Effective filters should be required in public housing owned or operated by the Department of Housing and Urban Development. Filter specification and HVAC upgrades can be based on local pollutant levels.

Footnotes

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8 Buffers

Buffers are strips of land, clusters of vegetation, or physical barriers located between sources of pollution (e.g., roadways), homes, schools or other places where people spend time. Buffers can reduce exposure to harmful air pollutants, such as ozone (O_3), particulate matter (PM), nitrogen oxides (NO_X), sulfur dioxide (SO_2), and carbon monoxide (CO), by absorbing or trapping some of the pollutants,[1] displacing pollutants upward to greater heights, and physically separating people from emission sources like roadways. About 45 million people in the US live within 300 feet of a large road, a railroad, or an airport, and many schools and childcare centers are located near highways. Living next to highly travelled roadways is associated with a number of negative health outcomes.[2] Buffers can improve ambient air quality, and can help to reduce irritation to airways, coughing, breathing difficulties and lung disease; reduce cardiovascular risk and prevent some heart attacks; and reduce risk of low birth weight infants.[3] Buffers have many co-benefits, including: reducing noise, providing shade that can help cool buildings, reducing CO_2 (carbon), improving storm water management, and providing spaces for greenways and non-motorized paths and corridors.

BUFFER RECOMMENDATION 1: Adopt regulations to create consistent and appropriate minimum setbacks between sensitive land uses and pollution sources.

Sensitive land uses include residential areas, schools, and day care and health care facilities as well as areas with high levels of cumulative risk. Pollution sources include freeways, heavily trafficked roadways, and point sources of emissions.

Concentrations of air pollutants from vehicle emissions are often highest closest to their source, and generally decrease with distance from the source. Separating freeways, heavily trafficked surface streets, and other pollutant sources from schools, playgrounds, childcare centers, health care facilities, rehabilitation centers, convalescent centers, hospitals, retirement homes, residences and other sensitive locations can reduce concentrations of pollutants that reach people.[4] The effectiveness of spatial buffers on human well-being is dependent on size and distance between the pollution source and people: When sufficient distance is provided between ground level sources of pollution (such as vehicles) and people, spatial buffers can reduce concentrations from these local sources as much as 80%[5] Furthermore, as described under Recommendation 2, the number, location, size, and potentially species of trees planted in the spatial buffers can impact their effectiveness.

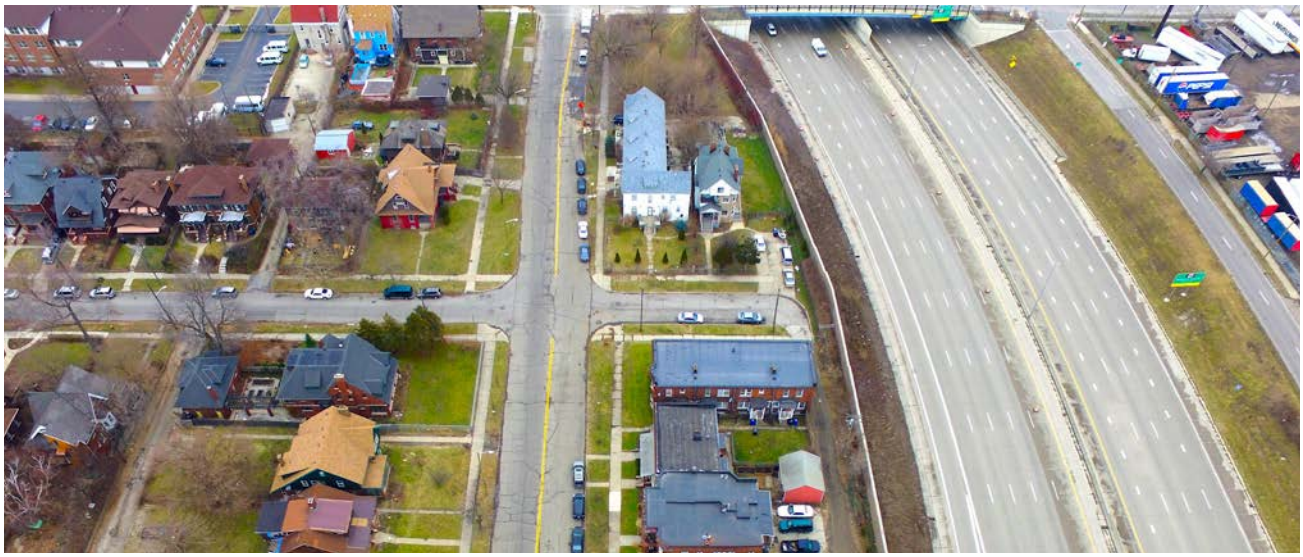
Reducing the number of schools located close to major freeways would reduce exposure to children, resulting in substantial health benefits to children.[6] In addition, we estimate that if all Detroit residents lived beyond 500 feet (150 meters) from a major freeway, there would be 9-10 fewer cardiopulmonary deaths per year due to diesel $PM_{2.5}$. Increasing vegetation by 45% within the 500 foot (150 meter) buffer areas along these same freeways would produce an estimated reduction of 2 to 6 cardiopulmonary deaths per year due to diesel $PM_{2.5}$ *(See CAPHE Resource Manual Section 7.3.8).*

Section 8.1.4 and Table 8.1.4-1 provide recommended setbacks, and recommendation 2.2 below provides additional information on vegetative buffers.

8.1.1 Education and Outreach

Education to increase awareness about air pollution is critical for Detroit residents, schools, community groups, and decision makers. Education and outreach programs can increase awareness about the adverse health effects of pollution and promote the use of buffers to mitigate exposures.

Community-based organizations can inform policy and decision makers about the health effects of locating homes, schools and other sensitive land uses near pollution sources. Education and outreach programs focused on policy change and investment in cleaner infrastructure can increase awareness of the health risks of pollution and the benefits of buffers, as well as strategies for implementing them. Buffers can be part of Community Benefits Agreements (CBAs) that help to mitigate the negative environmental and health effects of development projects. For example, Los Angeles County has discussed using CBAs to achieve 500-foot roadway buffer zones to keep



housing (including Section 8 federally assisted housing), from being constructed in places with current or potential air quality issues.[7]

Organizations with experience developing CBAs can provide information and recommendations to Detroit groups interested in using CBAs to request buffers around sensitive land uses. These same groups may also consider conducting Health Impact Assessments (HIAs) and Environmental Impact Assessments (EIAs) to estimate effects of proposed development projects on air quality and human health. These additional assessments can further highlight issues of concern and engage policy and decision makers in discussions of the impacts of locating homes, schools and other sensitive land uses near pollution sources (or of placing pollution sources near existing homes, schools and sensitive, populated areas).

The primary goal was to improve air quality in neighborhoods near expressways with green infrastructure that absorbs carbon dioxide, particulate matter, and other pollution from traffic.

Detroit environmental groups could develop and disseminate a "guidance statement" to policy and decision makers to assist in the determination of suitable distances between Detroit-based industries and sensitive land uses. Where separation is not feasible, guidance can aide in the design, planning, and implementation of appropriate buffers or other mitigation strategies (e.g., filters).[8] As an example, Western Australia published a document *"Separation Distances between Industrial and Sensitive Land Uses"* that makes recommendations for buffers, and the US Environmental Protection Agency has similar information for school siting.[9]

8.1.2 Support and Coordination

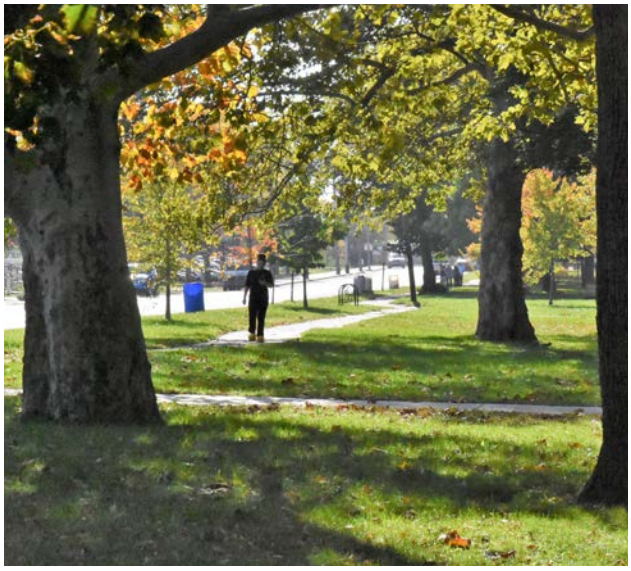
Forming partnerships among Detroit-based groups working to reduce air pollution to support and coordinate buffer implementation efforts would allow organizations to share insights, skills and knowledge, and to promote and implement buffers. Coordinated efforts can support strong, innovative initiatives that are more effective in reducing exposure of Detroit residents to air pollutants.

There are several examples of successful collaborations between environmental, community, and municipal groups to address air quality issues. For example, the Los Angeles Area Environmental Enforcement Collaborative, a unique collaboration of federal, state, and local governments and nonprofit organizations, is working together to improve the environmental and public health conditions for residents living near the I-710 freeway.[10] In addition, the Bronzeville Air Quality and Public Health Partnership, a coalition of community residents and leaders, non-profit agencies, academia, health practitioners, and government, is working together to address negative respiratory health impacts of air pollution on Chicago's South Side.[11]

In Detroit, Detroit Future City and The Greening of Detroit worked to implement a carbon buffering pilot program that prioritized sites and implemented carbon buffers based on air quality measures, public land availability, and future adjacent land uses. The primary goal was to improve air quality in neighborhoods near expressways with green infrastructure that absorbs carbon dioxide, particulate matter, and other pollution from traffic.[12]

Detroit-based collaborations between city and community organizations could further improve Detroit's air quality through development and implementation of policy changes and mitigation strategies, such as buffers. Potential municipal partners for buffer-related policy work and projects include the Detroit City

Council Green Task Force, the Detroit Public Schools Office of Energy and Sustainability, the City of Detroit Office of City Planning & Development, and the soon to be created Office of Sustainability. Collaboration with the Detroit Planning Department is critical to improve zoning around industrial sites. Coordination with the Board of Education to implement buffers around schools, targeting specifically the 58 schools identified through CAPHE research as being near roadways, holds promise for mitigating air pollution exposure in Detroit *(See CAPHE Resource Manual Section 7.3.3).*



Examples of nonprofit organizations that could be engaged in city-community partnerships include:

- Southwest Detroit Environmental Vision (SDEV), a nonprofit that works with residents, community organizations, government agencies, schools, businesses, and industries to combat environmental issues, including indoor and outdoor air quality, blight, and incompatible land uses.[13]
- Detroiters Working for Environmental Justice (DWEJ), a community organization that fosters sustainable communities through policy change, education, and workforce development that focuses on reducing health hazards, encouraging sustainable development, and influencing economic vitality.[14]
- Michigan Trails and Greenways Alliance (MTGA), an organization that fosters and facilitates the creation of an interconnected statewide system of trails and greenways for recreation, health, transportation, economic development and environmental/cultural preservation purposes.[15]
- The U.S. Green Building Council, Detroit chapter, a nonprofit, membership-based organization that seeks to transform the way buildings and communities are designed, built and operated to enable an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life in Eastern Michigan.[16]

Partnerships should seek input from local Detroit-based groups experienced in developing Community Benefits Agreements, for example Southwest Detroit Community Benefits Coalition (SDCBC), to provide information to inform buffer-related requests to reduce exposures.

8.1.3 Incentives and Funding

Incentive programs offer a simple, mutually beneficial way for cities to promote buffers. These could apply to both polluters and developers, and would be used to initiate and maintain appropriate setback distances, construct green infrastructure, and/or install innovative buffers.

The City of Detroit could implement financial incentive programs to encourage polluters and developers to utilize minimum setback distances using tax credits for new developments that implement minimum setback standards between sensitive land uses and freeways; financial incentives, such as tax deferrals, tax credits, and funding programs, that facilitate the purchase of land necessary to create setbacks; and incentive zoning programs or density bonuses that encourage developers to preserve spatial buffers and open space by providing a "bonus," usually in the form of the development's density or size, to developers in exchange for community improvements (e.g., increased open space, pedestrian paths,

affordable housing, special building features, public art projects, etc.[17]). Environmental protection is a major justification for the use of incentive zoning. Density bonuses, for example, are used to promote conservation, improve natural resources, enhance landscaping, maintain open space, and develop nature trails.[18]

The Jamaica Plain Neighborhood Development Corporation in Boston is an example of the successful use of density bonuses to reduce air pollution. Jackson Square, in Jamaica Plain, has among the highest asthma rates in Massachusetts.[19] The Jamaica Plain Neighborhood Development Corporation partnered with the Urban Edge Community Development Corporation to redevelop 11 acres of public and private land into a mixed-income, mixed-use, and more sustainable development. The plan included a density bonus, preserved existing open space, and created new open spaces to improve air quality and overall quality of life. As a second example, the Village of Caledonia in Racine County, Wisconsin maintains open space through an ordinance that offers developers up to an additional 20% density bonus for the number of lots allowed if they include additional standards, such as open space, internal and external connectivity for trails, designing 75% or more of all lots to abut open space, and preserving primary or secondary environmental corridors.[20]

The City of Detroit could develop and employ a density bonus program to encourage developers to preserve and/or install buffers between sensitive land use development projects and major roadways and other pollution sources. This is a particularly viable option in Detroit given the number of vacant parcels that could be clustered to create spatial buffers. The City could also explore the use of state level funding for brownfield remediation to help implement buffers.

