PUBLIC HEALTH ACTION PLANNING RESOURCE MANUAL

EXECUTIVE SUMMARY

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.

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1 INTRODUCTION: COMMUNITY ACTION TO PROMOTE HEALTHY ENVIRONMENTS (CAPHE): GOALS AND OBJECTIVES

1.1 Purpose

This *Public Health Action Planning Resource Manual* (PHAP-RM) provides information to support the development of a public health action plan to reduce air pollution and mitigate adverse health effects in Detroit. It contains information regarding air pollution including, for example, sources of pollutants, pollution monitoring and regulatory programs, estimates of health impacts and cumulative risks, and, most importantly, strategies that can reduce air pollution exposure and mitigate adverse health effects for Detroit residents. This Executive Summary provides an overview of the complete *Resource Manual*.

1.2 Our Partners and Goals

This work is conducted by the *Community Action to Promote Healthy Environments (CAPHE)*, a partnership of community-based organizations, academic researchers and public health and environmental health practitioners. Funding has been provided by the National Institute of Environmental Health Science (#RO1ES022616), and the Fred A. and Barbara M. Erb Family Foundation, with additional support from the Michigan Center on Lifestage Environmental Exposures and Disease (M-LEEad) (#P30ES017885).. CAPHE builds on, and substantially extends, the work of three long-standing CBPR partnerships: The *Detroit Community-Academic Research Center*, *Community Action Against Asthma*, and the *Healthy Environments Partnership*. The partnership brings together substantial resources, expertise, and knowledge of multiple groups committed to improved air quality, health and social justice in Detroit including: Detroit Future City, Detroit Health Department, Detroit Hispanic Development Corporation, Detroiters Working for Environmental Justice, Green Door Initiative, Michigan Department of Environmental Quality, Taubman School of Architecture and Urban Planning, Sierra Club, Southwest Detroit Environmental Vision, University of Michigan School of Public Health, and Wayne State University Transnational Environmental Law Center.

CAPHE's goal is to work collaboratively to develop and implement a scientifically-informed public health action plan to reduce exposure to air pollutants and mitigate adverse health effects in Detroit, with a particular focus on vulnerable populations.

1.3 Background and Context

People living and working in Detroit are exposed to elevated levels of ambient air pollutants. As described in Section 2 of the *Resource Manual*, air pollutants of concern include, but are not limited to, particulate matter (PM), diesel exhaust,[1, 2] volatile organic compounds (VOCs),[1,2,3,4] sulfur dioxide (SO_2), nitrogen oxides (NO_x),

[1] Du L, Batterman SB, Parker E, et al. 2011.Particle concentrations and effectiveness of free-standing air filters in bedrooms of children with asthma in Detroit, Michigan. Build Environ 46(11):2303-2313. PMCID: PMC3161201

[2] Keeler GJ, Dvonch JT, Yip F, et al. 2002. Assessment of personal and community-level exposures to particulate matter among children with asthma in Detroit, Michigan, as part of Community Action Against Asthma (CAAA). Environ Health Perspect. 110(suppl 2):173-181

[3] Batterman S, Chin JY, Jia C, et al. 2012. Sources, concentrations, and risks of naphthalene in indoor and outdoor air. Indoor Air 22(4):266-78.

[4] Jia C, Batterman SB, Godwin C. 2008. VOCs in industrial, urban and suburban neighborhoods: Part 2: Factors affecting indoor and outdoor concentrations. Atmospheric Environment 42(9):2101-2116.

ozone (O_3), and toxics such as manganese and lead (Pb). Well established health impacts associated with pollutant exposure,[5] [6] include asthma aggravation,[7] [8] hospitalization visits and deaths due to cardiovascular and respiratory disease,[9] [10] lost work and school days, and adverse birth outcomes.[11] Air pollution is a long-standing concern for Detroit residents, who disproportionately experience high rates of environmentally-related diseases. Air pollution continues to be identified as one of the top public health priorities by Detroit community members and community-based organizations.[12, 13]

Fortunately, many approaches and interventions can be used to reduce air pollution at its source, mitigate exposure, reduce adverse health effects, and improve public health.[14,] Public health actions informed by scientific evidence and described in this *Resource Manual* can make substantial contributions to public health.

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[5] Pope CA. 2007. 3rd. Mortality effects of longer term exposures to fine particulate air pollution: Review of recent epidemiological evidence. Inhal Toxicol. 19 Suppl 1:33-38.

[6] U.S. Census Bureau. 2010. 2010 Census, Detroit City Quickfacts. Available: http://quickfacts.census.gov/qfd/states/26/2622000.html [accessed 10 May 2016]

[7] Li S, Batterman S, Wasilevich E, Elasaad H, Wahl R, Mukherjee B. 2011. Asthma exacerbation and proximity of residence to major roads: A population-based matched case-control study among the pediatric Medicaid population in Detroit, Michigan. Environ Health 10:34. PMCID: PMC3224543

[8] Li S, Batterman S, Wasilevich E, et al. 2011. Association of daily asthma emergency department visits and hospital admissions with ambient air pollutants among the pediatric Medicaid population in Detroit: time-series and time-stratified case-crossover analyses with threshold effects. Environ Res 111(8):1137-1147. PMID: 21764049

[9] Milando C, Huang L, Batterman S. 2016. Trends in PM2.5 emissions, concentrations and apportionments in Detroit and Chicago. Atmos Environ 129:197-209.

