



# Moving Research to Action to Reduce Adverse Health Effects of Air Pollution: Community Action to Promote Healthy Environments (CAPHE)

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# Partner Organizations & Partnerships



DETROIT  
HISPANIC  
DEVELOPMENT  
CORPORATION



SIERRA  
CLUB  
FOUNDED 1892



Detroiters Working for  
Environmental Justice  
Fostering Clean, Healthy and Safe Communities





# Air Quality in Detroit

- Historically, Detroit has faced challenges with air quality
- Multiple pollutant sources
- Large exposed population
- Adverse health outcomes associated with air pollutants
- Vulnerable communities
- Opportunity to improve air quality and reduce health inequities



Photo 1: Incinerator, Detroit Renewable Power, Detroiters Working for Environmental Justice, 1-4-16

Photo 2: Truck Traffic, Detroit, Hannah Gordon, 6-18-15



# CAPHE's Overarching Goals

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- To develop a multilevel, integrated and scientifically-informed public health action plan designed to reduce adverse effects of air pollution on health
- To promote implementation of components of the plan



# CAPHE's Approach

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1. Builds on three longstanding community-based participatory research (CBPR) partnerships
2. Aims to increase knowledge about factors influencing exposure to air pollution and health effects
3. Translates findings into a public health action plan
4. Implements innovative policy and practice solutions to reduce pollutant exposure and mitigate adverse health effects
5. Evaluates process and impact



# Partner Roles & Leadership

## Community

- Identify priority action areas
- Identify key opinion & policy leaders
- Develop community & youth leadership
- Organize & coordinate with other environmental actions

## Academic

- Conduct background research
- Identify vulnerable communities & priority areas for intervention
- Estimate health impacts of selected mitigation strategies

## Joint Responsibility

- Identify key priority areas for new research
- Inform strategies for compiling & synthesizing information for PHAP process
  - Define components of the public health action plan
    - Implement public health action plan
  - Identify funding for continued action on the plan



# Aim 1: Strengthen, support & enhance capacity to work together

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- All partners bring valuable expertise and insights to inform decision making;
- Effective engagement in planning and decision making process is democratizing – (World Health Organization 1999).
- Requires attention to:
  - Structures for long term, effective participation
  - Group process



# Aim 1: Strengthen, support & enhance capacity to work together: Structures for Participation

Partners with direct responsibility for CAPHE



DETROIT  
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Core Team: Community and Academic Leadership



**Detroiters Working for  
Environmental Justice**

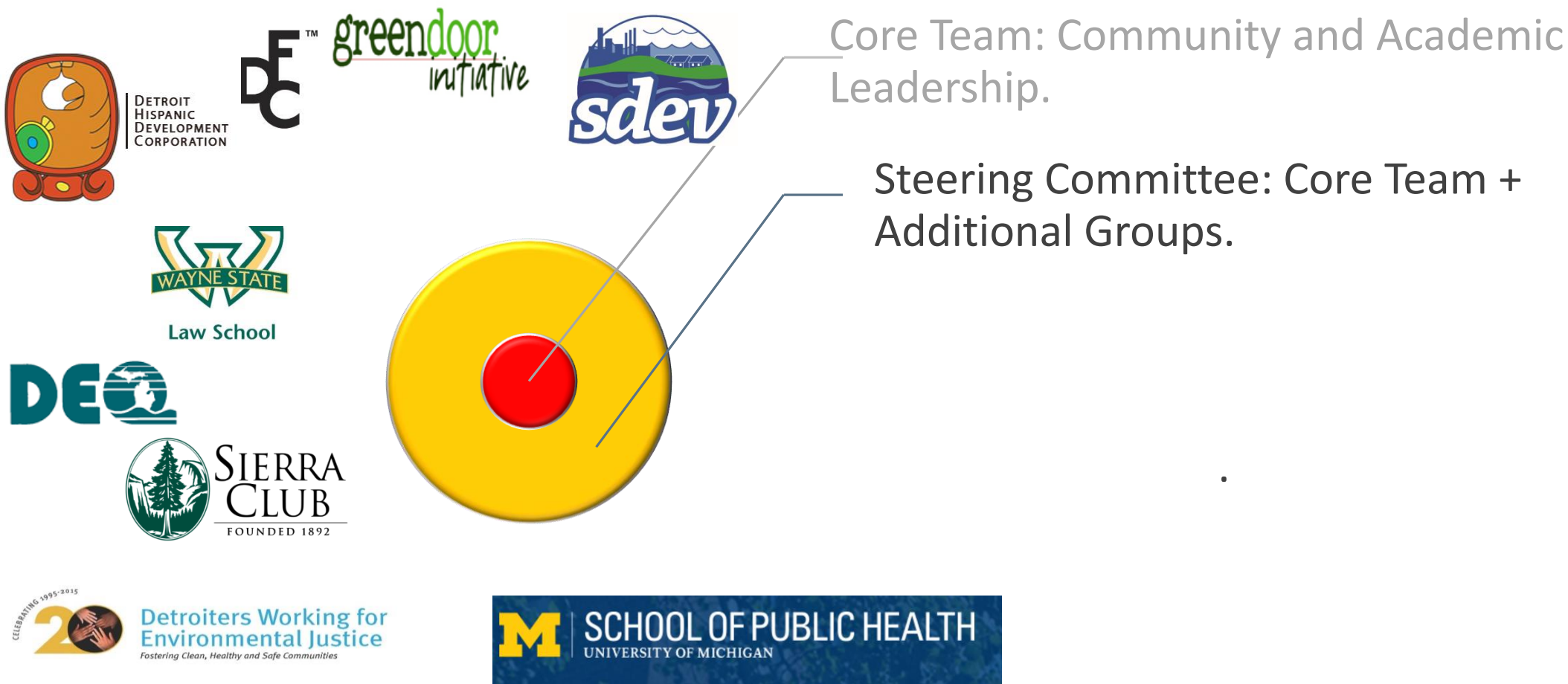
*Fostering Clean, Healthy and Safe Communities*