8.1.4 Planning and Regulations

Air pollution exposure may be mitigated through a variety of planning and regulatory strategies that use buffers and setbacks between sources of pollution and sensitive land uses.[21] For example, the City of Detroit could implement zoning ordinances that restrict industrial development near sensitive land uses, and that preserve land for vegetative planting, (e.g., prohibiting the building of new homes, schools or other sensitive land uses within 150 meters of roadways and other significant emission sources).

One example of changing setback requirements occurred in Los Angeles. The County of Los Angeles Public Health Department created their own *Air Quality Recommendations for Local Jurisdictions* guide. In this guide, they recommend a 500 foot buffer between new schools, housing or other sensitive land uses, and freeways. The County also recommends that new schools, housing or other sensitive land uses that are built within 1500 feet of a freeway must adhere to current best-practice mitigation measures to reduce exposure to air pollution. These mitigation measures include advanced air filtration, appropriate building orientation, and placement of outdoor physical activity facilities as far from emission sources as possible.[22] Table 2.1.4-1 shows recommendations from the California Environmental Protection Agency Air Resources Board regarding setbacks: Detroit could use these recommendations in establishing City guidelines.

The City of Detroit could develop and employ a density bonus program to encourage developers to preserve and/or install buffers between sensitive land use development projects and major roadways and other pollution sources.

Source Category	Advisory Recommendations
Freeways and High-Traffic Roads	Avoid locating new sensitive land uses within 500 feet (152 meters) of a freeway, urban roads with 100,000 vehicles/day, or rural roads with 50,000 vehicles/day.
Distribution Centers	Avoid siting new sensitive land uses within 1,000 feet (305 meters) of a distribution center that accommodates more than 100 trucks per day, more than 40 trucks with operating transport refrigeration units (TRUs) per day, or where TRU operations exceed 300 hours per week. Take into account the configuration of existing distribution centers and avoid locating residences and other new sensitive land uses near entry and exit ports.
Rail Yards	Avoid siting new sensitive land uses within 1,000 feet (305 meters) of a major service and maintenance rail yard. Within one mile (1,609 meters) of a rail yard, consider possible siting limitations and mitigation approaches.
Ports	Avoid siting new sensitive land uses immediately downwind of ports in the most heavily impacted zones. Consult local air districts or the MDEQ on status of pending analyses of health risks.
Refineries	Avoid siting new sensitive land uses immediately downwind of petroleum refineries. Consult with local air districts and other local agencies to determine an appropriate separation.
Chrome Platers	Avoid siting new sensitive land uses within 1,000 feet (305 meters) of a chrome plater.
Dry Cleaners Using Perchloroethylene	Avoid siting new sensitive land uses within 300 feet (92 meters) of any dry cleaning operation. For operations with two or more machines, provide 500 feet (152 meters). For operations with three or more machines, consult with the local air district. Do not site new sensitive land uses in the same building with perc dry cleaning operations.
Gasoline Dispensing Facilities	Avoid siting new sensitive land uses within 300 feet (92 meters) of a large gas stations (defined as a facility with a throughput of 3.6 million gallons (13.6 million liters) per year or greater). A 50 foot (15 meter) separation is recommended for typical gas dispensing facilities.

TABLE 8.1.4-1. *Recommendations for siting sensitive land uses. Taken from the California Environmental Protection Agency Air Resources Board.* [23]

A second example of implementing new setback requirements occurred in Colorado around oil and gas facilities. In 2013, the Colorado Oil and Gas Conservation Commission required 500 foot setbacks between wells and other facilities and buildings designed for human occupancy. This setback was extended to 1000 feet from high occupancy buildings (e.g., schools, nursing facilities, life care institutions, correctional facilities, child care centers). The new setback required a setback of at least 350 feet from "designated outside activity areas" (e.g., outdoor venues or recreation areas). If oil and gas operators would like to locate their facility closer than the minimum setback distance, waivers from the building owners are required. In addition to waivers, oil and gas operators must also implement mitigation measures to reduce impacts of their operations upon the environment and general public.[24]

The City of Detroit could require minimal setback distances between industrial facilities and sensitive land uses. If buffers with minimal setback distances are not feasible, polluters should carry out substantive mitigation measures to reduce individuals' exposure to air pollution.

BUFFER RECOMMENDATION 2: Plant vegetative buffers and/or install sound walls where current minimum setbacks distances are not met.

Spatial buffering (see recommendation 1) between sensitive sites and sources of air pollution is not always possible, particularly in Detroit's older neighborhoods. In the areas where recommended setbacks cannot be achieved (e.g., schools or homes are too close to existing roadways), vegetative and/or sound wall buffers between pollutant sources and sensitive land uses can be an effective alternative to spatial buffers.[25]

In Detroit, an estimated 69,000 (about 10%) residents live within 500 feet (150 meters) of a major freeway. Roughly 70,000 – 90,000 trucks travel on major corridors (I-75, I-94, I-96, M10 and M39) in Detroit daily,[26] and as many as 6,900 trucks a day (2.5 million annually) cross the Ambassador Bridge linking Detroit and Windsor, Canada.[27] There are approximately 75 Detroit public schools within 650 feet (200 meters) of large highways.[28] Of these 75 schools, 58 of were in operation in 2014-2015 and had an estimated student population of 24,490.

Vegetated and sound wall buffers can reduce concentrations of ozone (O_3), particulate matter (PM), nitrogen oxides (NO_X), sulfur dioxide (SO_2), carbon monoxide (CO) and other pollutants.[29] The effectiveness of trees and tree canopies in removing pollutants depends on many factors, including the pollutant type, the site conditions, and the density of plantings in the buffer area. Due to these variables, research estimates of the proportion of pollutants removed range from under 1% to approximately 13%.[30] Enlarging and extending vegetated areas can increase their effectiveness in removing pollutants from the air.

Buffers, walls, and windbreaks work most effectively for sources that release pollutants at or near ground level (like exhaust emissions from vehicles, and dust from storage piles) and areas upwind of the buffer or barrier. Properly installed windbreaks (i.e., continuous rows of trees or shrubs planted to provide a wind barrier) can lower concentrations of CO and $PM_{2.5}$ generated by vehicles by 12-40%. Similarly, sound walls within 50 feet (15 m) of the roadway can reduce concentrations of these traffic related pollutants by 15 to 50%. Sound walls, depending on their construction, may redirect pollutants to other areas, and so they need to be positioned to prevent pollutants from inadvertently being directed into residential areas.[31] It is important to note that vegetative buffers and sound walls are less effective for air pollutants emitted from industrial stacks (such as power plants), which – because they are so high - travel greater distances before dropping low enough for people to breath them in.

8.2.1 Education and Outreach

Understanding how buffers work and why they are important in addressing Detroit's air quality issues and protecting residents' health can increase the likelihood that decision makers agree to take action to install vegetative and/or sound wall buffers throughout the city.

The Clean Air Coalition of Western New York is an example of a group that successfully used education and outreach to advocate for the use of vegetative buffers. The coalition hosted a local organization that designs and implements green buffers to protect vulnerable neighborhoods in Buffalo. They held community workshops, facilitated meetings, and met with City Council members to discuss increasing vegetative buffers. As a result of their work, the Peace Bridge Authority (an international compact entity between the State of New York and Canada) agreed to spend $3 million on green infrastructure to improve air quality and buffer vulnerable neighborhoods from diesel exhaust.[32]

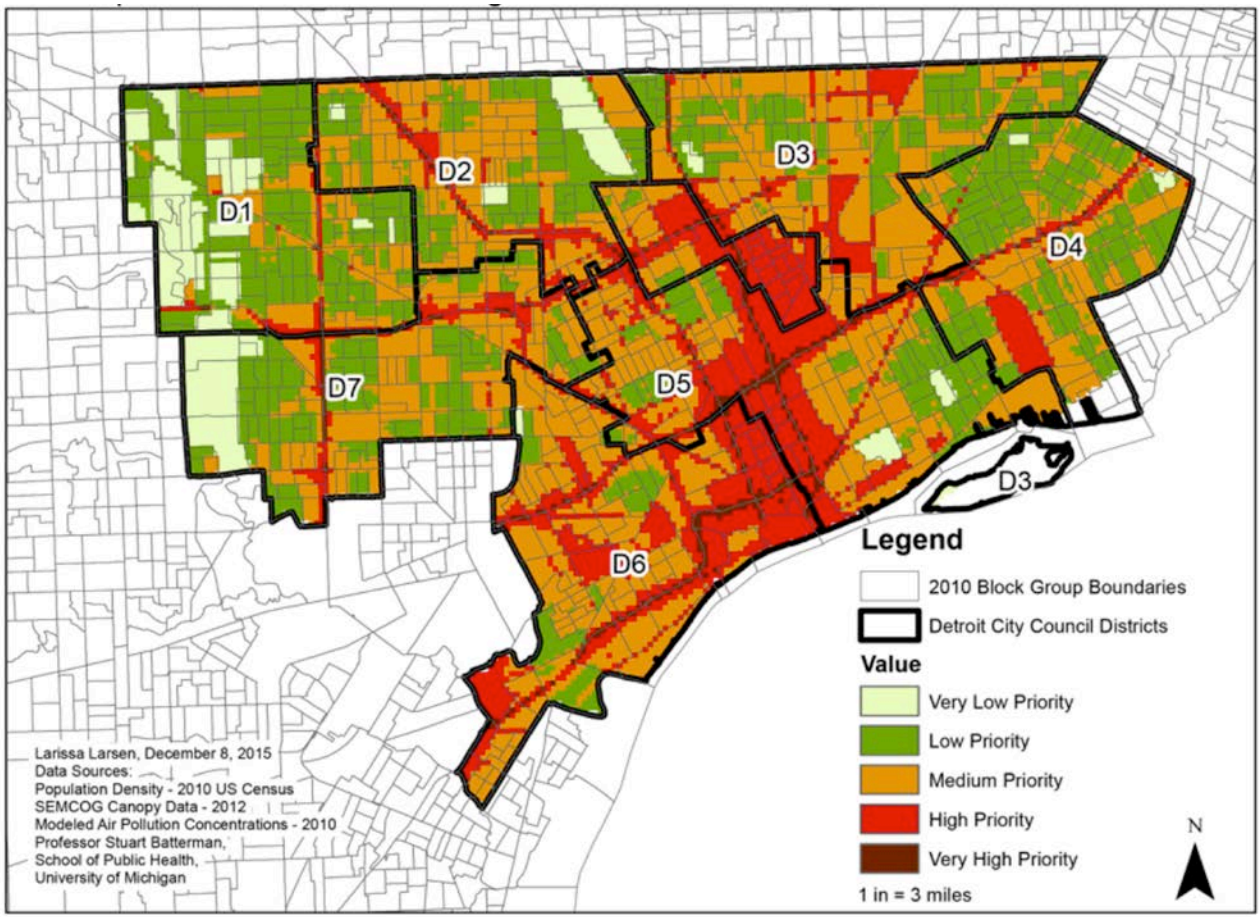
Engaging in education and outreach to spread awareness of buffers among Detroit community members, businesses, and other stakeholders will enable these groups to learn more about:

1) the effective use of buffers (e.g., high priority areas and strategies for planting; recommendations for tree types; maximizing benefits);
2) the co-benefits buffers provide (e.g., lower maintenance along roadways; prevention of water runoff; climate change mitigation);
3) how to identify the most promising buffer locations (e.g., downwind from homes/ schools; high vacancy residential areas; between polluting sources and residential areas/schools); and
4) strategies for minimizing potential adverse effects of buffers (e.g., planting in ways that do not increase driving risk and selecting trees that are non-allergenic, emit no or low VOCs, and effectively capture pollutants]).