[10] Peters A, Dockery DW, Muller JE, Mittleman MA. 2012. Increased particulate air pollution and the triggering of myocardial infarction. Circulation 103(3):2810-2815.

[11] Le HQ, Batterman SA, Wirth JJ, et al. 2012. Air pollutant exposure and preterm and term small-for-gestational-age births in Detroit, Michigan: Long-term trends and associations. Environ Int 44:7-17. PMID: 223141

[12] Detroit Works Project. 2012. Strategic Action Plan. Available: http://detroitfuturecity.com/framework/ [accessed 10 May 2016]

[13] Southwest Detroit Environmental Vision. 2013. SW Detroit Environmental Vision Care Project Action Plan. http://www.sdevweb.org/healthybusinesses.htm

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1.5 Air Quality, Health and Environmental Justice

Exposure to air pollutants varies from place to place, and there is substantial evidence that some populations are more exposed to higher levels of air pollutants, described as *"vulnerability"*. In addition, some population groups, including those who are very young, elderly, or infirm, may be more strongly affected by exposure to air pollutants, termed *"susceptibility"*. As detailed in Section 3 of the *Resource Manual*, factors associated with increased vulnerability include race, ethnicity, economic and educational level. Factors associated with increased susceptibility include being young or old, and having pre-existing cardiovascular (heart) or pulmonary (lung) disease. The concept of *cumulative risk* accounts for vulnerability and susceptibility of populations, and also captures the combined effects of exposures to multiple pollutants from multiple sources. Such factors can be mapped and analyzed at various geographic scales, e.g., census tracts, allowing identification of populations whose health is likely to be more adversely affected by exposure to air pollutants.

1.6 Air Quality Exposure and Monitoring

Section 4 describes air quality monitoring in Detroit conducted by the Michigan Department of Environmental Quality (MDEQ) and others. It describes, for key pollutants, the monitoring network, concentration trends, and attainment with the National Ambient Air Quality Standards (NAAQS). These standards are intended to be health protective. From a regulatory and political perspective, exceedance of the NAAQS, called *non-attainment*, can greatly increase the awareness of and attention to air pollution problems. Given their importance in Detroit, the *Resource Manual* focuses on O_3, $PM_{2.5}$, and SO_2.

- O_3 trends suggest a decrease in levels in Detroit since 2002, but current levels are fluctuating around the new (2015) and recently-lowered NAAQS. O_3 levels are fairly similar across Detroit; the Allen Park monitoring site currently shows the highest concentrations in the region. Detroit (like many other urban areas) may exceed the new O_3 standard, and significant reductions in precursor NO_x and VOC emissions that form O_3 may be required if O_3 levels do not attain the NAAQS (to be determined in Fall, 2016).
- $PM_{2.5}$ trends have been downward since 1995 at many monitoring sites. However, results differ from site-to-site, and trends are less apparent and even "flat" in more recent years and at industrial sites. Monitors located in Dearborn and at Southwestern High School record among the highest levels in the area.

- The very high SO_2 levels seen in the 1980s have decreased considerably, but SO_2 levels in portions of Wayne County do not meet the most recent (2010) NAAQS. The region contains a number of major and poorly controlled SO_2 sources. SO_2 monitoring is limited, although several sites have been recently added around the Marathon Refinery (See map of monitoring sites). Unlike O_3 and $PM_{2.5}$, SO_2 forms localized "hotspots," typically near the larger sources like coal-fired power plants and steel mills. The SO_2 non-attainment region is shown in Figure 1.6-1.[14] A proposed *State Implementation Plan* (SIP) for SO_2 was released by MDEQ in August, 2015[15]; an updated plan, which incorporated comments from the public and US EPA, was submitted to US EPA for final approval in May 2016[16] ; this plan is designed to bring areas into compliance with the NAAQS.