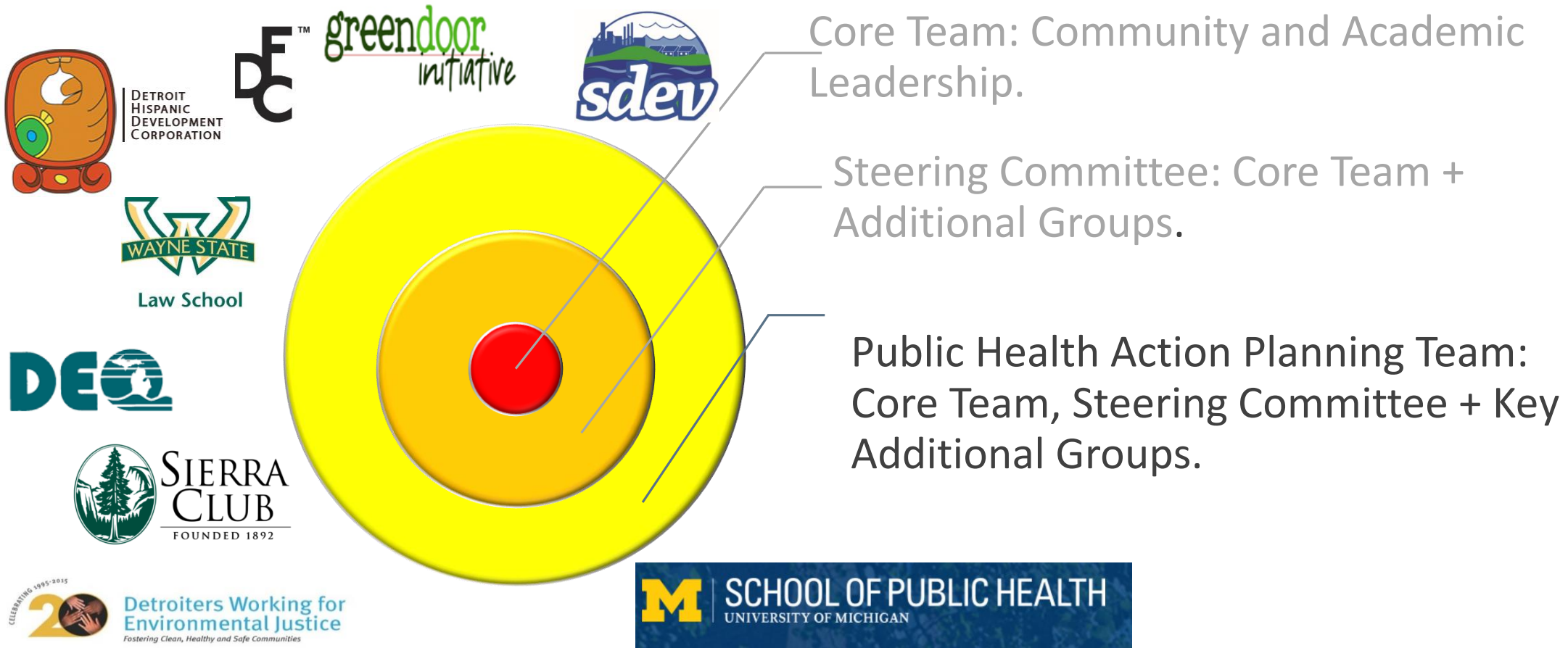


# Aim 1: Strengthen, support & enhance capacity to work together: Structures for Participation





# Aim 1: Strengthen, support & enhance capacity to work together: Structures for Participation





## Aim 1: Strengthen, support & enhance capacity to work together: Process for working together

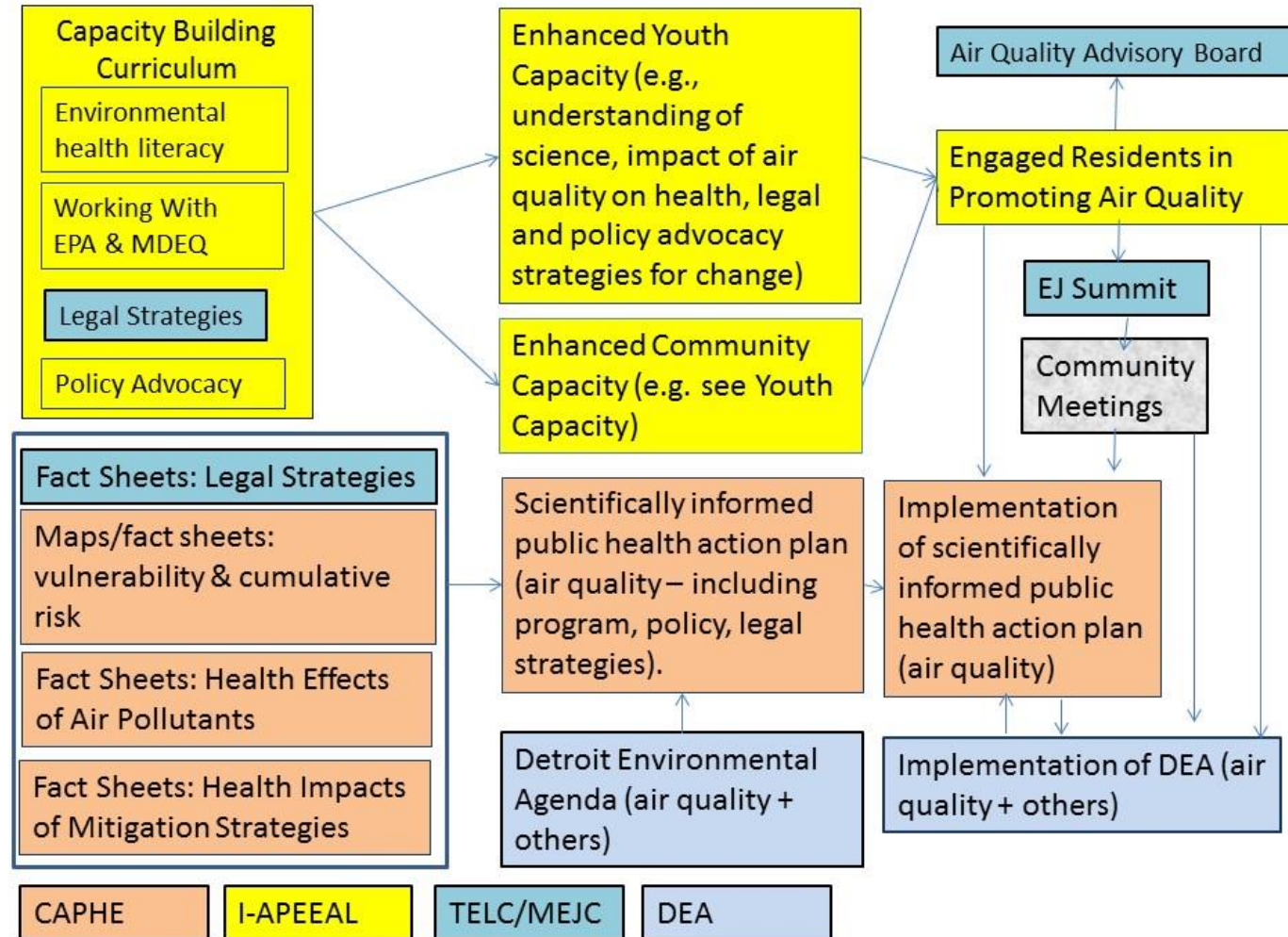
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- Community-based participatory research principles
- Group norms
  - Jointly agreed upon process for working together (e.g., how we make decisions as a group)
- Dissemination guidelines
  - Jointly determined guidelines for dissemination of our work
  - Engagement of community and academic partners in presentations and publications



# Leveraging to build capacity: I-APEEAL\*

- Capacity Building Success
- DHDC and DWEJ leadership
- Substantially supplements funds for action
  - Full-time DWEJ-based Project Coordinator
  - Full-time DHDC-based Youth Coordinator + youth stipends