CAPHE's "Vegetative Buffers Tool Kit" is designed to aid residents, decision makers, and regulators in identifying buffer sites and in installing buffers. This guide is similar to the Green Farmstead Partner Program's *Guide for Installing Vegetative Environmental Buffers.* The CAPHE guide includes information on site constraints, soil conditions, selection criteria, and design options. It also includes case studies/examples and identifies potential funding sources.[33]

Prioritizing tree-planting sites within the City of Detroit is especially important, and site prioritization can enhance air pollution removal. Based on an approach conducted in New York City in 2011,[34] CAPHE combined three spatial layers of information including pollution concentration (for $PM_{2.5}$ and NO_2), population density, and lack of tree canopy, to create an index of priority planting areas. Figure 8.2.1 - 2 provides results from this analysis, ranging from very low priority tree planting areas, to very high priority tree planting areas. The findings from this study help identify specific locations for tree planting, including information on tree species and on where impervious surfaces may limit planting.[35]

FIGURE 8.2.1 – 2: *Prioritized Tree Planting Areas to Enhance Vehicular Air Pollution Removal*



Additional considerations for site selection for buffers in Detroit include identification of where the city's most vulnerable residents, who are often burdened with cumulative impacts from multiple environmental stressors, are located. As a result, a critical component of buffer-related education and outreach initiatives is spreading awareness among relevant decision makers and residents to encourage adoption of buffers in the specific locations that would most benefit (e.g., in areas surrounding the Ambassador and Gordie Howe Bridges, Industrial Park and Logistic Centers, truck/rail transfer stations, schools near major roadways, and along freeways and heavily trafficked roads).

To better protect Detroit communities at the greatest risk, local environmental groups may wish to share information about the enhanced benefits of supplementing spatial buffers with vegetation and sound barriers.

Abundant opportunities should be provided for community involvement, via community workshop and partner meetings with community members, developers, and City Council members, in designing and implementing vegetative and sound wall buffers, both to protect vulnerable neighborhoods and to serve as a mechanism for encouraging green development.

Given the momentum for greening projects throughout Detroit, it may be feasible to implement plans for vegetative buffers that complement or expand on current efforts to use vegetation as an air pollution mitigation measure.

8.2.2 Support and Coordination

Several organizations in Detroit have incorporated or supported vegetative and/or sound wall buffers. Given the momentum for greening projects throughout Detroit, it may be feasible to implement plans for vegetative buffers that complement or expand on current efforts to use vegetation as an air pollution mitigation measure. The following initiatives could consider expanding efforts to include vegetative/sound wall buffer implementation, installation, and policy change work:

- Detroit Greenways Coalition, who is currently working to promote and build a network of greenways and bike lanes that will connect people and places, improve the quality of life, beautify neighborhoods, and stimulate neighborhood-level economic development in Detroit.[36]
- Detroit Complete Streets Coalition, who is working to create safer streets for all users, including those in wheelchairs, bicyclists, seniors and youth, so that pedestrians, bicyclists, motorists and public transit riders of all ages and abilities are able to move safely along and across streets, which may include sidewalks, crosswalks, and bike lanes.[37]
- The Greening of Detroit, a non-profit organization, that plants trees, engages in urban forestry education, job training, and other community programs, and works to maintain and improve urban farms in Detroit, all toward the goal of improving the city's air quality.[38]
- The City of Detroit stormwater remediation and reforestation efforts.

City, state, and local authorities are critical partners in vegetative/sound wall buffer proposals, projects, and policy change efforts. Collaborations with the Detroit Planning Department, for example, would allow local environmental and community groups to promote the use of sound walls and vegetative buffers to create more green space, especially in heavily trafficked residential areas.

Efforts to locate sound walls and buffers should be coordinated with the Michigan Department

of Transportation's (MDOT) Noise Abatement Program to identify the most feasible locations. MDOT implements barriers when an area meets specific 'feasibility' and 'reasonableness' criteria. These critiera consider the number of people potentially affected and the estimated reduction in noise pollution that may be realized by building sound walls. Because sound walls also reduce the amount of air pollutants that reach populations, they can have health benefits beyond those associated with noise reduction.[39]

By coordinating with these state and local authorities, local organizations proposing buffer projects can ensure that their plans comply with roadside planting standards and are complementary to city plans. They may also be eligible for funding support.

8.2.3 Incentives and Funding

Incentive programs offer a mutually beneficial way for cities to promote vegetative and sound wall buffers, espeically for industry and developers. The City of Detroit could offer tax deferrals and/or tax credits to industry and developers to encourage buffers. "Development incentives programs" provide financial and other incentives to encourage developers to incorporate green infrastructure into new developments and redevelopments. Incentives can include reduced permit fees, expedited permitting processes, or tax credits. Programs might target specific development types. For example, Chicago's Green Permit Program offers an expedited permit process and reduced permit fees for green technologies and LEED certifications; Philadelphia also offers a "fast track" permitting process for storm water management and tax credits to developers for implementing some green technologies.[40]

Another option to help cover costs of buffers is the citywide application of a one-time fee or tax to new residential construction projects and certain commercial or industrial developments. The city could use these revenues to purchase land for buffers or provide funds for planting and maintenance of vegetative buffer projects.

Another innovative funding option is "green" or "environmental" impact bonds (commonly known as "social impact bonds"), which are fixed income, liquid financial instruments that raise funds for environmentally beneficial activities.[41] In a city undergoing revitalization, like Detroit, socially progressive investors may be interested in funding green infrastructure projects, including vegetative buffers, to improve the City's overall outdoor air quality and protect residents in surrounding areas.

In December 2014, the Goldman Sachs Social Impact Fund made a $6.9 million preferred equity investment to finance the redevelopment of Detroit's East Riverfront neighborhood. The project will transform blighted city-owned land, reconnect the Riverfront area to the downtown core, and help meet the demand for high-quality housing in Detroit. 20% of the housing units will be set aside for households earning less than the area median income, helping to preserve an economically diverse neighborhood.[42]

The State of California conducted its first Green Bond sale in September 2014, with the intent to finance projects that provide clean water, reduce air pollution, and support energy efficiency and conservation in public buildings.[43] Another example occurred in the Commonwealth of

Massachusetts. This state plans to use a $350 million Green Bond sale to pay for open-space protection efforts, clean water, energy efficiency, river revitalization, and a marine terminal to support offshore wind projects.[44]

California was the first state to develop a comprehensive cap-and-trade system for greenhouse gas emissions, and the City of Santa Monica responded by planting over 1,000 trees in 2011 and 2012 to obtain carbon credits.[45] Local and state environmental groups in Michigan could encourage our state to adopt a carbon credit initiative to fund green buffer projects that might include urban forestry and green buffers in Detroit.

Other options for funding vegetative and sound wall buffer projects in Detroit include federal, state, and foundation grants. Federal grants include:

- Green Building Grants (EPA), offering subsidies and grants to communities involved in creating ecologically friendly housing. These projects are given subsidies depending on the developers and suppliers used.[46]
- CARE Grants (EPA), focusing on communities where there are concerns regarding hazardous pollutants, including air, water, soil pollutants or building (such as lead paint or mercury poisoning) pollutants.[47]
- Area-Wide Brownfield Grants (EPA), providing grants and technical assistance to communities, states, tribes and others to assess, safely clean up and sustainably reuse contaminated properties.[48]
- Pollution Prevention Grant Program (EPA), funding grants/cooperative agreements that implement pollution prevention technical assistance services and/or training for businesses and support projects that utilize pollution prevention techniques to reduce and/or eliminate pollution from air, water and/or land.[49]
- National Park Service Community Assistance in Conservation and Outdoor Recreation Grants, assisting community-led natural resource conservation and outdoor recreation initiatives that 1) conserve waterways; 2) preserve open space; or 3) develop trails and greenways. [50]
- HUD Sustainable Communities Regional Planning Grants, supporting metropolitan and multijurisdictional planning efforts to integrate housing, land use, economic and workforce development, transportation, and infrastructure investments to empower jurisdictions to consider 1) economic competitiveness and revitalization; 2) social equity, inclusion, and access to opportunity; 3) energy use and climate change; and 4) public health and environmental impact.[51]
- Source Reduction Assistance Grant Program (EPA), funding pollution prevention through source reduction and resource conservation work.[52]

State of Michigan grants include:

- Brownfield Redevelopment Grants and Site Reclamation Grants (MDEQ), funding local government and other public bodies to investigate and remediate sites of environmental contamination in preparation for economic redevelopment projects.[53]
- Community Pollution Prevention Grants (MDEQ), providing matching grants to county governments, local health departments, municipalities, and regional planning agencies to further foster partnerships and sustainability.[54]
- Michigan Department of Natural Resources Trust Fund Grants, providing funds to local governments to purchase land or rights to land for public recreation or protection of land because of its environmental importance or its scenic beauty, and assists in the appropriate development of land for public outdoor recreation.[55]

Foundation grants include:

- The Kresge Foundation, which seeks to invigorate city neighborhoods as envisioned in the Detroit Future City Strategic Framework Plan, funding projects that build on Detroit's physical, social, cultural, and economic assets to promote quality of life in green, healthy, active neighborhoods.[56]
- Partners for Places, which invests in local projects to promote a healthy environment, a strong economy, and wellbeing of all residents.[57]
- Community Foundation for Southeast Michigan – GreenWays Initiative, which works with municipalities and organizations, sharing their experience on greenways development — e.g., zoning, financing, leveraging public and private dollars — and greenways maintenance.[58]
- Erb Family Foundation, which supports environmental projects in Detroit that promote green infrastructure; strengthen collaborative, community-based efforts working at the intersection of environmental justice, sustainable business and public health; and that align research, policy and practice and develop local environmental citizenship, advocacy and leadership.[59]
- C.S. Mott Foundation, which awards grants for environmental projects in Michigan focused on advancing clean energy and climate change solutions.[60]

On a much smaller scale, CAPHE mini-grants will be available to community groups throughout Detroit to support the implementation of vegetative buffers in strategic locations in 2017 and 2018.

Finally, local environmental groups and advocacy organizations should encourage the City of Detroit to undertake a collaborative, multifaceted, large-scale effort to create new funding opportunities across sectors (e.g., private, public, and philanthropic) to help increase support for and incentivize the development of green buffers, tree planting, and open space projects and programs in Detroit.

8.2.4 Planning and Regulations

The most effective method for increasing vegetative and sound wall buffers in strategic locations in Detroit is through citywide planning, policies, rules, and regulations requiring that vegetative or sound wall buffers be implemented where spatial buffers are not possible. The City of Detroit could require vegetative or sound wall

The City should consider creating policies requiring buffers, for example, by requiring and enforcing environmentally friendly land uses (e.g. vegetative and spatial buffers, use of greenery, tree planting) in construction and design plans for developers who want to construct new projects in Detroit.

buffers to be incorporated in future development projects and/or as part of Community Benefits Agreements. The City should consider creating policies requiring buffers, for example, by requiring and enforcing environmentally friendly land uses (e.g. vegetative and spatial buffers, use of greenery, tree planting) in construction and design plans for developers who want to construct new projects in Detroit.

For example, San Jose, California included air pollution emission reduction policies in their Envision San Jose 2040 Master Plan. In this plan, the City requires the use of pollution-absorbing trees and vegetation in buffer areas between substantial air pollution sources and sensitive land uses (where feasible).[28]

Another example is from Davis, California. Their General Plan requires a minimum of 10% of newly-developing residential land be designated for use as open space, primarily for neighborhood greenbelts, and up to 20% of a project's greenbelt requirement may be used towards increasing the size of parks or other open-space within a development.[61]

CAPHE solicited the Great Lakes Environmental Law Center (GLELC) to complete a comprehensive analysis of the legal issues potentially involved in the widespread installation of roadside vegetative buffers on different types of roadways throughout Detroit, called "Roadway Buffers: A Legal Analysis." Their findings suggest that if the City of Detroit desired to install a roadside vegetative buffer that would involve any amendments between the curbs, such as the elimination of a lane or the installation of a median with a vegetative buffer, or if it desired to plant trees along an interstate highway, then it would most likely be confronted with jurisdictional and non-municipal regulatory issues that would have to be addressed.

GLELC also found that while the mechanism for the development of roadside vegetative buffers exists, the City lacks a comprehensive policy regarding the installation of roadside trees. The analysis suggests that in order to implement widespread vegetative buffers, the City of Detroit will most likely need to do two things: create a clear policy to promote the installation of roadside vegetative buffers, and simplify the web of City departments that are potentially involved with roadside vegetative buffer projects.

The creation of a roadside vegetative buffer policy in Detroit could be done by ordinance, executive order, or technical guidance documents. There are a few key indicators of successful policies: 1) Support from the mayor, 2) a clear policy directive, and 3) developing the needed technical guidance. For further description, and case-stody examples, please see: *Roadway Buffers: A Legal Analysis.*

Supplemental Environmental Projects (SEPs) could also support the use of vegetative buffers in key industrial areas. SEPs encourage businesses, developers, and/or individuals who previously failed to comply with environmental laws to undertake environmentally beneficial projects. SEPs could provide financial support for vegetative buffers in strategic locations

in Detroit. Local environmental groups can facilitate this process by educating those responsible for approving SEPs about the most strategic locations in Detroit and offering specific suggestions for buffer projects that would most benefit Detroit's most vulnerable communities.