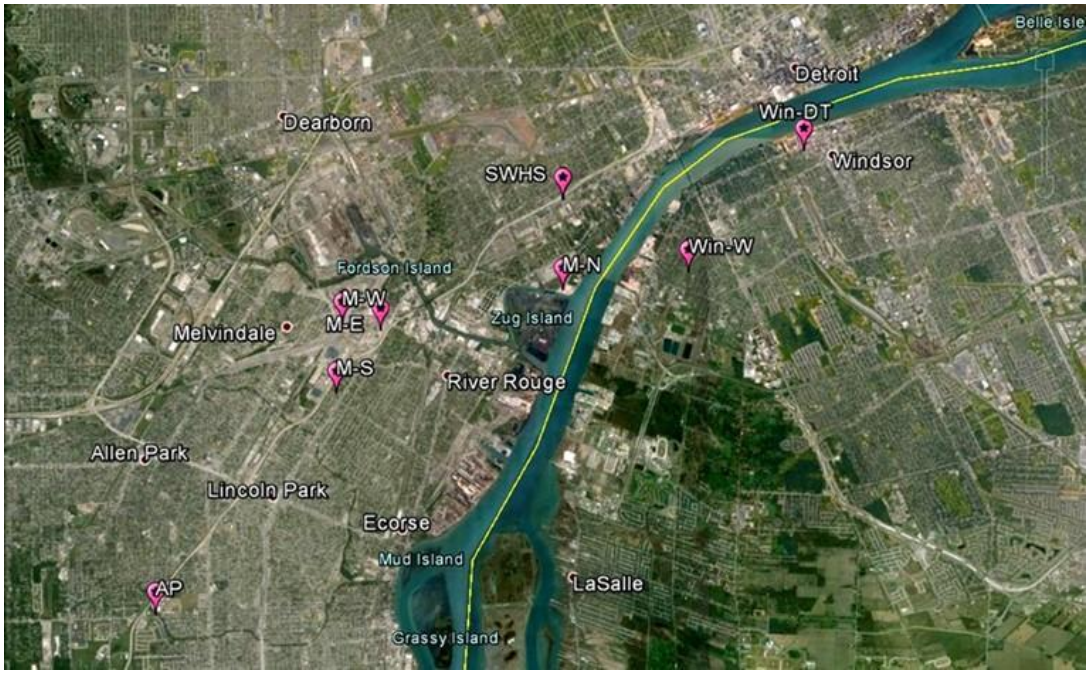

Figure 1.6-1. Locations of current SO_2 monitoring sites in the Detroit area. SWHS is Southwestern High School, AP is Allen Park, M is Marathon (North, East, West, South), Win-DT is Windsor Downtown, Win-W is Windsor West. Uses Google maps.

1.7 Air Pollutant Sources, Exposures and Health Impacts

Detroit is notable for its numerous and large industrial pollution sources. These *point sources* include coal-fired power plants, coke, steel and cement facilities, petroleum refineries, and incinerators, among others. In addition, *mobile sources*, which include cars, trucks, trains and other vehicles, emit a substantial amount of $PM_{2.5}$, NO_x, and other pollutants.

In addition to the type and quantity of pollutants emitted, exposure is affected by the proximity of emission sources to homes, schools, playgrounds and other frequented locations. The number of people living or going

[14] Michigan Department of Environmental Quality. 2016. Public Participation Documents for DTE Electric Company Trenton Channel Power Plant, March 9, 2016. Available: http://www.deq.state.mi.us/aps/downloads/permits/PubNotice/227-15/227-15and125-11CFactSheet.pdf [accessed 2 May 2016]

[15] Michigan Department of Environmental Quality. 2015 Proposed Sulfur Dioxide One-Hour National Ambient Air Quality Standard State Implementation Plan, August 20, 2015.Available: http://www.deq.state.mi.us/aps/downloads/SIP/SO2SIP.pdf [accessed 2 May 2016]

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to school or work in an area determines how many are exposed.[9, 17] Detroit has many large neighborhoods and schools adjacent to large industrial facilities. Moreover, about 69,000 Detroit residents live within 150 meters of a major freeway, and 58 Detroit public schools (operating in 2014-15) with an estimated 24,490 students are within 200 meters of a major roadway, distances where concentrations from mobile sources tend to be most elevated.[18]

Exposure is also affected by meteorology and source factors, like smoke stack height, that influence the dispersion of pollutants. Emissions from many sources, especially those with elevated stacks and those that react in the atmosphere to form new *secondary* pollutants, like O_3, can affect a broad region, and sometimes the areas most affected are several or many miles distant from emission sources. In contrast, highways and industrial sources with low stack heights mostly expose the local neighborhoods. Section 5 of the *Resource Manual* provides maps of emission sources, the spatial patterns of pollutants resulting from major sources (accounting for meteorology and source characteristics), and estimates of health impacts from $PM_{2.5}$, O_3, and NO_x exposures.

Exposures to $PM_{2.5}$, O_3, NO_2, and SO_2 can have a substantial impact on the health of people living in the Detroit area, as summarized in Table 1.7-1. In the Detroit area, outdoor air pollution from all sources is responsible for an estimated 721 premature deaths (571 due to $PM_{2.5}$, and 150 due to ozone), 1,600 hospitalizations for respiratory and cardiovascular disease, over 300,000 days with respiratory symptoms among children with asthma, 500,000 days of missed work, and more than 990,000 days of missed school.[19] The total health burden from $PM_{2.5}$, O_3, NO_2 and SO_2 totals over 13,500 disability-adjusted live years (DALYs), which is a measure that summarizes health impacts by the time is lost to premature death or poor health. In total, the annual monetized value of the health burden from air pollution is $7.3 billion. These impacts are caused by air pollution from both local and regional sources. Local point sources emissions of $PM_{2.5}$, NO_x, and SO_2 cause, each year, an estimated 140 hospitalizations for respiratory and cardiovascular diseases, up to 27,000 respiratory symptom days among children with asthma, 3300 lost days at work, and 29 deaths. Mobile sources cause an estimated 150 hospitalizations, up to 23,000 respiratory symptom days among children with asthma, 1,200 lost days at work, and 11 deaths. Combined, point and mobile sources are responsible for almost 1,200 DALYs. In total, the monetized value of the health burden from point and mobile sources is $660 million each year.[20] These results are discussed in more detail in Section 5 of the *Resource Manual*.

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[17] Rioux CL, Tucker KL, Mwamburi M, Gute DM, Cohen SA, Brugge D. Residential traffic exposure, pulse pressure, and C-reactive protein: Consistency and contrast among exposure characterization methods. *Environ Health Perspect* 2010; 118(6):803-811. PMCID: PMC2898857

[18] Vette A, Burke J, Norris G, et al. The near-road exposures and effects of urban air pollutants study (NEXUS): Study design and methods. Sci Total Environ 2012.