## Aim 2: Identify key air pollution sources associated with adverse health outcomes & evaluate potential mitigation strategies

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- Background information on air pollutants and health in Detroit (e.g. fact sheets)
- Identification of communities experiencing excess exposure
- Identification of vulnerable communities
- Identification of a subset of mitigation strategies to quantify health and environmental benefits
- Preliminary recommendations



# Specific Aim 2: Identify key air pollution sources associated with adverse health outcomes & evaluate potential mitigation strategies



## PROJECT PARTNERS:

Community Action Against Asthma  
Detroit Community-Academic Urban Research Center  
Detroit Future City  
Detroit Hispanic Development Corporation  
Detroiters Working for Environmental Justice  
Green Door Initiative  
Healthy Environments Partnership  
Sierra Club  
Southwest Detroit Environmental Vision  
University of Michigan Schools of Public Health, Medical School & College of Architecture and Urban Planning  
Wayne State University Law School  
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## SULFUR DIOXIDE

### WHAT IS SULFUR DIOXIDE?

Sulfur dioxide (SO<sub>2</sub>) is a gas formed when fuel containing sulfur, such as coal and oil, is burned.<sup>1,2</sup> SO<sub>2</sub> is colorless and at high levels has an irritating odor like struck matches. You can be exposed outside if you breathe the air that contains SO<sub>2</sub>.

Combustion sources also emit several other sulfur gases, although the predominant one is SO<sub>2</sub>. In the atmosphere, SO<sub>2</sub> can react with other pollutants, especially in the summer, to form sulfate particles.<sup>2</sup> These particles are tiny, and can penetrate deep in the lungs and cause many health effects. These particles can become acidified and cause 'acid rain.' This fact sheet focuses on SO<sub>2</sub>.

### WHAT ARE THE HEALTH EFFECTS OF SULFUR DIOXIDE?

Exposure to SO<sub>2</sub> has been associated with many serious health concerns. Short term exposure can cause:<sup>2</sup>

- Difficulty breathing
- Coughing and shortness of breath
- Irritation of the nose, throat, and lungs
- Stomach pain
- Menstrual disorders
- Watery eyes
- Inhibition of thyroid function
- Loss of smell
- Headaches, nausea, vomiting
- Fever, convulsions, and dizziness

Long Term exposure can cause:<sup>2</sup>

- Chronic bronchitis, emphysema, and respiratory illness
- Aggravation of existing heart disease
- Decreased fertility in men and women

Children, the elderly, and people with asthma, cardiovascular disease or chronic lung disease (such as bronchitis or emphysema), are most susceptible to adverse health effects associated with exposure to SO<sub>2</sub>.<sup>1</sup>



DTE Energy's Monroe Power Plant (Photo: Bloomberg)

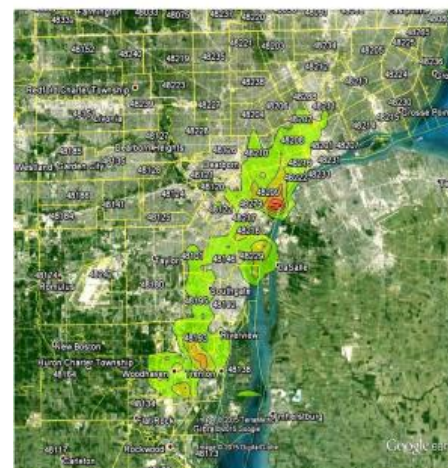
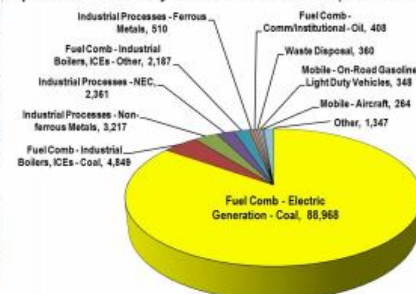
CA-PHE is funded by the National Institute of Environmental Health Sciences—Grant # R01ES022616

## WHAT ARE THE MAJOR SOURCES OF SULFUR DIOXIDE IN DETROIT?

In the southeastern Michigan area (7 counties), SO<sub>2</sub> emissions in 2011 were 105,000 tons, equivalent to nearly 12 tons of SO<sub>2</sub> emitted each and every hour of the year. Most (85%) of these emissions come from power plants burning coal to produce electricity.<sup>3</sup> The largest SO<sub>2</sub> emitters are in Monroe, Trenton, and River Rouge. The Monroe plant (shown overleaf) recently has been outfitted with scrubbers that greatly reduce emissions.

The pie chart to the right shows the major sources of SO<sub>2</sub> in the southeast Michigan area. These include the DTE coal-fired power plants in Monroe, Trenton Channel and River Rouge, and the US Steel Great Lakes facility in Ecorse.