Detroit could create regulations requiring industries that receive tax benefits to utilize buffers. The Los Angeles (California) City Council recently approved groundbreaking land use policies to help ease health hazards in the city's most polluted neighborhoods. The "Clean Up Green Up" ordinance requires new and expanding businesses in "green zones," toxic hot spots where residents are largely low-income and Latino, be subject to more stringent development standards and restrictions, e.g., setbacks, landscaping requirements and buffers.[62]

BUFFERS RECOMMENDATION 3: Increase tree canopy throughout the City of Detroit.

Trees are important natural filters for air pollution, and a single tree can absorb ten pounds of air pollutants a year.[63] The tree canopy coverage in Detroit is 18-22%, under the national average of 27.1% and well below American Forests' recommendation of 40% coverage for (eastern) metropolitan areas. Planting additional trees in strategic locations throughout Detroit can improve air quality and health for city residents while helping to reduce the adverse health effects associated with extreme urban heat events.. Increasing tree canopy has many co-benefits including enhancing visual interest, screening noise, filtering odors, and separating traffic and industry from residential or leisure activities (see recommendation #1), ultimately improving quality of life for residents, and the desirability of Detroit neighborhoods.

8.3.1 Education and Outreach

Many outreach and education activities can be used to promote awareness among a diverse array of stakeholders. This information should help residents, businesses, schools and policy makers better understand the benefits of trees in Detroit, and encourage active engagement in expanding Detroit's tree canopy. Information can include: the role of trees in absorbing pollutants; high priority areas in Detroit where planting trees would be most beneficial; recommendations for tree types; funding sources to support planting initiatives; and specific strategies for planting trees in urban settings.

As an example, Trees Atlanta recently launched an outreach campaign entitled "Learn. Do. Give" to help residents of Metro Atlanta understand the benefits of urban trees and to explore the how they can help support Atlanta's urban canopy. The campaign offers opportunities to learn about trees through a speaker series, workshops, walking tours, environmental education programs, a tree species and planting search engine and map, and a champion tree contest; do something good for the urban canopy in Atlanta by helping to physically plant trees; and give support by attending annual tree sales or donating to the organization.[65] Detroit and local environmental organizations could offer similar programs aimed at spreading awareness of the importance of trees to Detroit's urban landscape by educating community members and stakeholders about tree selection, site selection, and planting strategies, and sharing information about how to get involved with planting initiatives throughout the city.

Interactive mapping can provide up-to-date information about the current tree canopy and help identify where there are gaps. The *Greening of Detroit's Opentreemap* enables neighborhood organizations individuals, governments, and others to collaborate in mapping and exploring the urban forest. Users can enter data about specific trees, e.g., location, size, and species. The system then calculates benefits such as CO_2 storage, water and energy conservation, and reduction in airborne pollution for the user.

This allows residents to help the city inventory its trees and as well as learning more about the benefits of trees.[66]

Effective and responsive engagement among Detroit residents, schools, businesses, and policy makers is crucial for initiating tree planting projects or installing other vegetative buffers in neighborhoods or communities. For example, some community members may voice concerns about trees reducing visibility. Providing information, listening, and responding effectively to questions, concerns and priorities is essential to mutually agreed upon solutions to air pollution problems. Tree-planting projects that engage community members in each step – from identifying the need, selecting an optimal site, choosing tree species, planting the tree(s), and helping water it are essential.

The *Alabama Urban Forestry Partnership* used a model format for engaging diverse community representatives with local government service providers to improve communication surrounding the delivery of urban forestry services in Goodwater, Alabama. Three primarily African American communities who had not historically benefited fully from the state's urban forestry program were invited to participate in a "Diversity Outreach Meeting." These meetings included small group discussions about the community, concerns about urban trees, previous encounters with service providers, barriers that keep them from participating in programs, and suggestions to improve agency support. As a result, for the first time two of the communities received Urban and Community Forestry Financial Assistance Awards and technical assistance from local government service providers. This model format was identified as a program objective in Alabama's five-year strategic plan.[67]

More recently, Hollywood, Florida received grant funds to increase canopy cover in low-to-moderate income neighborhoods, educate residents on the importance of tree cover, teach proper tree maintenance, and enhance the benefits of ongoing city and state mobility, sustainability, and tree cover projects. The program's first component is community education and outreach, in which program staff present to the civic association of Hollywood Gardens West about benefits of street trees and, importantly, *gather input from the community* about expectations and needs from street trees in terms of placement, aesthetics, and utility.

Local environmental groups may also wish to spread awareness of the US Environmental Protection Agency's (EPA) recent recommendation for buffers around roadways adjacent to schools. EPA suggests that a well-designed buffer can reduce pollutant concentrations from vehicle sources 15 - 50%, and that the combined use of trees and sound walls may reduce downwind vehicle pollution by up to 60%. To select appropriate trees and shrubs specific for vegetative buffers, the EPA recommends consulting the U.S. Department of Agriculture's i-Tree Species tool, as well as experts from plant nurseries, city government, or the U.S. Forest Service.[68]

Detroit-based organizations could partner with the City of Detroit and local businesses to coordinate efforts aimed at improving air quality. The following organizations should be

engaged in an expansive, collaborative initiative aimed at expanding Detroit's tree canopy:

- The Greening of Detroit, a non-profit organization that plants trees, engages in urban forestry education, job training, and other community programs, and works to maintain and improve urban farms in Detroit, all toward the goal of improving the city's air quality. Greening has also prioritized sites and implements carbon buffers based on air quality measures, public land availability, and the future adjacent land uses. The primary goal of this program is to improve air quality in neighborhoods near expressways with green infrastructure that absorbs carbon dioxide, particulate matter, and other pollution from traffic.[69]
- Detroit Future City, which led an initiative that brought together Detroit residents and civic leaders from nonprofit and for-profit sectors to develop a shared vision for Detroit's future and recommendations for specific actions for reaching that future.
- American Forests Community ReLeaf Project, who evaluated and improved the ecosystem provided by Rouge Park, Detroit's largest standing forest and spurred the creation of the city's first outdoor education center. Funds from the project are now being used to help establish a coalition to create a citywide reforestation, wood reuse, and job creation strategy.
- Southwest Detroit Community Benefits Coalition (SWDCBC), a grassroots organization seeking to raise awareness of and improve the quality of life for those facing environmental and health impacts from proximity to Detroit's industrial sites.
- Detroiters Working for Environmental Justice (DWEJ), an advocacy organization that empowers individuals, communities, and organizations in Southeast Michigan to educate, advocate and organize for cleaner, healthier communities and environments. SWDCBC and DWEJ are developing a Green Buffers Plan for in the Delray neighborhood of southwest Detroit that contains many industrial facilities and the new international trade crossing. These groups are also working to identify where buffers can connect residents to the riverfront, Fort Wayne, parks, greenways and other assets.
- The "Healthier and Greener Detroit" (HGD) Workgroup, established in 2015 as a partnership between the Greening of Detroit and the Institute for Population Health (IPH), with representatives from other Detroit organizations. Funded through a grant from Trees Forever, they developed policy recommendations for the targeted use of trees, including the goal of increasing Detroit's tree canopy from 16.6% to 30% by 2025.[70]

The primary goal of this program is to improve air quality in neighborhoods near expressways with green infrastructure that absorbs carbon dioxide, particulate matter, and other pollution from traffic

Detroit groups working on tree-planting initiatives may also coordinate with local and regional forestry organizations (e.g., U.S. Forest Service) to explore priority locations, and identify tree - planting goals. For example, the City of Lancaster, Pennsylvania used surveying technology (LiDAR) and aerial imagery to determine where tree canopy currently existed and where there was potential for tree canopy, information utilized to set feasible planting goals and prioritize locations.[71]

8.3.2 Incentives and Funding

Tree-planting initiatives are growing in cities across the country, and many funding opportunities exist. The following financial assistance programs are available to cities,

communities, and local organizations seeking support for tree-planting projects:

- The Michigan Department of Natural Resources and the DTE Energy Foundation are awarding grants totaling $159,825 to 41 Michigan communities for local tree-planting projects.[72]
- The Michigan Department of Natural Resources also awards Community Forestry Grants to provide information and technical assistance to municipal governments, schools, nonprofit organizations and volunteer groups for urban and community forest activities such as tree inventories, management plans, planting and other maintenance activities.[73]
- The Arbor Day Foundation supports innovative practices in community forestry. Through the TD Green Streets Grant Program, municipalities can receive one of ten $20,000 grants to support local forestry projects in low-to-moderate income neighborhoods.[74]
- American Forests and Bank of America have partnered to provide a $250,000 grant to fund Community ReLeaf, an assessment of urban forests and climate change in five U.S. cities, including Detroit.[75]
- The Alliance for Community Trees, a national nonprofit dedicated to improving the health and livability of cities by planting and caring for trees, awards various grants (e.g. Community Tree Planting Grants and NeighborWoods® Grants) to fund urban forestry projects.[76]
- Michigan Conservation Districts offer quality, affordable trees and shrubs for planting projects in Michigan. Seedlings, transplants and bare-root fruit trees can be ordered wholesale.[77]
- The USDA Forest Service's National Urban and Community Forestry Challenge Grants are awarded annually to state governments, nonprofits, or educational entities who demonstrate how healthy urban forests can increase public health benefits, improve development and redevelopment efforts, and contribute to urban food production.
- Urban and Community Forestry Grants are awarded by many state governments to help assist municipalities and local units of government in developing, managing and sustaining local community forestry programs.[78]
- Community Action to Promote Healthy Environments (CAPHE) offers mini-grants to Detroit communities that can be used to promote local tree planting and vegetative buffers in vulnerable communities.

Several cities are funding tree-planting efforts. For example, Portland, Oregon's Department of Environmental Services offers two programs to incentivize residents to plant more trees. The first, the "Treebate" program, provides credits to residents' city water/sewer utility bill for half of the purchase price per tree.[79] The second, the "Free Tree" program, works to build new partnerships to ensure that trees are planted

in locations where they meet multiple needs (e.g., along industrial and commercial districts and transportation corridors where air quality improvement, shading, and noise buffering are critical additional benefits). The city also offers free trees to under-served neighborhoods and for school planting events.[80] The Departments of Parks and Recreation in New York City and Boulder, Colorado, are examples of cities that provide free trees to city residents who request that a tree be planted in their neighborhood. Between 1950 and 1980, about 500,000 trees were lost in Detroit to Dutch elm disease, urban expansion, and attrition.[81] To begin to compensate for this loss and to counteract the potentially harmful effects of the city's air pollution problem, Detroit could invest in a program in which it agrees to plant trees, free of charge, to city residents who feel their neighborhood would benefit.

8.3.3 Planning and Regulations

As revitalization and redevelopment efforts unfold in Detroit, the City should implement planning and regulations that encourage communities, neighborhoods, and residents to engage in tree planting. Key will be crafting and adopting a comprehensive Open Space Plan to support the development and financial feasibility of tree planting projects. Detroit Future City recently commissioned the Center for Community Progress to examine the viability of long-term open-space options identified in the Detroit Future City Strategic Framework. In this report, they found that "the single most critical action Detroit can take to increase the financial feasibility of long-term open space is to craft and adopt a comprehensive Open Space Plan, Master Plan of Policies, and Zoning Ordinance that detail and codify permanently designated open space areas."[83]

Portland, Oregon developed an innovative "Open Space Zone" intended to preserve and enhance public and private open, natural, and improved park and recreational areas. These areas serve many functions, including "enhancing and protecting the values and functions of trees and the urban forest."[84]

Detroit could pass regulations aimed at protecting the city's existing tree canopy to avoid losing trees to new development. The City of Port St. Lucie, Florida, has a Tree Protection and Mitigation ordinance that provides for the protection of mature trees. Trees removed in development must be replaced and increased. The ordinance is linked to a citywide initiative to increase the city's tree canopy to create a more sustainable urban forest, reduce the amount of carbon dioxide in the atmosphere, and to conserve resources.[85]

Detroit may also promote the use of Supplemental Environmental Projects (SEP) to encourage businesses, developers, and/or individuals who previously failed to comply with environmental laws to undertake environmentally projects. Such projects can provide financial support for tree planting initiatives in strategic locations, such as between pollution sources and residential areas, along roadways, and in sensitive areas. The California Air Resources Board's (CARB) SEP Policy allows community-based projects to be funded from a portion of the penalties received during settlement of enforcement actions. CARB allows SEP to be used in lieu of a portion of a penalty payment to mitigate the effects of a particular violation.[86]

Footnotes

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9 Compliance and Enforcement

Compliance and enforcement refers to activities that relate to air pollution regulations. Key air quality regulations encompass: (1) emission-related requirements for pollution sources that limit emission rates or that promote dispersion and reduce concentrations; (2) ambient air quality standards and guidelines that limit airborne concentrations of pollutants; (3) equipment and process rules that address the feedstocks, fuels, technological controls, and other materials or activities at a facility; and (4) reporting, disclosure and emergency planning requirements that require authorities to be informed about routine and emergency emissions.