[19] This analysis used a "no-threshold" assumption when estimating health impacts, that is, there was no level of exposure below which health impacts did not occur. Exposures to $PM_{2.5}$, NO_2, and O_3 are based on area monitoring data. Exposures to SO_2 are based on estimates from FRESH-EST, which uses point source emissions. Martenies, SE, Batterman, SA, et al. Health and inequality assessment of the burden of disease attributable to ambient air pollution in Detroit, Michigan. Manuscript in preparation.

[20] This analysis used a "no-threshold" assumption when estimating health impacts, that is, there was no level of exposure below which health impacts did not occur. Martenies, SE, Batterman, SA, et al. Health and inequality assessment of the burden of disease attributable to ambient air pollution in Detroit, Michigan. Manuscript in preparation.

Table 1.7-1. Summary of health impacts due to air pollution ($PM_{2.5}$, NO_2, SO_2, and O_3 in the Detroit area. Total air pollution exposure is from both local and regional sources. Local point and local mobile sources are in the Detroit area, and apply to $PM_{2.5}$, NO_x and SO_2. Footnote explains categories.[21]

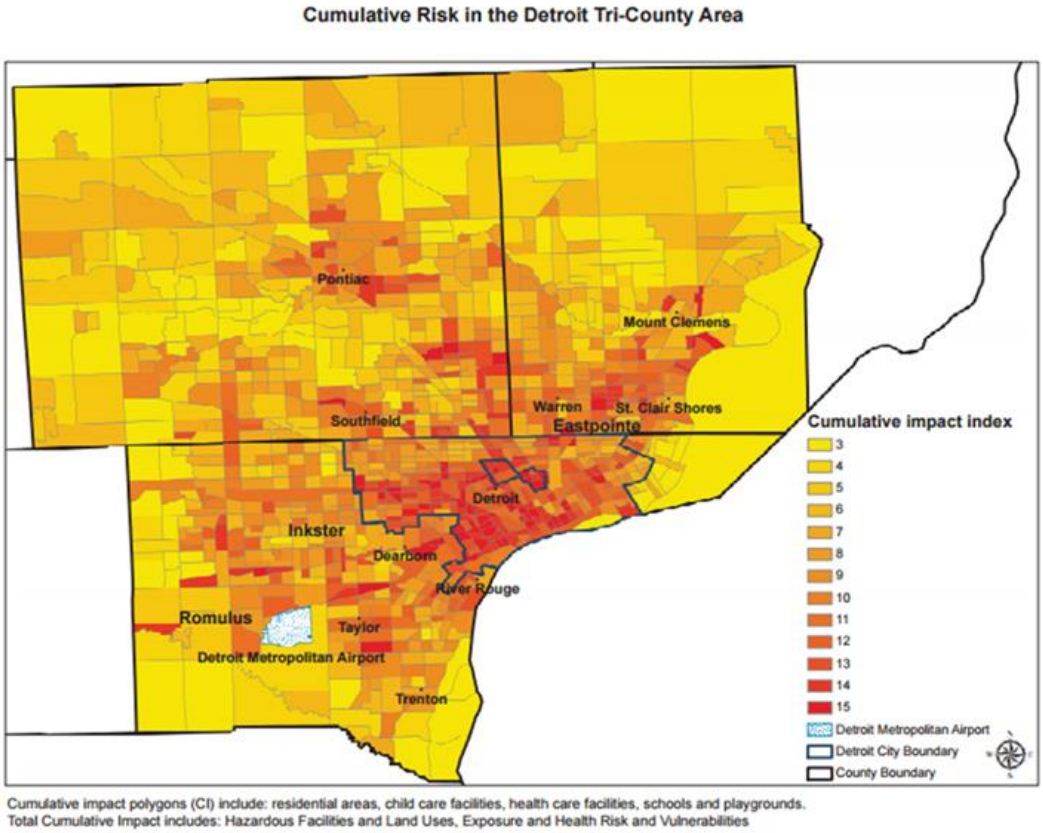
Outcome	Measure	All Sources	Local Point Sources	Local Mobile Sources
Premature mortality[1]	deaths	721	29	11
Cardiovascular impacts[2]	hospitalizations	249	13	4
Respiratory impacts[3]	hospitalizations	1,366	131	147
Asthma impacts - children[4]	ED visits, days with symptoms	348,388	26,664	23,443
Restricted activity days[5]	work loss days, school absences	1,957,805	22,530	8,489
DALYs[6]	sum of years of life lost	13,553	971	217
Monetized impact	millions of dollars	7,308	551	113

1.8 Cumulative Risk: Air Pollution and Population Vulnerability

Factors such as income and race can increase vulnerability to air pollution. Figure 1.8-1 shows the cumulative risk index across the Detroit metropolitan area, which accounts for air pollution, hazardous land uses, and population vulnerabilities. Section 6 provides greater detail four areas of Detroit, and includes tables and maps of pollution sources, vulnerabilities and susceptibilities. Locations with higher proportions of people of color are more likely to experience higher exposures to air pollutants and associated health risks, and also to contain higher proportions of populations that are susceptible to their adverse health effects (e.g., young children, older adults).