### Top Sources in 7 County Area for SO<sub>2</sub> Emissions (104816 tons/yr)



## WHO IS EXPOSED TO SO<sub>2</sub>?

Because most of the SO<sub>2</sub> sources are along the Detroit River, people living or working in Southwest Detroit, Ecorse, Trenton, Lincoln Park, and Wyandotte areas have the highest exposure and the greatest risks of negative health effects due to SO<sub>2</sub> exposure.

The map to the left shows the expected higher exposure areas in green, orange and red (in order of increasing SO<sub>2</sub> levels). These areas are based on air quality modeling of Detroit-area SO<sub>2</sub> sources using allowable emissions. Modeling is used to predict the 4<sup>th</sup> highest 1-hour concentration, which is the form of the National Ambient Air Quality Standard for SO<sub>2</sub>.

## HOW CAN YOU LOWER EXPOSURE?

The Michigan Department of Environmental Quality (MDEQ) sets and enforces SO<sub>2</sub> ambient standards and emission limits. Petition MDEQ and your local decision makers to lower SO<sub>2</sub> emissions from industry, monitor air quality, and meet air quality standards with a margin of safety.

## REFERENCES

1. Environmental Protection Agency. 2015. Sulfur Dioxide. <http://www.epa.gov/airtrends/airquality/sulfur.html> [accessed 3/3/15]
2. U.S. Library of Medicine. 2015. Sulfur Dioxide. [http://toxtown.nlm.nih.gov/text\\_version/chemicals.php?id=29](http://toxtown.nlm.nih.gov/text_version/chemicals.php?id=29) [accessed 3/3/15]
3. National Emissions Inventory. 2011. Sulfur Dioxide. Emissions. [http://www.epa.gov/med/grossell\\_site/indicators/air-pollution.html](http://www.epa.gov/med/grossell_site/indicators/air-pollution.html) [accessed 3/3/15]

## ABOUT COMMUNITY ACTION TO PROMOTE HEALTHY ENVIRONMENTS

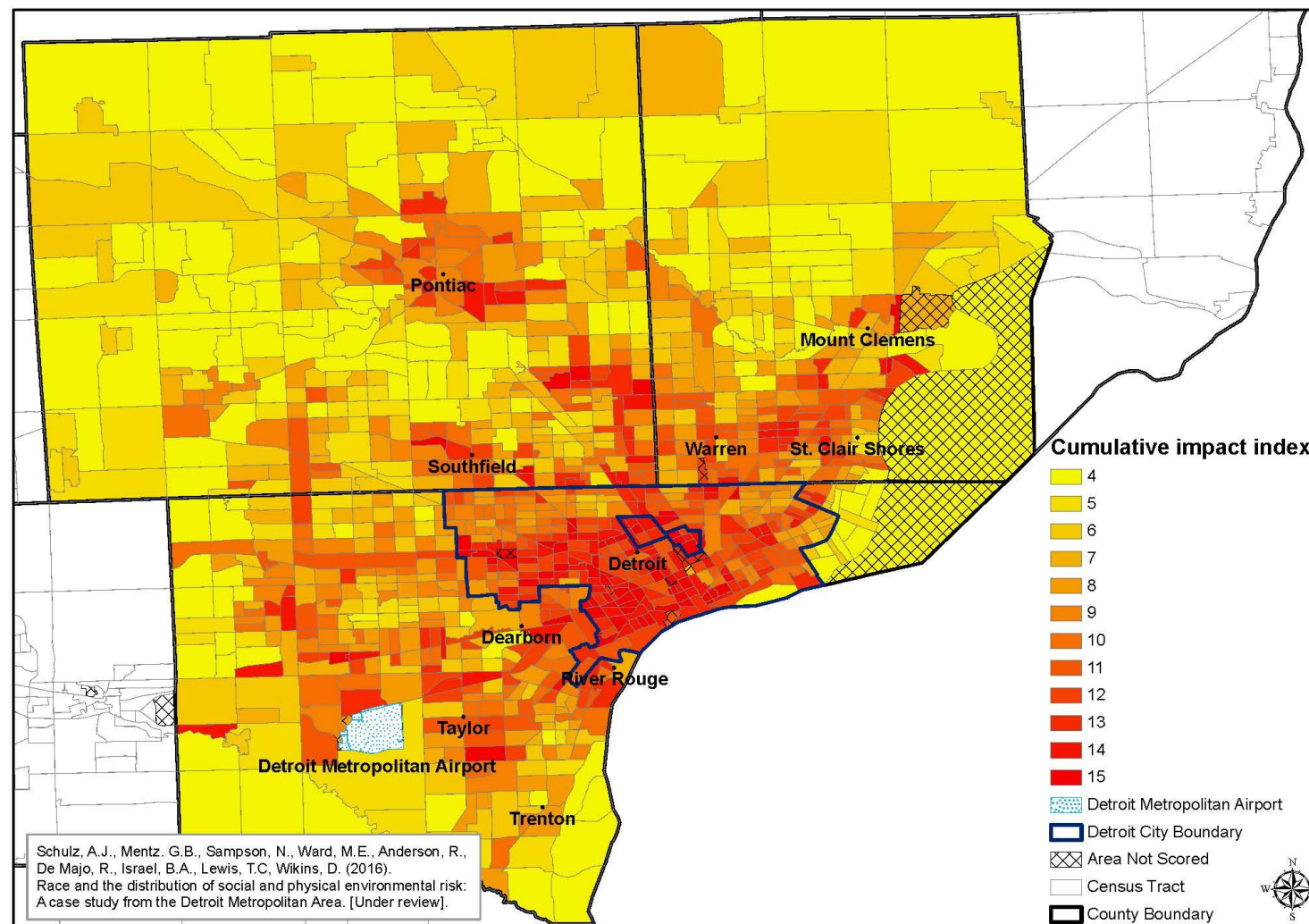
CA-PHE uses a community-based participatory research approach in which partners are involved in all phases of the work. This includes defining the research problem, designing and implementing the study, interpreting and distributing the results, deciding how results will be applied and applying the results to create a public health action plan to improve health in Detroit. CA-PHE builds on 15 years of community-academic research partnerships. Members from these long-standing partnerships serve on CA-PHE's Core Team, Steering Committee and Public Health Action Team. This structure promotes collaboration and shared decision making at all levels of the CA-PHE project, ensuring Detroit residents will have a significant voice in identifying and creating solutions to Detroit's air pollution problems.