Air pollution regulations are set by federal, state and local authorities; state and local regulations may be more stringent than federal regulations, but not more lax. Monitoring and inspection activities are needed to demonstrate that air quality and industrial operations comply with local, state and federal regulations. If air quality levels or industrial operations are not in compliance, then a violation notice may be issued and enforcement activities may be initiated with the goal of achieving compliance. Enforcement activities include administrative and judicial paths to attain compliance. The current air quality management framework is compliance-oriented. Public health is considered only to the extent that regulations and standards are adequately protective of health.

National, state, regional and local authorities have different roles with respect to air pollution regulations *(See Section 4 CAPHE Resource Manual Section 4).*

- The Environmental Protection Agency (EPA), under the Clean Air Act, sets concentration limits on certain air pollutants through the National Ambient Air Quality Standards (NAAQS), source standards that set emission limits from certain sources, and other rules

This is an opportune time to improve compliance and enforcement activities given the SO_2 and pending O_3 SIPs, which increase attention at all levels to air quality issues.

for asbestos and other toxic pollutants under the National Emission Standards for Hazardous Air Pollutants (NESHAP). The EPA must approve state, tribal and local agency plans for reducing air pollution; if a plan does not meet requirements, the EPA can issue sanctions and take other actions against the state. The EPA also sets ambient monitoring requirements and provides funding to support monitoring and other programs.

- The Michigan Department of Environmental Quality (MDEQ) Air Quality Division (AQD) enforces EPA regulations and other state environmental laws. MDEQ monitors air quality; inspects facilities; develops and enforces permits, rules and standards; develops State Implementation Plans (SIPs) that describe how pollution will be reduced in cases of NAAQS noncompliance; involves the public and industries through hearings and comment opportunities; and performs many other functions.
- The Southeast Michigan Council of Governments (SEMCOG) is responsible for ensuring that regional transportation plans are consistent with the air quality goals established by MDEQ as part of the SIP process through a process called a conformity assessment. These assessments focus on traffic-related air pollutants, including ozone (O_3), oxides of nitrogen (NO_x), and particulate matter (PM); these also include transportation control measures (TCMs).
- The City of Detroit enforces any local ordinances related to air quality, e.g., the city's anti-idling ordinance[1] and requirements for clean fuels in certain city owned or contracted vehicles.

A portion of Detroit and Wayne County are in noncompliance with the 2010 sulfur dioxide (SO_2) NAAQS, and MDEQ developed and submitted to EPA a SIP that requires emission reductions at several SO_2-emitting industrial sources and an increase in stack height at another source.[2] In addition, MDEQ has recommended that Livingston, Macomb, Monroe, Oakland, Washtenaw and Wayne counties be designated to be in noncompliance with the 2015 ozone (O_3) NAAQS.[3] O_3 is formed from reactions between precursors NO_x and volatile organic compounds *(VOCs; See Section 4 CAPHE Resource Manual Section 4)*. If approved, MDEQ will need to develop and obtain approval for a SIP that focuses on reducing emissions of NO_x and VOCs. This likely will involve point, mobile and area sources that emit O_3 precursors, and several levels of government, e.g., MDEQ and SEMCOG.

This section focuses on compliance and enforcement recommendations for MDEQ, which has primary responsibility in this area. Recommendations pertaining to monitoring, an element of broader compliance and enforcement activities, are provided in Section 10 of the Public Health Action Plan. *This is an opportune time to improve compliance and enforcement activities given the SO_2 and pending O_3 SIPs, which increase attention at all levels to air quality issues.*

COMPLIANCE AND ENFORCEMENT RECOMMENDATION 1: Increase the coverage, timeliness and stringency of facility inspections and enforcement activities, and assure compliance with existing permits and regulations.

Michigan's ability to address environmental problems was flagged in a federal audit of the water program in 2010 and more recently with investigations related to the Flint water crisis. Historically, MDEQ has been understaffed and underfunded, e.g., since 2000, MDEQ's staff has been cut by more than a quarter and the agency's general fund budget declined nearly 60%.[4] The Detroit field office, which is responsible for enforcement activities throughout Wayne County, has just 31 employees.[5] In some areas, the MDEQ is critically understaffed. Overall, increasing facility inspections and enforcement activities will require capacity, staff and funding for MDEQ.

An example of understaffing at MDEQ important to Detroit, concerns building demolitions occurring as part of the blight removal program. Old buildings targeted for demolition contain lead-based paint, and many also contain asbestos. The demolition and subsequent removal (load-out) of building materials can release "fugitive" dust containing lead and asbestos, two hazardous air pollutants that can cause exposure and contaminate nearby areas. Asbestos is regulated under the National Emission Standards for Hazardous Air Pollutants (NESHAP), a part of the federal Clean Air Act. The Air Quality Division of MDEQ administers the asbestos NESHAP program, including reviewing notifications (pending actions), inspecting demolitions and asbestos removals, and initiating enforcement actions when violations occur. In recent years, approximately 7,000 notifications per year have been received statewide, reviewed for completeness and timeliness, and inspections made based on contractor history, areas of the state, and type of project.[6] In Detroit alone, approximately 3,000 building demolitions have been conducted in recent years, many of which require asbestos abatement and compliance with the NESHAP program. In 2014-16, MDEQ was able to inspect only 8% of demolitions in Detroit providing NESHAP notifications given the two field staff assigned to Detroit for this program. (Only four staff are assigned statewide to the NESHAP program). This percentage will drop significantly as the demolition program ramps up to as many as 10,000 demolitions per year and if staffing remains constant, as is budgeted for the near future.

9.1.1 Education and Outreach

MDEQ should increase transparency of facility inspections, enforcement activities and permitting processes by widely disseminating information about AQD's activity. Michigan law requires that the AQD submit to the legislature an annual report on its activities, e.g., the number of permit applications received, actions taken on those applications, inspections performed, the number of violation letters sent, and penalties and enforcement actions taken against permit violators.[7] This report is not readily available on the MDEQ AQD website. DEQ should make this information available

to the public, hold information sessions, and answer questions and receive feedback.

9.1.2 Support and Coordination

Increased AQD activity related to compliance and enforcement should be informed and supported by better data related to emissions, ambient concentrations, and facility performance. To this end, MDEQ should:

- Improve emissions inventory data, particularly for PM and toxics, and provide an enhanced and publically available database that can better inform assessment and enforcement efforts. This should include real-time emissions and ambient monitoring and warning systems, as used in industrial areas in the US, Canada and elsewhere to detect harmful pollutant levels, with real-time dissemination and notification to communities and emergency response personnel should a standard be exceeded. Louisiana has proposed such an inventory data system for all major point sources.[8, 9]
- Require industry operated ambient monitoring networks, with third party oversight, that are integrated with the MDEQ monitoring network (Section 10.1 of the Public Health Action Plan Recommendations).
- Coordinate among MDEQ, Michigan's Attorney General and US Department of Justice for an annual (or more frequent) report for the public regarding compliance and enforcement activities and status.

Increased AQD activity related to compliance and enforcement should be informed and supported by better data related to emissions, ambient concentrations, and facility performance.

9.1.3 Incentives and Funding

As noted, funding for MDEQ has remained stagnant and inadequate. The governor's recent budget recommendation (FY2016 and FY2017) is $487.9 million, of which AQD receives about 5% ($26.7 million). The level is fundamentally unchanged since 2000 when the AQD received $24.4 million.[10] Since formation in 1995, MDEQ's share of the state's general fund budget has declined considerably (1.16% in 1996, and 0.41% in 2015).[11]

The Clean Air Act requires that fees collected from Renewable Operating Permits (ROPs) be used to fully fund Title V permitting programs at the state level. These fees are typically charged on a per ton emitted basis. Section 324.5522 of the Natural Resources and Environmental Protection Act (Act 451 of 1994) outlines the current ROP fee schedule,[12] which applies through October 1, 2019 after which MDEQ will need to submit a new plan to the EPA. Act 451 limits the activities for which these fees can be used[13] and also requires that fines collected as a result of permit violations be placed into the general fund.[14]

MDEQ should obtain additional funding for technical staff and inspectors that would allow more frequent inspections, enhanced monitoring, and other analyses. Potential funding sources include: an increased allocation for enforcement in the state's budget; higher Renewable Operating Permit (ROP) fees; instituting Permit to Install (PTI) fees (no PTI fee currently exists.[15]); and increasing fines and establishing mechanisms to redirect fines from regulatory violations back to MDEQ for inspections and technical assistance. Some of these mechanisms require revisions of Act 451.

Additional staff at the Attorney General and Department of Justice offices responsible for enforcement should be hired. These staff often pay for themselves through fines from consent orders, settlements and judgments.

9.1.4 Planning and Regulations

MDEQ should take the following steps to ensure enforcement activities are increased to an appropriate level:

- Evaluate current inspection practices and identify gaps and deficiencies;
- Develop revised rules appropriate for the scale of the building demolition program in Detroit to ensure that lead, asbestos and dust generation and exposure is minimized.
- Establish priorities for inspection programs, focusing on areas of high environmental burden or cumulative health impacts;
- Set goals for inspection frequency and make these goals known to community groups;
- Set goals for timely enforcement, and track actions related to compliance and enforcement on an expanded web site, and;
- Communicate inspection and enforcement activities to the public on a regular basis.

Additional staff and funding may be required for some of these recommendations.

COMPLIANCE AND ENFORCEMENT RECOMMENDATION 2: Require the use of qualitative and quantitative health impact assessments and cumulative impact assessments as part of the air quality management process, including enforcement actions, SIP development and permitting.

MDEQ should adopt a policy that requires the inclusion of health and cumulative impact assessments in the air quality management process. Health impact assessments (HIAs) are used to characterize the potential health impacts (either adverse or beneficial) of proposed projects, policies, plans and programs.[16] Quantitative HIAs use spatially-resolved information regarding ambient concentrations, baseline health rates, and at-risk populations, while qualitative HIAs require expertise in public engagement and qualitative research methods.[17] Cumulative impact assessments (CIAs) identify how environmental and social stressors combine to affect vulnerable populations, bringing together data from exposure assessment, mapping, and social and environmental epidemiology.[18] CIAs also examine effects of multiple pollutants. Overall, these analyses strive to evaluate how a facility, permit or other action might affect a community, and they represent the most accurate and comprehensive picture of risk and pollution burden available. HIAs and CIAs apply to many air quality management activities, e.g., evaluating alternatives when developing SIPs, evaluating permit conditions, identifying potential health impacts of a permit violation to design appropriate enforcement actions, and educating the public, industry and other stakeholders about air pollution impacts. For example, California has adopted a *Health in All Policies* approach to incorporate health into the policy evaluations of traditionally non-health sectors, e.g., transportation.[19] This recommendation addresses this need in air quality management.

9.2.1 Education and Outreach

MDEQ personnel and other stakeholders should be educated on the development and use of HIAs. MDEQ and other state agencies currently lack this expertise. Several tools and organizations facilitate access to data and methods,[20] e.g., the EPA's Benefits Mapping and Analysis Program (BenMAP) provides quantitative screening-level spatially-resolved health and economic impact assessments, and training is available from the EPA.[21] Additional training is required for more comprehensive assessments, e.g., those involving inequality metrics. Training on qualitative HIA methods can be obtained from Human Impact Partners[22] and other organizations. HIAs incorporate strategies for engagement of stakeholders throughout the HIA process, including identification of health concerns, interpretation of results, development of recommendations to reduce adverse health impacts and maximize health benefits, and dissemination of results widely, including to communities affected.

HIAs provide an opportunity to engage with residents, educate community members about the health and equity impacts of pollutant sources in their neighborhoods, and obtain feedback during air quality management activities. Because not all impacts can be quantified,[23, 24] community engagement is needed to identify and understand the potential health, social, economic, cultural and other impacts, and in the process of identifying recommended strategies to minimize health burden and maximize health benefits. Information collected during a health impact assessment should be shared with the community as well as other stakeholders once the assessment is complete.

9.2.2 Support and Coordination

Coordination across state agencies, non-governmental organizations, community groups, and potentially academic partners is needed to use HIAs in air quality management in an effective manner. Assessments incorporating quantitative health and inequality metrics require data on emissions, concentrations, meteorology, baseline health rates, population demographics, and socioeconomic variables. These data are typically available from MDEQ, Michigan Department of Health and Human Services (MDHHS), US Census Bureau, local health departments, and others. Additional data regarding social impacts can be collected directly from the community. Collecting, updating, and selecting the most appropriate data will require cooperation among governmental and non-governmental organizations, and possibly formal data sharing and collaborative agreements. Coordination of HIAs in Detroit could be facilitated by:

- Creating opportunities and mechanisms for interagency cooperation among MDEQ, MDHHS, Office of Civil Rights, public safety departments, public health departments, among others. Some of this is performed under the *Clean Air Act Emergency Response Planning* coordinated by Wayne County.
- Developing partnerships involving government, academia, community organizations, industry and others. Detroit community organizations with expertise in HIAs or related areas include the *Detroit Hispanic Development Corporation, Green Door Initiative, Detroiters Working for Environmental Justice,* and *Data Driven Detroit.*[25]
- Developing a best practices guide that describes the development and use of HIAs in regulatory activities, including the use of environmental justice and equity analyses.[26, 27, 28]

9.2.3 Incentives and Funding

HIAs can be time consuming and resource intensive, thus, MDEQ may require funding to conduct these assessments. However, the effort required to conduct HIAs will decrease as databases are assembled. MDEQ should explore opportunities to reduce costs, potentially by partnering with MDHHS, local health departments, SEMCOG, the Centers for Disease Control and Prevention (CDC), and the EPA. Additional support, particularly for Detroit analyses, might be obtained from foundations (e.g., Pew, Erb) and government entities (e.g., CDC).