[21] Notes for table (1) Mortality includes all-cause mortality due to $PM_{2.5}$ exposures and non-accidental mortality due to ozone exposures. (2) Cardiovascular impacts include hospitalizations for cardiovascular disease and non-fatal heart attacks. (3) Respiratory impacts include hospitalizations for asthma, COPD, and pneumonia. (4) Asthma impacts among children includes emergency department visits for acute asthma exacerbations and days with cough, wheeze, shortness of breath or one or more asthma symptoms. (5) Restricted activity days include days with restricted activity, work loss days, and school absence days. (6) Disability-adjusted life years are the sum of years of life lost due to premature mortality (i.e., the difference between expected life span and age of death) and the amount of time lost to poor health due to morbidity outcomes.

Figure 1.8-1. Southeast Michigan Tri-County Area (Oakland, Macomb, Wayne): Cumulative Risk.



1.9 Mitigation Strategies

Many approaches can be used to reduce air pollution emissions and mitigate exposures of air pollutants. Section 7 of the *Resource Manual* describes strategies that include, for example, emission controls, buffers, filters, and anti-idling restrictions. The *Resource Manual* describes approaches and their scientific rationale, and describes actions underway in Detroit, successful or promising strategies used elsewhere, and applicable strategies for Detroit. Quantitative estimates of the health benefits are included for several strategies. The strategies fall into three groups:

- Reducing emissions, which includes three sets of options aimed at: (1) point source controls; (2) clean energy; and (3) mobile source controls;
- Reducing exposures, which includes two sets of options address (4) indoor air filters; (5) vegetative and non-vegetative buffers; and
- Cross cutting strategies, which includes (6) enhanced compliance and enforcement of air quality rules, and (7) enhanced ambient monitoring

1.9.1 Strategy 1: Point Source Controls

Point source controls reduce the amount of pollutant generated by an industrial process or use equipment to reduce pollutant releases. They apply to gas and particulate phase pollutants, and to conventional (PM, NO_x, SO_2, CO, and lead), and hazardous pollutants such as lead and benzene. Point source controls reduce air pollution before it reaches nearby communities, which is especially important for Detroit given the intense

industrial activity, the old and relatively "dirty" facilities that lack modern emissions controls, and the nearby, large and vulnerable populations, especially in southwest Detroit. As an example, reducing SO_2 emissions from the three DTE coal-fired power plants in the Detroit area would reduce asthma-related health outcomes among children and adults due to SO_2 exposure by an estimated 28%. Current efforts in Detroit to reduce emissions include: actions outlined in the SO_2 SIP; MDEQ programs to enforce and encourage PM emission reductions (e.g., control of fugitive dust); controls on VOC and other pollutants; and ongoing inspection, monitoring and enforcement programs. Strategies to encourage point source controls in Detroit include promotion of *clean energy*; use of *incentives and removal of regulatory and financial barriers* for renewable energy; *reforming utility approaches and Public Service Commission rules* to encourage innovation and clean energy; developing *Detroit city commitments to renewables*; *increasing the frequency and stringency of facility inspections*, *installing or updating controls* at older facilities, further *reducing fugitive emissions*; and *improving flare efficiency*. Implementing health impact assessments when setting permit conditions would introduce analyses of effects on human health and associated costs into the decision making process.

1.9.2 Strategy 2: Clean Energy

Clean energy includes *renewable energy* sources that have lower emissions and/or lower environmental impacts than conventional coal, petroleum and other fossil fuels.[22] Solar, wind, geothermal, biomass[23], and hydropower energy can displace fossil fuel energy and reduce pollutant emissions.[24] Moreover, clean and renewable energy can help transform the energy and physical landscape in Detroit, and promote economic revitalization. While Detroit's location is not ideal for wind power generation, wind power-generated electricity can be obtained from distant facilities, as encouraged by renewable portfolio standards (RPS). Ongoing clean energy initiatives include: the Michigan Renewable Energy Portfolio, the Clean Power Plan, the Detroit Climate Action Collaborative's work around greenhouse gas emissions, and the Sierra Club's Beyond Coal Campaign. Several local businesses supplement their energy use with solar or wind energy, for example, IKEA, the Detroit Zoo, the Detroit-Wayne County Metro Airport, and the Sugar Law Firm. Additional clean energy sources appropriate for Detroit include much greater use of *photovoltaic (PV) panels*, *heat pumps, and bioenergy.*

1.9.3 Strategy 3: Mobile Source Controls

Mobile source controls reduce pollution generated by cars, trucks, buses, construction equipment, and other moving sources. Mobile source emissions represent a large fraction of emissions in Detroit (and most other cities). Engine idling controls, retrofits of diesel engines, use of clean fuels, and transportation control measures (TCMs), can substantially reduce emissions of $PM_{2.5}$, NO_X, CO_2, CO, diesel exhaust, and VOCs. Lower

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22 EPA (Environmental Protection Agency). Energy and Environment. Available:https://www.epa.gov/energy/learn-about-energy-and-environment [accessed 3-2-16] and EPA (Environmental Protection Agency). State and Local Climate and Energy Program. Available: http://www3.epa.gov/statelocalclimate/local/topics/renewable.html [accessed 3-2-16].

23 Although biomass is sometimes considered a form of clean energy, it can be a significant contributor to greenhouse gases and other harmful air pollutants (see Section 7.7.2.4 for details).