# Cumulative Risk: Exposure + Vulnerability



Cumulative impact polygons (CI) include: residential areas, child care facilities, health care facilities, schools and playgrounds.  
Total Cumulative Impact includes: Hazardous Facilities and Land Uses, Exposure and Health Risk and Vulnerabilities





# Inequitable Distributions of Risk

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- The proportion people of color at the census tract level is significantly associated with:
  - Greater cumulative air pollutant exposure and health risk ( $p < 0.001$ )
  - Greater exposure to cumulative risk (vulnerability + exposure) ( $p < 0.001$ )



# Quantifying effects of potential mitigation strategies



Evaluate potential mitigation strategies (e.g., feasibility, relevance)

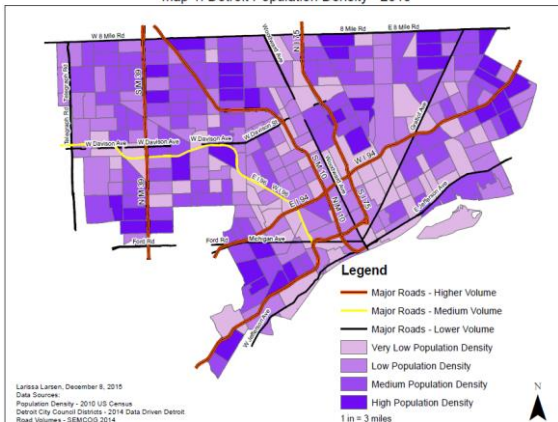
Identify a short list of promising strategies for Detroit

Conduct a quantitative assessment of the relative value (e.g., number of deaths averted)