9.2.4 Planning and Regulations

Like most states, Michigan currently does not have legislation requiring the use of HIAs in the regulatory processes.[29] A policy to evaluate health and inequality impacts using site-specific HIAs is feasible and would provide assurance that air quality management decisions are protective of public health. This policy would go beyond current EPA requirements that require compliance with NAAQS or MDEQ rules that set maximum risk-based screening levels. Such policies can emphasize sources located near populations and sources with characteristics that can increase local exposure (e.g., industrial facilities with short stacks, vehicle traffic near populated areas). While some of these sources may be relatively small, have costs per ton of pollutant removed that appear high, and historically may not have not received much attention, health and inequality impacts can be significant.

MDEQ should develop, vet and implement a HIA program to assess health, vulnerability, susceptibility and inequality impacts for its air quality management activities. Program priorities for HIA use should include planning, permitting and enforcement actions. HIAs can evaluate a facility or permit's impact on a community, and thus can inform regulators and allow development of strategies that effectively reduce exposures and impacts. For example, Minnesota requires CIAs before issuing air permits,[30] and New Jersey and California are investigating and implementing ways to incorporate CIA in permitting and enforcement.[31, 32] A detailed example showing how HIAs can be used to evaluate health and equity impacts pertaining to the SO_2 SIP in Detroit is described in the references.[33] MDEQ and the State of Michigan should also incorporate HIAs and CIAs into long range planning and economic development activities.

COMPLIANCE AND ENFORCEMENT RECOMMENDATION 3: Increase public input in air quality management including the development of regulations, permitting and enforcement activities.

At present, public participation in compliance and enforcement activities is limited and not very effective. This results from several reasons: The level of technical capacity is often limited in the affected communities; a lack of relevant information provided by MDEQ regarding impacts; difficulty in developing and coordinating responses in the 30 day comment period, the relatively few types of decisions that can be contested, and perceptions and reality that very few permits are denied. MDEQ should encourage affected communities to be active participants in compliance and enforcement activities by: supporting development of technical capacity within communities, extending the 30 day comment period and providing prior notice of pending actions, and providing information about the types of decisions that can be contested and upon what grounds.

9.3.1 Education and Outreach

MDEQ should increase the public's understanding and participation in air quality management activities, including permitting and enforcement. Education and outreach activities and materials (including MDEQ's website) should also be revised, and should include:

- Expanding MDEQ efforts to educate the public regarding air quality management. MDEQ's website has a series of webinars on topics such as permitting and dispersion modeling.[34] These materials are prepared with industry in mind. Other materials are oriented to the public.[35] There is a need to update and expand information provided to community members, including, but not limited to air monitoring, control technologies, permits, and the legal/regulatory framework. Information gaps and the development of these materials should be informed with community input.
- Increasing notification, information and transparency. This includes: posting received permit applications in a highly visible manner on the AQD website and other public forums (MDEQ's calendar currently is limited to some pending actions[36]); increasing time available to review draft materials; providing plain language descriptions of overall facility emissions, impacts and environmental performance in public information documents (not just potential increases associated with the permit); and dedicating MDEQ staff to translate technical materials into multiple languages (English, Spanish, Arabic).
- Publicizing MDEQ's toll-free telephone number (800-662-9278) and use other mechanisms to report air pollution problems. Currently, MDEQ field office employees use this information to investigate complaints and perform inspections. Other complaint hotlines include the Zero Waste Detroit's campaign encouraging residents living near the Detroit Incinerator to call and send reports via email to the organization that includes information to help target enforcement actions, e.g., observations of visible smoke from the incinerator's stack.[37] MDEQ should develop an on-line website and smart-phone app by which residents can submit air pollution complaints.
- Creating opportunities for ongoing and bi-directional communication with representatives from affected communities to be responsive to concerns and allow community members to help set priorities. Often, individuals living near an air pollution source may know more about the local environmental conditions than agency officials, and citizens can offer perspectives and experiences not necessarily represented by the government or regulated industries.
- Establishing a balanced stakeholder advisory board that includes members of affected communities. Active residents on such boards also help to spread education on air quality issues throughout the community.
- Ensuring that meeting materials, online content and other communication materials are available in multiple languages and that interpreters are available for public hearings. Many residents of southwest Michigan, for example, speak a language other than English.

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9.3.2 Support and Coordination

Meaningful engagement with communities would be bolstered by MDEQ partnering with community based organizations and community groups in affected area. A number of groups are committed to environmental issues and can increase and broaden public engagement, increase the effectiveness of communication efforts, and ensure notification

of affected residents. Examples of such groups include *Detroit Future City, Detroit Hispanic Development Corporation, Detroiters Working for Environmental Justice, Community Benefits Coalition, Green Door Initiative, Greening of Detroit, American Lung Association, Sierra Club,* and *Southwest Detroit Environmental Vision.*

MDEQ could provide financial support for technical assistance services and advisors for communities. For example, the US EPA Superfund Program provides technical expertise to communities though a Technical Assistance Services for Communities (TASC) Program, which provides scientists, engineers and other professionals to review and explain information to communities at no cost to communities; a Technical Assistance Grant (TAG) Program for non-profit incorporated community groups to contract with independent technical advisors to interpret and help the community understand technical information; and, a similar Technical Assistance Plan (TAP) (funded by polluters) enabling community groups to retain the services of an independent technical advisor.[38] In some ways, these are similar to community benefit agreements.

9.3.3 Incentives and Funding

Meaningful public participation will require additional time and resources. The Clean Air Act stipulates that fees collected from Renewable Operating Permits (ROPs) be used to fully fund Title V permitting programs at the state level. Fees are typically charged on a per ton emitted basis. Section 324.5522 of the Natural Resources and Environmental Protection Act (Act 451 of 1994) outlines Michigan's ROP fee schedule[39] and applies through October 1, 2019 after which MDEQ must submit a new plan to the EPA. Act 451 limits activities for which these fees can be used[40] and requires that fines collected from permit violations are placed into the general fund.[41]

Increased staffing and support of expanded outreach and communication activities will require additional funding for MDEQ. Potential funding sources include: an increased allocation for enforcement in the state's budget; higher Renewable Operating Permit (ROP) fees; instituting Permit to Install (PTI) fees (no PTI fee is used currently[42]); and increasing fines and establishing mechanisms to redirect fines from regulatory violations back to MDEQ. Some of these actions will require revisions of Act 451. MDEQ might also identify strategies that could shift costs and/or responsibility for some community outreach activities to polluters.

9.3.4 Planning and Regulations

MDEQ should adopt a policy that more heavily weights community feedback, health impacts, and cumulative impacts in air quality management decisions. Michigan law recognizes that permits can be denied if actions taken as a result of the permit "present an imminent and substantial endangerment to human health, safety, or welfare, or the environment."[43] This legal showing is not easy and there is a perception among Detroit residents that community concerns and health

impacts are undervalued or dismissed during the decision making process. MDEQ should increase transparency and ensure that public input is considered by:

- Requiring HIAs and CIAs to inform decision-making and making these analyses part of the application review materials. Canada and Minnesota have similar requirements,[44] and New Jersey and California are investigating ways to incorporate CIA in permitting and enforcement practices.[45, 46] HIAs and CIAs strive to evaluate a facility or permit's impact on a community, and thus give a more accurate and comprehensive picture of risk and pollution burden within a community.
- Tightening permit conditions for PTIs or ROPs or other actions that affect areas with high cumulative impacts or cumulative risks. If analyses indicate the potential for adverse impacts, then MDEQ should require additional protections, e.g., lower emissions or mitigation measures that reduce impacts;
- Making public the negotiations with industry regarding permit conditions; and
- Making public the rationale used to approve or deny permits in order to increase transparency in the decision making process.

Footnotes

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[41] MCL 18.1443. Available: http://legislature.mi.gov/doc.aspx?mcl-18-1443 [accessed 21 November 2016].

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[43] MCL 342.5510. Available: http://legislature.mi.gov/doc.aspx?mcl-324-5510 [accessed 21 November 2016].

[44] The Minnesota Pollution Control Agency (MPCA) cumulative risk assessment statute and program states that MPCA may not issue a permit to a facility without analyzing and considering the cumulative levels and effects of past and current environmental pollution from all sources on the environment and residents of the geographic area within which the facility's emissions are likely to be deposited for certain facilities in Hennepin County. Available: https://www.revisor.mn.gov/statutes/?id=116.07 [accessed 21 November 2016].

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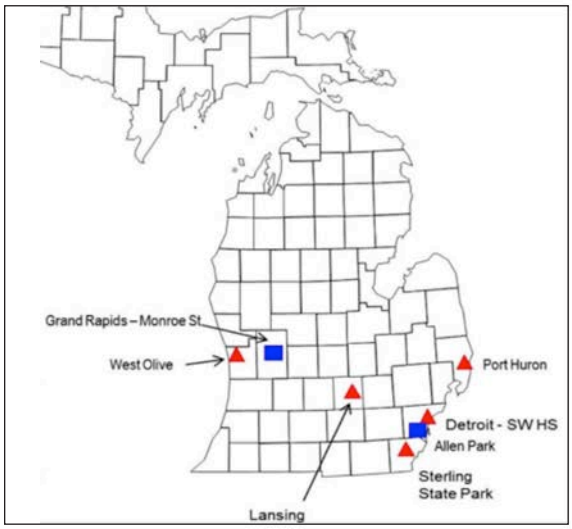
10 Air Quality Monitoring

Ambient air quality monitoring provides measurements of certain air pollutants in outdoor air in order to understand concentrations, exposures and health impacts. Monitoring is used to determine compliance with ambient air quality standards, and can be used to help identify responsible or contributing emission sources. Monitoring provides the best data for community members to know what is in the air they breathe, track pollutant trends, assess the adequacy of pollution controls, and evaluate the performance of the overall air quality management strategy. The recommendations in this section focus on monitoring ambient air quality. There are several other types of air quality monitoring, including deposition monitoring (the amount of pollutants that accumulate on surfaces) and monitoring of emissions (the amount of pollutants from smoke stacks and other sources) that are not covered here *(See CAPHE Resource Manual Section 7.6).*

Air quality monitoring is conducted by the Michigan Department of Environmental Quality (MDEQ), the US Environmental Protection Agency (EPA), and sometimes county and local governments, tribes, industry, community organizations, researchers, and individuals. MDEQ conducts most of the monitoring in the Detroit area. MDEQ conducts regular (often continuous) measurements of $PM_{2.5}$, NO_x, CO, O_3, and lead (Pb). Some monitoring sites measure additional parameters, including diesel exhaust, ultrafine PM, reactive gases, metals, and organic compounds. Figure 1 shows the locations of current MDEQ-operated monitoring sites for SO_2 and $PM_{2.5}$ (federal reference method only). MDEQ has recently placed a monitor in Southwest Detroit to respond to residents' requests (Figure 2), which will operate for a year. Additional monitoring sites are operated by Marathon and several other industries.