24 EPA (Environmental Protection Agency). Mercury and Air Toxics Standards (MATS): Cleaner Power Plants. http://www3.epa.gov/airquality/powerplanttoxics/powerplants.html [accessed 3-2-16].

VOC and NO emissions also will help to reduce O_3, a major and possibly growing air pollution problem.[25] Mobile source controls reduce pollution before it reaches communities, and particularly benefits those who live, work, and spend time near major roadways, rail and shipping areas, freight terminals and some industrial sites. Reducing these emissions can improve respiratory and cardiovascular health, birth outcomes, premature death, cancer, cognitive function and other health outcomes.[26,.27] There are many types of mobile source controls.

- Diesel engine retrofits, which either replace engines or install effective emission controls on older diesel engines (especially those built before 2007), can attain a great reduction in PM emissions. Retrofits can be used on trucks, school buses, construction vehicles (e.g. dump trucks and cranes), diesel-powered equipment (e.g. generators and pumps), ships and trains. Retrofits would particularly benefit the many residents living near busy roads, children riding school buses (70% of DPS's bus fleet is diesel[28]), and truck drivers. To date, 30% of Detroit Public School buses have been converted from diesel to propane-gas. Also, Southwest Detroit Environmental Vision has led a retrofitting program with funding from MDEQ, Michigan Department of Transportation, U.S. Environmental Protection Agency, and local business partners. Additional retrofit strategies include: *passing laws and ordinances at State and local levels to require pollution control devices*; *requiring low-emission vehicles and construction equipment in city contracts*; and including *low-pollution construction equipment language in Community Benefits Agreements*.

- Idling controls reduce emissions by turning off the engine when a vehicle is not in motion. This is accomplished using anti-idling technology, laws or regulations. Truck drivers are especially vulnerable to adverse health impacts from idling vehicles given the amount of time they are exposed. In addition, residents living near freeways and heavy use areas, such as customs plazas, bridges and intermodal facilities, would also benefit. Current actions include an *anti-idling ordinance* passed by the City of Detroit in 2010 and enforced by the Detroit Police Department (Traffic Enforcement Division); the Detroit-based *Anti-Idling Workgroup* that works to raise awareness about the Detroit ordinance and to support and encourage enforcement; other efforts to designate, publicize and enforce truck routes in the city,[29] and the use of *community truck surveys* to document truck routes, raise awareness within communities, and advocate for changes in truck routes.[30] Additional anti-idling steps that could be implemented include the *development and implementation of anti-idling hotlines and web-based tools* to allow residents to report

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[25] OEHHA (Office of Environmental Health Hazard Assessment). 2007. Fuels and Your Health: A Fact Sheet by Cal/EPA's Office of Environmental Health Hazard Assessment and the American Lung Association. Available: http://oehha.ca.gov/public_info/facts/fuelstoi.html. [Accessed 17 February 2016].

[26] Community Action to Promote Healthy Environments, Health Effects of Air Pollutants Chart.

[27] EPA (Environmental Protection Agency). 2016. Near Roadway Air Pollution and Health. Available: http://www3.epa.gov/otaq/nearroadway.htm. [Accessed 23 March 2016].

[28] Crain's Detroit Business. 2015. Detroit students to ride to school on propane-fueled buses. Available: http://www.crainsdetroit.com/article/20150902/NEWS/150909990/detroit-students-to-ride-to-school-on-propane-fueled-buses [accessed 3 February 2016].

[29] DEA (The Detroit Environmental Agenda). 2013. Available pg. 50: http://www.dwej.org/wp-content/uploads/2015/12/ElectionDraftAnnalieseEdits-nohyperlinks.pdf [accessed 2-10-16]

[30] SDEV (Southwest Detroit Community Benefits Coalition. Progress. Available: http://www.swdetroitcbc.org/projects-and-progress [accessed 2-11-16].)

idling violations; *expanding enforcement* by enabling multiple agencies to enforce the anti-idling ordinance; *creating county- or state-level anti-idling restrictions* to allow county and state agencies to enforce idling restrictions; *encouraging or requiring idling reduction technologies and drivers lounges*, for example, at the customs plaza at the new Gordie Howe Bridge; using *incentives for drivers* to reduce idling; and *raising awareness* through city-wide campaigns (e.g., with signage) and using *EPA's Smartway Partnerships*.

- Clean fuels replace conventional fuels (e.g., gasoline and diesel) in cars, trucks, construction equipment, and other motorized vehicles and portable equipment. Some clean fuels can be substituted directly; others require special equipment or retrofits. Currently, the *Clean City Detroit* partnership is working to expand the use of clean fuels, *Metro Cars Detroit* is using propane in its fleet, and the *Green Fleets Program* is converting gas-powered utility fleets to compressed natural gas. Additional strategies include the *requirement of zero-emissions (electric) vehicles* for city and private fleets; *expanding awareness, education and training*; creating *financial incentives*; retiring *older high emissions vehicles*; and *requiring emissions testing*.