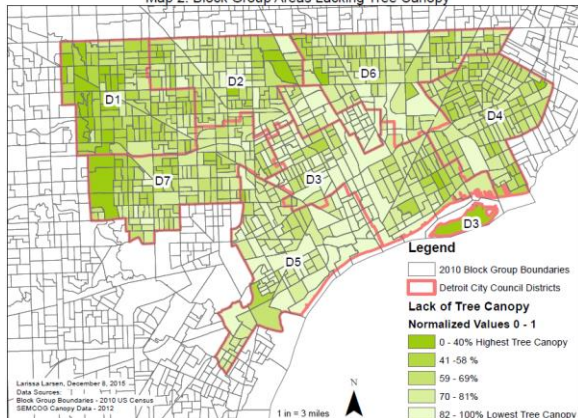


# Prioritizing tree planting locations

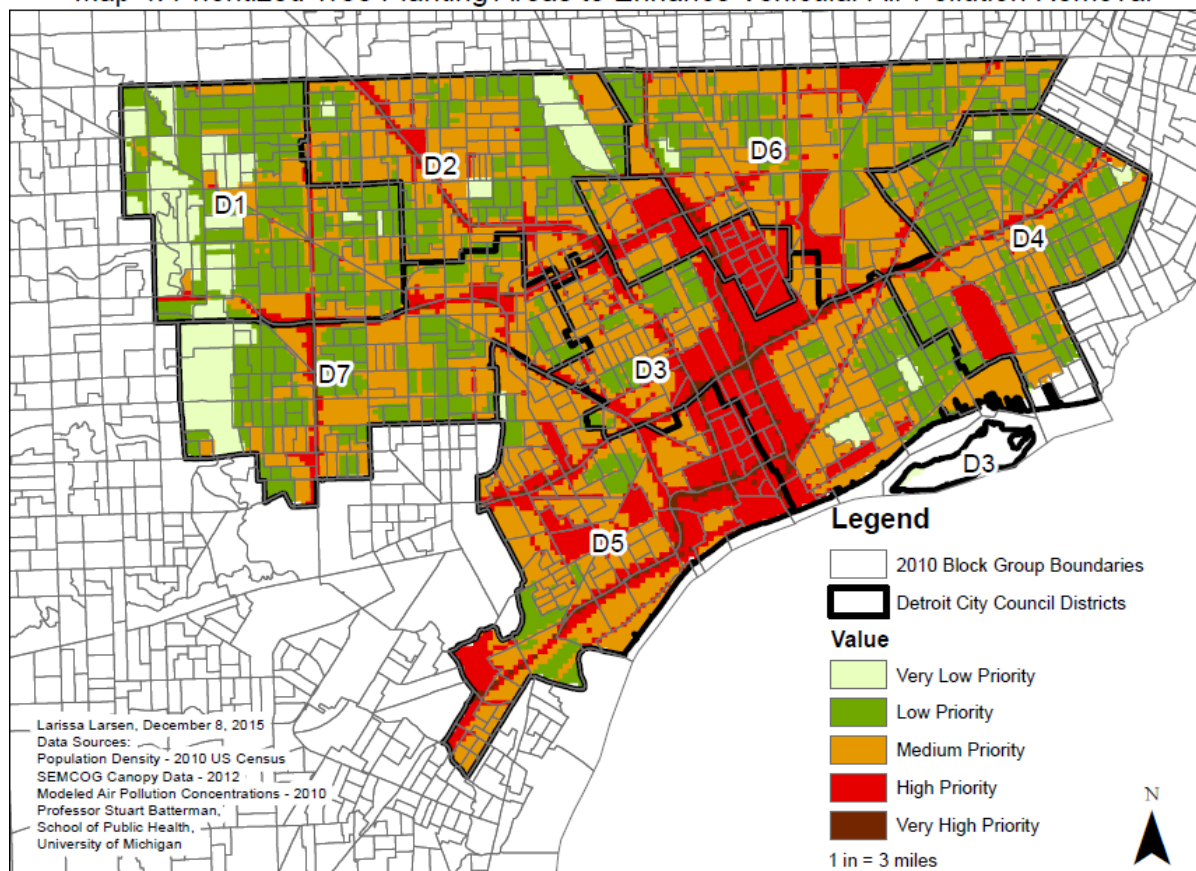
Map 1: Detroit Population Density - 2010



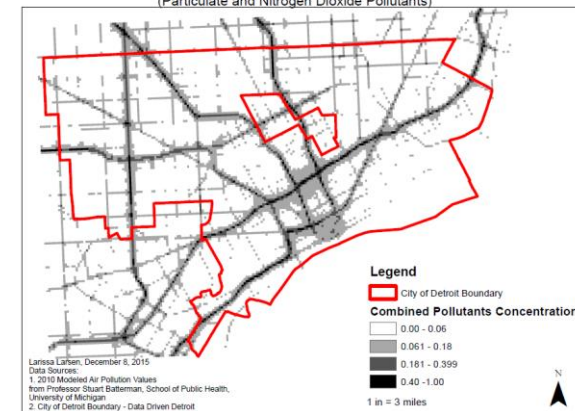
Map 2: Block Group Areas Lacking Tree Canopy



Map 4: Prioritized Tree Planting Areas to Enhance Vehicular Air Pollution Removal