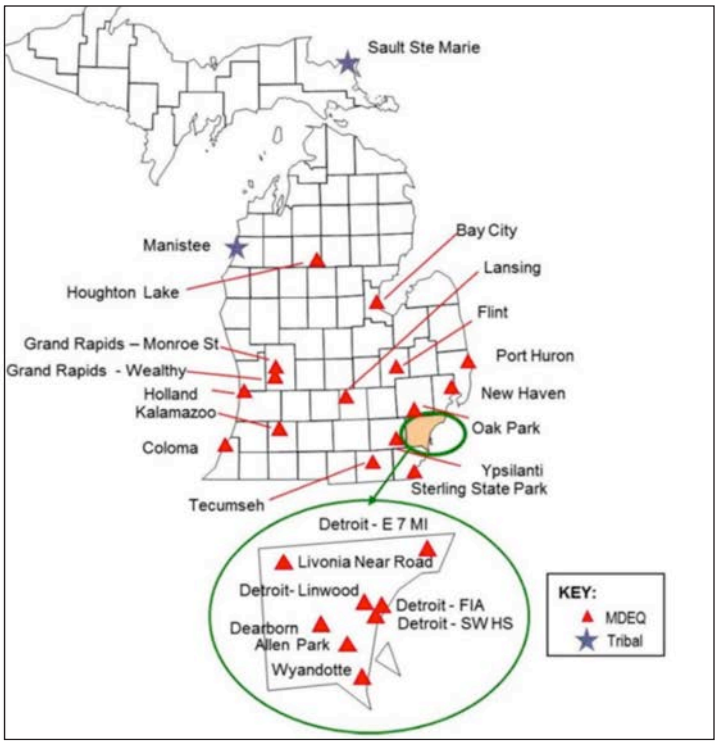


FIGURE 1: *Left - location of SO2 monitoring sites in Michigan operated by MDEQ. Excludes a temporary MDEQ site in SW Detroit and 4 sites operated by Marathon.*

Right - location of $PM_{2.5}$ (FRM) monitoring sites in Michigan operated by MDEQ. Excludes several $PM_{2.5}$ sites using other monitoring methods. Figures taken from: Michigan Department of Environmental Quality: https://www.michigan.gov/documents/deq/deq-aqd-amu-2015_air_mon_network_review_461700_7.pdf

FIGURE 2: *Air quality monitoring site recently placed by MDEQ at the New Mount Herman Church in Southwest Detroit in ZIP code 48217 for the 2016-7 period.*

The locations of air quality monitors and the pollutants monitored are selected for specific reasons. Some locations are selected to represent impacts from traffic and industry; other locations are selected as "neighborhood" sites that represent the exposure of the general population, and some represent "regional" or background (upwind) levels. In addition, a number of special monitoring studies have been conducted by state and academic researchers to better understand air quality issues in the Detroit area, and the recent emergence of low cost monitors and sensors has enabled a number of communities to actively monitor air quality themselves.

This section provides recommendations for improving air quality monitoring in the Detroit area. *Sections 4 and 7.6 of the CAPHE Public Health Action Resource Manual* provide further explanation of the principles, technologies and importance of air monitoring as well as a discussion of the air monitoring already happening in and around Detroit.

AIR QUALITY MONITORING RECOMMENDATION 1: Increase the number of monitoring sites and utilize mobile and transportable monitors.

Air quality monitoring should provide sufficient spatial coverage to address existing as well as new and changing air quality concerns. To improve monitoring across Detroit and the surrounding areas, MDEQ, with community input, should identify the most critical locations for air quality monitors, prioritize those locations to revise and expand the existing monitoring network, and then implement this new and expanded network. An example of prioritization might place air quality monitors near the I-94 expansion and the Gordie Howe Bridge and I-75 developments to document changes in air quality associated with these developments. Strategies to gather input for prioritization could include: (1) community meetings to identify areas of air quality concern; (2) pilot monitoring in areas of potential concern; (3) dispersion modeling analyses; (4) evaluation of air quality complaints to the MDEQ hotline (discussed below); and (5) ongoing review of industrial and/or transportation-related developments. Both mobile and fixed site monitoring can and should be used.

MDEQ should deploy semi-permanent, transportable and mobile air quality monitoring equipment to meet air quality concerns and increase flexibility. Figure 2 shows a semi-permanent site recently established by MDEQ in Detroit; Figure 3 shows a mobile platform. These systems should utilize high quality monitoring techniques that comply with EPA and MDEQ guidance. These systems can help identify impacts from emission sources, e.g., industry in Southwest Detroit, and should be deployed for periods sufficient to develop annual average concentrations, trends, and other information sufficient to determine risks and health impacts. Mobile monitoring platforms are also useful to monitor emergency events, and for a variety of targeted investigations. Several states have successfully used mobile air monitoring platforms. For example, after a US Forest Service study found high levels of heavy metals in Portland, Oregon, the state regulatory agency deployed mobile monitors to study the pollution hot spots.[1] The Louisiana Department of Environmental Quality operates a mobile air monitoring lab (MAML), which can monitor a variety of pollutants.[2] Researchers at the US EPA and the University of Michigan have used mobile monitoring platforms to quantify traffic-related air pollutants.[3]

FIGURE 3: *Louisiana DEQ's Mobile Air Monitoring Lab, an example of a mobile air quality monitoring system. Figure taken from: https://www.opednews.com/articles/Dangerous-Levels-of-Radium-by-Meryl-Ann-Butler-120826-116.html*

10.1.1 Education and Outreach

In addition to the technical objectives outlined in the previous section, expanding the existing monitoring network provides opportunities for education and outreach to the local community. Educational events can be organized around the installation of new monitoring sites to allow community members to learn about the technologies used for air quality management. Mobile units (such as in Figure 3) would be particularly good for outreach efforts as they allow community members to be introduced to monitoring where they live and work. These outreach events are important in strengthening community capacity by increasing familiarity

with monitoring technology and the capacities and limitations of ambient monitoring. They can also emphasize the benefits of the type of information that monitoring can provide.

A large variety of handheld and low cost monitoring systems can be used to monitor air quality. These include systems for PM, VOCs, and certain gases. Systems that provide real-time displays of pollutant concentrations can be used in schools and education and outreach activities, potentially to great advantage. Monitoring can increase the awareness of the importance of pollution exposure for individuals with asthma. Coordinating such educational events with the City of Detroit's 'smart asthma inhaler' project could help expand education and awareness.

MDEQ and industry should collaborate to expand the air quality monitoring networks.

10.1.2 Support and Coordination

10.1.2.1 Government Air Monitoring

MDEQ and industry should collaborate to expand the air quality monitoring networks, including the small network operated by Marathon. Since 2012, Marathon has operated four monitors around its facility that measure SO_2, benzene, and other pollutants; these data are reported monthly to MDEQ and made available on the EPA web site. Because monitoring data show that SO_2 concentrations exceed the NAAQS (in particular, measurements at MDEQ's Southwestern High School site), portions of Wayne County have been designated as non-attainment for SO_2. However, air quality modeling shows that the areas of highest SO_2 concentration may be missed by the existing monitors *(See CAPHE Resource Manual Section 4).* Currently, SO_2 monitoring is limited to 2 permanent MDEQ sites, 1 temporary site, 4 Marathon sites, and 2 sites in Windsor. A larger area may be in non-attainment for SO_2. To more accurately assess non-attainment status, MDEQ and industry should increase the number of SO_2 monitoring locations, prioritizing areas that have higher modeled concentrations. It can be difficult to optimally site SO_2 monitors for several reasons, including the episodic nature of SO_2 peaks, the nature of the SO_2 NAAQS (a 1-hr average), the presence of multiple major SO_2 sources, and logistical issues of, for example, security, power, and access. Use of mobile monitors may be particularly helpful to address this problem.

State and county emergency response and federal FEMA have air quality monitoring capabilities. These organizations typically are not considered part of the air quality monitoring data infrastructure, although they may have relevant data and capacity. Data, capacity and the ability of these groups to participate should be investigated in order to support and coordinate additional air quality monitoring efforts.

10.1.2.2 Industry Monitoring

Air quality monitoring networks operated or sponsored by industry should be expanded to prioritize: (1) fence-line monitoring to detect pollutants at the facility's boundary (these pollutants will disperse into adjoining neighborhoods); (2) real-time monitoring; and (3) multi-pollutant monitoring. In addition, monitoring data should be made publically available in near-real time and linked to text notification systems. While industries are often reluctant to install monitoring systems due to cost and disclosure concerns, they can benefit from monitoring that more accurately identifies pollution sources, helps control process leaks, improves the efficiency and effectiveness of controls, and addresses community concerns.

Strategies to increase industry-sponsored monitoring include:

- Requiring monitoring in enforcement actions. Industry-sponsored monitoring programs can result from consent decrees (negotiated

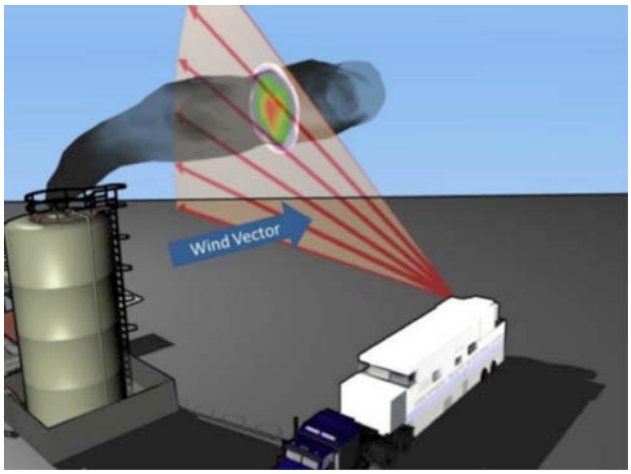
settlements between a facility and the government following an enforcement action).[4] The public can provide comments during negotiations and advocate for increased monitoring, additional monitoring requirements (e.g., pollutants included), and/or better access to monitoring data.

- State legislation. State legislation represents a possible strategy for increasing monitoring. For example, in 2016 in Louisiana, House Bill 469 was introduced (but later voted down) that would have required major industrial sources in the state to install fence-line air monitoring systems, provide community notification, and report real-time data to a public website. [5, 6]
- Federal regulation. Air quality monitoring requirements exist in several federal regulations. For example, EPA's recent Refinery Rule requires fence line monitoring of benzene, sets an action limit, and requires public reporting of monitoring results.[7] Strategies to advocate for stronger federal monitoring requirements include submitting comments during public comment periods.
- MDEQ permits. MDEQ could require additional air quality monitoring in operating permits, in particular, to address those emission sources where controls or emission estimates are difficult or unreliable. This might utilize options and incentives, e.g., monitoring could be required for open materials storage, but not for enclosed storage; similarly, for fugitive VOC emissions, monitoring might be required if appropriate leak detection or secondary control systems are not used. In addition, MDEQ could evaluate and allow the use of lower cost methods or periodic sampling to reduce costs.
- Assessing and coordinating industry capabilities. Many industries retain monitoring equipment and trained personnel for onsite compliance and emergency response. These should be inventoried and engaged to support air monitoring activities.

Monitoring system design and operations should be reviewed by MDEQ to meet quality assurance guidelines.

Industry-sponsored or conducted monitoring data should be publicly available in near-real time to support community and academic research, improve understanding of air quality, increase transparency and trust between industry and communities, and allow residents to take action in the case of an air pollution emergency. MDEQ has several websites that could incorporate additional monitoring data. Examples of expanding access to air quality data include California's www.fenceline.org that houses monitoring data from fence-line monitoring at refineries.[8]

FIGURE 4: *Depiction of a ground-based DIAL monitoring system used to track emission plumes. Taken from: http://www.h-gac.com/taq/airquality/raqpac/documents/2015/Jan%2015/DIAL%20%202015%20Houston%20Meeting%20January%20(sent%20version).pdf*



10.1.2.3 Remote Sensing

Remote sensing technologies should be utilized to better map air quality concentrations and improve emission estimates. This includes the use of ground-based systems, (e.g., Differential Absorption Light Detection and Ranging (DIAL) and Fourier Transform Infrared Spectroscopy (FTIR)), which monitor pollutants including VOCs, methane, SO_2, HCL, NO and NO_2 along a line of sight or fence-line.[9] Such systems can track plumes (Figure 4),[10] measure fugitive emissions (e.g., process leaks), and improve emission estimates at refineries and

other sources, as used by the City of Houston for benzene and other VOCs.[11, 12] In these and other applications, remote sensing has certain advantages and often increased accuracy over other monitoring or emission estimation approaches. This is particularly useful for emission estimates of process and fugitive emissions, which can be highly uncertain. More generally, remote sensing techniques can provide opportunities to validate emission estimates and assumptions in permits.

Satellite-based remote sensing should be used for PM and O_3. Current approaches allow concentrations to be estimated to a 1x1 km or smaller scale. While these estimates need to be verified with data from ground-based monitors, satellite-based data may permit an enhanced understanding of exposures and health impacts.

10.1.3 Incentives and Funding

There are many existing funding mechanisms to support expansion of monitoring by both industry and MDEQ. The primary way to increase funding of MDEQs monitoring network would be to increase appropriations to the agency in the state budget. The governor and legislature could increase general funding of the agency, or could earmark funding for air quality monitoring.

Work is needed to maintain and expand financing of MDEQ's current monitoring network and to avoid potential shut-down of existing monitors due to budget cuts. Since its formation in 1995, the MDEQ has experienced a declining share in the state's general fund budget (representing 1.16% in 1996, and 0.41% in 2015).[13] Since 2000, MDEQ's general fund budget has decreased by nearly 60% and staff have been cut by more than a quarter.[14] While temporary additional funding has been allocated to the agency to address the Flint water crisis in the most recent budget draft issued by the governor, additional funding is needed for the Air Program and to support and expand the air monitoring network.

MDEQ has received and should solicit additional federal funds to support the air monitoring network. MDEQ has benefited from support and grants for air quality monitoring, primarily from the US EPA. For example, the Community Scale Air Toxics Ambient Monitoring (CSATAM) Program provides states with funds to support monitoring of air toxics. Michigan used this funding in 2003 to examine impacts of the commercial border crossing on air toxics in Detroit, and in 2007 - 2008 to conduct a risk assessment of air toxics in Detroit.[15] More recently, Michigan received support to measure air toxics at near-road monitoring sites.