- 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.[31] Due to the possible designation of O_3 non-attainment, and because O_3 strategies require a regional effort, TCMs in the Detroit area will likely receive increased attention in the near future. Current TCM-related efforts include the *Regional Master Transit Plan*, the *M1 Rail* along Woodward, *incentives for public transportation*, *pedestrian and bike lanes* and *bike sharing programs* to encourage non-motorized transportation, and *increasing road capacity*. Additional transportation strategies include: expanding all of the previously mentioned programs, plus adding *commuter benefits programs*, *public transit incentives*, *truck rerouting;* using *high occupancy vehicle lanes* and/or *high occupancy toll lanes*, and using *automatic tolls, value pricing, restricted driving days* and *low emissions zones*.

1.9.4 Strategy 4: Indoor Air Filters

Most air filters or purifiers remove particulate air pollutants, including dust, small particles, pollen, allergens, animal dander, and fibers. Some filters can remove gases such as SO_2 and VOCs, though these are uncommon. When designed and used appropriately, air filters can be effective, especially since people spend most of their time indoors[32] and since filters reduce exposure to indoor sources of air pollution (e.g., cooking, smoking, vacuuming) and outdoor sources (e.g., traffic, power plants). We estimate that installing filters in Detroit area homes would reduce the number of outdoor $PM_{2.5}$-related asthma exacerbations (defined using cough) by about 33,000 each year and avoid other adverse health impacts among both children and adults, including more than 100 hospitalizations for respiratory and cardiovascular disease and 140 premature mortalities,

[31] EPA (Environmental Protection Agency). 2011. Transportation Control Measures: An information document for developing and implementing emissions reductions programs. Available: https://www3.epa.gov/otaq/stateresources/policy/430r09040.pdf [accessed 23 March 2016].

[32] Klepeis NE, Nelson WC, Ott WR, Robinson JP, Tsang AM, Switzer P, et al. 2001. The National Human Activity Pattern Survey (NHAPS): a resource for assessing exposure to environmental pollutants. Journal of exposure analysis and environmental epidemiology 11:231-52.

which primarily occur among older adults; installing filters in all schools would avoid about 12,000 asthma exacerbations among children.[33] Two recent programs have used filters in Detroit. As part of a negotiated *Supplemental Environmental Project* (SEP) to resolve air quality violations,[34,.35] AK Steel agreed in 2015 to install air filters in the Salina Elementary and Intermediate Schools. In 2012-13, a study placing air filters in the homes of children with asthma showed dramatic reductions in particle concentrations.[36] Applicable filter strategies include *expanding use of higher performance filters* (MERV 11 and above) in homes, schools and commercial buildings; prioritizing buildings near major roads, construction sites, and other air pollution sources; creating multi-stakeholder *"Air Filter Management Programs" and/or "Filter Committees"* for schools; supporting businesses to upgrade ventilation and filter systems; *increasing awareness of tax credits for green building*, which includes indoor filtration systems; using *certification systems* to encourage green buildings and improved air quality; creating and using *regular maintenance schedules* for filter replacement and improving preventative maintenance in schools, homes and commercial spaces; expanding awareness and use of EPA's *Indoor Air Quality Tools for Schools;*[25] encouraging Detroit and other municipalities to pass ordinances stipulating that schools adopt and implement an air quality and preventative maintenance programs; and using *Community-Benefits Agreements* to expand the use of filters, especially in buildings near emission sources.

1.9.5 Strategy 5: Buffers and Barriers

Buffers can reduce exposure using vegetative (e.g., trees, shrubs), distance, and/or physical barriers (e.g., sound walls) between pollution sources and homes, schools and other places where people may be exposed. Buffers reduce exposure by absorbing or blocking some of the pollution, thus lowering concentrations. Buffers can help to reduce concentrations of O_3, PM, NO_x, SO_2, and CO,[12] especially at residences and schools near highways and industrial facilities. Initiatives underway in Detroit include *a carbon buffers pilot program* implemented by Detroit Future City and Greening of Detroit at a several sites; a *green buffers plan* to protect the Delray and portions of Southwest Detroit from industry and increased vehicle traffic from the future Gordie Howe International Bridge led by the Community Benefits Coalition and Detroiters Working for Environmental Justice; *policy recommendations for planting trees* developed the Healthier and Greener Detroit workgroup; and a *noise abatement program* for installation of sound walls by the Michigan

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[33] These health benefit estimates assume a "no-threshold" relationship between exposure and health outcomes, that is, there is no level of exposure below which adverse health outcome do not occur.

[34] The United States Department of Justice. 2015. United States of America and the Michigan Department of Environmental Quality v. AK Steel Corporation. Available: http://www.justice.gov/sites/default/files/enrd/pages/attachments/2015/05/19/env_enforcement-2523241-v1ak_steel_lodged_decree.pdf [accessed 11 February 2016].

[35] The Detroit News. 2015. AK Steel to pay $1.35M fine, install filters at schools. Available: http://www.detroitnews.com/story/business/2015/05/20/ak-steel-fine-install-filters-schools/27658285/ [accessed 11 February 2016].

[36] Du L, Batterman S, Parker E, Godwin C, Chin JY, O'Toole A, et al. 2011. Particle concentrations and effectiveness of free-standing air filters in bedrooms of children with asthma in Detroit, Michigan. Building and Environment 46: 2303-2313.

[25] EPA (Environmental Protection Agency). Indoor Air Quality Tools for Schools Action Kit. Available: http://www.epa.gov/iaq-schools/indoor-air-quality-tools-schools-action-kit [accessed 2 March 2016]

[12] Nowak, DJ, Crane, DE, Stevens, JC. Air pollution removal by urban trees and shrubs in the United States. Urban Forestry and Urban Greening 4:115-123.

Department of Transportation. Additional strategies include requiring *minimum setbacks* (150 meters or more from heavily trafficked roadways to residential areas, schools, health care facilities, senior centers and other sensitive land uses); expanding efforts to *create vegetative buffers along major roadways*, with particular attention to vulnerable populations; *increasing tree canopy*; creating policies that *require buffers when new developments are implemented*; *requesting buffers as part of Community Benefits Agreements*; and *supporting partnerships* between relevant organizations, such as Greening of Detroit and state and local authorities, to assure integration of buffer plans with other planning activities.

1.9.6 Strategy 6: Enhanced Compliance and Enforcement of Air Quality Rules

Section 7.6 of the *Resource Manual* summarizes the federal, state and regional regulations and 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. Additional strategies to improve compliance and enforcement with air quality goals include: routine incorporation and use of *health impact and cumulative impact analyses* to investigate and potentially quantify health risks and impacts; transitioning to a *regulatory focus on public health and safety*, rather than compliance; *periodic integrated and long range air quality planning*; additional *funding to support technical staff and inspectors* to increase the frequency and stringency of inspections and monitoring; *increasing notification, information and transparency* throughout the permitting process; providing *external technical assistance* for communities; increasing *opportunities for meaningful public participation*; increasing the *stringency of permits and practices* to reduce emissions from point, non-point, non-road, and fugitive sources, including lowering allowable emissions to approach actual emissions; *improving emissions inventory data*, particularly for PM and toxics; and requiring *additional emissions monitoring and testing* for industrial facilities to better understand actual emissions.

1.9.7 Strategy 7: Enhanced Ambient Monitoring

Ambient monitoring measures existing air quality in order to understand concentrations, exposures and health impacts. In addition, monitoring determines compliance with ambient air quality standards, and can help identify culpable (or contributing) emission sources. Monitoring provides the best data for community members to know what is in the air they breathe, to track trends, assess the adequacy of controls, and evaluate the performance of the overall air quality management strategy. Section 7.6 of the Resource Manual describes current ambient monitoring conducted in the Detroit area. Monitoring site locations and parameters are selected for specific reasons, e.g., some sites sample near-road and industrial impacts, while others represent the exposure of the general population. MDEQ conducts most of the monitoring in the Detroit area, which includes regular (often continuous) measurements of $PM_{2.5}$, NO_x, CO, O_3, and lead (Pb). A small number of sites measure additional parameters, including diesel exhaust, bioaerosols, ultrafine PM, reactive species, metals, and organics. Several additional monitoring sites are operated by Marathon and other industries. MDEQ is siting an additional monitor in Southwest Detroit to respond to citizen requests. 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. Additional monitoring strategies include: *increasing industry monitoring*, including "fence line" monitoring at the facility boundary; *expanding the SO_2 monitoring network* since SO_2 "hotspots" tend to be very localized and potentially missed; *identifying*

monitoring gaps using a structured process with public input; *applying remote sensing* and other techniques to develop spatially-resolved understanding of pollutant exposures; *providing further analyses of collected data to understand trends and apportionments; deploying permanent or transportable ambient monitoring equipment* to understand spatial impacts from particular sources, particularly heavy industry in Southwest Detroit, with sufficient data to develop annual average concentrations of toxics; providing *funding and in-kind support for low-cost and community air monitoring,* and *enhancing MDEQ's websites and public information* to allow more informative displays of source emissions and ambient monitoring results.

1.10 Next Steps

The Community Action to Promote Healthy Environments (CAPHE) Public Health Action Planning Team used the information in the Resource Manual to inform decision making in phase 1 of the public health action planning process aimed at developing mitigation strategies. In phase 2, which began in October, 2016, the team will reach out to additional stakeholders for further input to the final CAPHE Public Health Action Plan (PHAP). After its release in early 2017, we will work to implement the PHAP. Upcoming goals and activities include:

Trainings on the PHAP: The goal of the PHAP trainings is to enhance the knowledge of air quality and health among community partner organizations and constituents. Trainings will include information about air pollution emissions, exposures, adverse health effects, and elements of the Public Health Action Plan. We plan to conduct 4 trainings on the CAPHE PHAP, two per year over the next two years (2017-2018).

Community Meetings: The goal of the community meetings is to enhance the knowledge of air quality and health among Detroit residents. We plan to conduct a series of community meetings, town halls and forums, which will promote environmental health literacy and increase capacity to improve air quality and reduce adverse health effects.

Policy Advocacy Trainings: The goal of the policy advocacy trainings is to enhance the capacity of residents and leaders to inform environmental policies. Policy Advocacy Trainings will build community capacity to promote the policy recommendations included in the final CAPHE Public Health Action Plan. We plan to conduct between 4 and 6 trainings, 2-3 per year, over the next two years (2017-2018).

Mini Grant Program: The goal of the mini-grant project is to enable residents, community groups, and others to make changes to the Detroit environment to reduce exposure to air pollutants. The mini-grant program will support pilot projects by community groups that implement key air-pollution reduction recommendations from the PHAP (i.e. vegetative buffers, idle control measures, etc.). We plan to launch the mini-grant program in Spring 2017, and we will award 4-9 mini-grants per year for the next two years (2017-2018).