Opportunities to support industrial-sponsored air quality monitoring should be pursued. Air quality monitoring expenses would qualify for a tax exemption under Michigan's Air Pollution Control Facility Tax Exemption.[16] The installation of air quality monitors as a part of a negotiated settlement for Clean Air Act violations can allow facilities to pay lower fines. More creative but less common funding structures include joint ventures between industry and other groups. For instance, a DIAL monitoring system installed at a Shell oil refinery resulted from a joint venture between Shell and Siemens Environmental Limited.[17]

10.1.4 Planning and Regulations

Most air quality monitoring is performed to comply with federal and state regulations. However, the required number of monitoring sites is low, and does not provide adequate spatial coverage given the diversity of emission sources in Detroit. MDEQ, EPA and other stakeholders should collaborate to identify locations where additional air monitoring is needed and most advantageous, such as predicted "hot spots," freeway expansions, and industrial development, among others. A proactive approach can help address community concerns, assure public health protections, and comply with existing regulations.

In parallel with a revised air quality monitoring program, emissions monitoring and testing programs should be expanded to provide more complete and accurate information about emissions. These programs are described in *Section 1 of the CAPHE Public Health Action Planning Manual.* Here, it is important to note that the requirements for emissions monitoring are limited, and most emissions estimates are based on calculations that have not been verified by monitoring.

AIR QUALITY MONITORING RECOMMENDATION 2: Identify and implement targeted air quality monitoring projects that investigate exposures, air quality trends, health risks, pollutant hot-spots, fugitive emissions, source apportionment, monitoring system adequacy, efficacy of controls, epidemiology, health impact analyses, health interventions, and/or other public health concerns.

Air quality monitoring provides essential information to investigate many important issues, e.g., air quality trends, pollutant hot-spots, area and fugitive emissions, source apportionments, monitoring system adequacy, efficacy of emission/exposure controls, indoor/outdoor exposures, health risks, disproportionate impacts, health impact analyses, and epidemiologic associations between exposure and adverse health outcomes. Typically, projects addressing such topics couple air quality to other technical analyses, e.g., dispersion modeling, particle characterization, toxicology, statistics, etc. As noted elsewhere, these projects could include the use of fixed, semi-permanent, transportable, mobile and low cost air quality monitoring equipment. This recommendation is aimed at promoting "targeted projects" involving air quality monitoring that ultimately would help to reduce air pollution exposures and improve public health.

There are many potential areas that could be targeted for monitoring programs in Detroit. A subset includes:

- Monitoring of air toxics in residential areas adjacent to heavy industry in Southwest Detroit, e.g., the steel smelters, coke facilities, incinerators, AK Steel, US Steel, and others.

- Monitoring of lead and asbestos in residential areas near where buildings are being demolished. The City of Detroit has approximately 80,000 homes slated for demolition, an unprecedented number, and demolitions can release these toxic pollutants. Airborne monitoring for asbestos does not exist, and lead is monitored at only three distant sites in the larger metropolitan area.
- Monitoring near industries that have a record of air pollution violations.

10.2.1 Education and Outreach

Education and outreach activities are needed to describe the various types of targeted projects that might be undertaken, to help prioritize them, and to motivate support and participation for the projects. With community input, MDEQ or others could identify and prioritize air quality projects that could be investigated using air quality monitoring data.

A structured and scientifically-sound process with public engagement should be used to identify and prioritize potential focal projects. One approach is to use an air quality *advisory board or steering committee* that includes key stakeholders, including public, researchers, industry, and government.

10.2.2 Support and Coordination

Support and coordination goals and needs depend on the type and scope of the targeted project. Important organizations likely will involve city, county, state, and national organizations, as well as community organizations, universities, industry and labor. Key players likely would include MDEQ, Michigan Health and Human Services, Detroit and county health offices, US EPA, US National Institute of Health (NIH), Center for Disease Control (CDC), local universities, and others. An *advisory board or steering committee,* possibly organized by MDEQ, could review and initiate strategies to prioritize and coordinate the projects. Creating partnerships and collaborative air monitoring efforts between Michigan, Ontario and adjoining states could also be beneficial to improve air quality.

10.2.3 Incentives and Funding

Funding for targeted projects can be obtained by government and foundation grants, MDEQ funds, and industry. Often, the development of pilot data is needed to show feasibility, capacity and importance. Funds for some projects might be obtained as part of a negotiated settlement for Clean Air Act violations. In addition, other air pollution exposure and control strategies might reserve some funding or support to investigate effectiveness, (e.g., the effectiveness of point source controls or buffers could be investigated in targeted projects). For industry-funded studies, air quality monitoring and the associated studies would likely qualify for a tax exemption under Michigan's Air Pollution Control Facility Tax Exemption.[18]

10.2.4 Planning and Regulations

Many possible targeted projects are expected to go beyond the requirements of federal and state regulations, although they could support planning and regulatory activities. Relevant planning and regulatory agencies should be informed and possibly included in the advisory board or steering committees providing oversight to these efforts.

A structured and scientifically-sound process with public engagement should be used to identify and prioritize potential focal projects.

AIR QUALITY MONITORING RECOMMENDATION 3: Increase public engagement with air quality monitoring activities.

Air quality monitoring activities provide important opportunities for bi-directional communication and engagement. Monitoring information can inform the public and focus engagement and actions that ultimately improve public health and reduce exposures. Simultaneously, they can improve public support and input into monitoring approaches and associated data analysis, helping to prioritize revisions and expansions of the monitoring network.

10.3.1 Education and Outreach

10.3.1.1 Air Monitoring Education

Air quality methods and data can be very technical, thus there is a need to explain the need for and use of air quality monitoring. Important topics for education and translation include: (1) how monitoring works, (2) health effects of monitored pollutants; (3) interpretation of monitoring results; (4) relevant standards and health benchmarks; and (5) communication of air pollution concerns or violations to the appropriate authorities. Strategies to increase the public understanding of and engagement with air quality monitoring include:

- Technical assistance through the EPA Superfund Program. The *Technical Assistance Services for Communities* (TASC) Program supports scientists, engineers and other professionals for the review and explanation of information at no cost to communities; the *Technical Assistance Grant* (TAG) Program for non-profit community groups supports contracting with independent technical advisors to interpret and help the community understand technical information; and a similar *Technical Assistance Plan* (TAP) program (funded by polluters) enables community groups to retain the services of an independent technical advisor.[19]
- Create educational materials and workshops. Materials might include the effective and appropriate uses of monitoring data in an easy to understand format, explanation of the Air Quality Index (AQI), and other topics. Material should be disseminated in ways consistent with how most residents receive information, e.g., social media, local news networks, etc. For example, the San Diego Air Pollution Control District (APCD) maintains a district Twitter page that provides daily air pollution updates and advertises community organized events.[20]
- MDEQ should increase community outreach on air pollution issues. Many state environmental agencies have community outreach divisions that provide information, conduct outreach and give talks to interested groups, e.g., the San Diego district's Community Outreach office gives presentations on air quality to groups upon request.[21]
- Create and disseminate a "Best Practices" document for community engagement that compiles best practices from multiple sources for fostering equitable and effective multi-directional communication amongst communities, agencies (e.g., MDEQ) and policy makers regarding air quality monitoring and use of data to protect the public, with particular attention to communities disproportionately affected.

Opportunities to promote air quality monitoring education through non-governmental sources include enhancing CAPHE and partner organization websites. This would build on existing resources compiled through CAPHE as well as prior work done by partner organizations. Additionally, this might promote more informative and relevant displays, based on the expertise and experience of the partnering organizations.

Opportunities to engage in citizen science should be pursued. These can link to youth engagement and green jobs training. There are an increasing number of resources for citizen science air quality monitoring, including EPA's *Citizen Science Air Monitoring Toolkit*.[22] Citizen-science projects could be conducted in collaboration with city and state officials to increase awareness and encourage public participation, increase the relevance of data for decision-making, and to promote environmental and public health objectives. Most of these projects use low cost monitors.

Air quality monitoring should be communicated effectively to residents and residents' knowledge and concerns should reach decision makers.

Employ "low-cost" air quality monitors used by individuals and community organizations.[23] US EPA and others have developed some guidance for these monitors.[24] Potentially, such monitors can be widely deployed, including use on vehicles and flying drones, and can be used to create "pollution maps" and investigate "pollution hotspots." While not appropriate for enforcement and some other purposes, low-cost monitors have many advantages and applications, e.g., they can be used to increase community engagement, provide education and training, and collect data to inform placement of permanent monitors. MDEQ personnel can assist with technical know-how, allow colocation with monitors in MDEQs network for validation, and assist with data interpretation. Creating a set of 'best-practices' that includes the types of units to use for air monitoring, the estimated costs of the different types of monitors, and estimates for costs of ongoing monitoring, could also help community groups, non-profits, and schools utilize air monitors.

10.3.1.2 Public Engagement in Decision-Making

Bi-directional communication between residents, community organizations, industry and regulators is beneficial and should be encouraged. Air quality monitoring data should be communicated effectively to residents and residents' knowledge and concerns should reach decision-makers. Individuals living near air pollution sources may better understand local environmental conditions than agency officials and can offer critical perspectives, experiences and knowledge not necessarily represented by the government or industry. Communication can be facilitated by face-to-face meetings, social media, websites, and hotlines. For example, the Detroit-based *Zero Waste Detroit* organization encourages residents living near the Detroit Resource Recovery incinerator to call MDEQ's hotline and use emails to help target enforcement actions.[25]

Over the 2015-2016 period, MDEQ interacted with members of the 48217 ZIP Code area, which resulted in the installation of air quality monitoring site at the New Mount Herman Church in Southwest Detroit (shown earlier in Figure 2). This action is commendable. Still, MDEQ needs to develop, vet and implement an effective process that provides effective and regular public engagement and bi-directional communication during the design, siting, and data reporting phases related to such activities.

The process should respond to community concerns, as well as the monitoring gaps discussed next.

A structured and scientifically-sound process with public engagement should be used to identify monitoring gaps. MDEQ evaluates and recommends updates to its monitoring system annually based largely on federal monitoring requirements. While MDEQ is required to provide opportunity for public comment, the *Air Quality Monitoring Network Review* document is available only on MDEQ's website[26] and historically public input is limited. MDEQ should increase outreach and formalize the incorporation of public comment into air quality monitoring revisions. As discussed elsewhere, data from dispersion modeling, EPA's Environmental Justice Screening Tool (EJSCREEN), and other sources could be incorporated.[27]

MDEQ, SEMCOG and other authorities should increase opportunities for meaningful and sustained public participation through the use of *community advisory boards*. MDEQ has advisory groups for core programs and the MDEQ Air Program has used state-wide panels, e.g., an *Air Advisory Council* and an *Air Toxics Working Group.* MDEQ should include residents on these and other groups, create a local air quality monitoring group, or create a state-level air quality community working group. MDEQ has previously formed citizen working groups, e.g., an *Areas of Concern Program Statewide Public Advisory Council,* which was used for the protection of the Great Lakes.[28]

10.3.2 Support and Coordination

Opportunities to expand public participation in air quality monitoring activities include:

- Promoting and expanding existing MDEQ materials and programs for outreach and education. The State of Michigan and others have guides for business and the public on environmental laws[29] and for public participation.[30, 31]
- Expanding MDEQs Office of Environmental Assistance. This office includes a Speakers Bureau and an Environmental Education Coordinator position. These programs should be promoted and expanded to increase outreach and community engagement.[32, 33]
- Expanding opportunities for youth education and citizen science, potentially engaging *Detroit Hispanic Development Council, Green Door Initiative*, and others.
- Partnering with organizations conducting research and education projects related to air quality, including American Lung Association, the Center for Urban Responses to Environmental Stressors (Wayne State University), the Michigan Lifestage Environmental Exposure and Disease Center (University of Michigan), and others.
- Partnering with the City of Detroit's Health Department with their 'smart asthma inhalers' project.

10.3.3 Incentives and Funding

Government, universities, foundations, and industry could fund and/or provide in-kind support for education, engagement, and community air monitoring activities. Opportunities include:

- CAPHE Mini-grants, which could support citizen science and other projects, e.g., support the purchase of low cost monitors deployed to specific sites for ongoing monitoring.
- US EPA Environmental Justice Small Grants Program could support community-led air monitoring and other activities.[34]
- EPA Region 2 (Chicago) Citizen Loan Program makes monitoring equipment available to rent by citizen groups.[35]

10.3.4 Planning and Regulations

Regulatory agencies including MDEQ and US EPA should collaborate with community residents and organizations to increase capacity and enhance the quality and relevance of air quality monitoring data. Ultimately, the air quality monitoring data can motivate and inform regulatory and enforcement actions.

Public access to monitoring data collected by industry should be required. As examples, the EPA's recent rules for monitoring at oil refineries and the state bill (for Louisiana) discussed earlier include such provisions. Requirements for access should be included in the permit conditions.

Footnotes

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