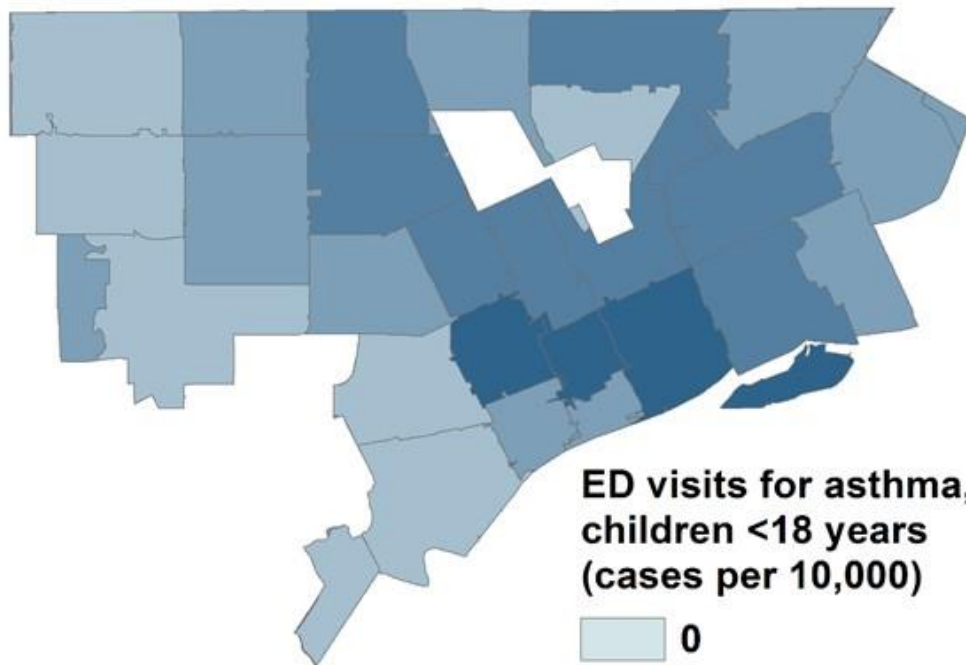
Map 3: Vehicular Air Pollution Concentrations (Particulate and Nitrogen Dioxide Pollutants)



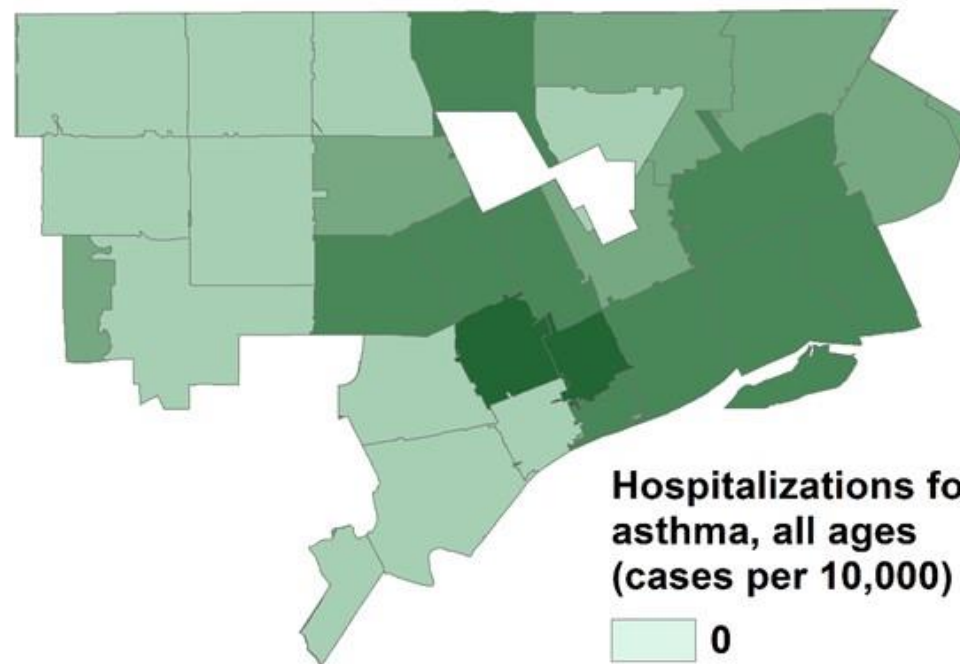
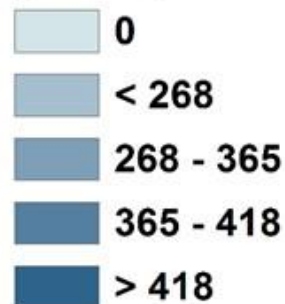


# Quantitative Health Impact Assessment: Example for SO<sub>2</sub> and asthma

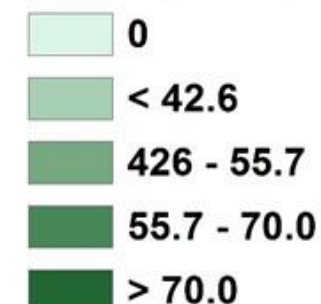
*Baseline asthma outcome incidence rates by ZIP codes in Detroit, MI  
used to derive health impacts attributable to pollutant exposure*



**ED visits for asthma,  
children <18 years  
(cases per 10,000)**



**Hospitalizations for  
asthma, all ages  
(cases per 10,000)**

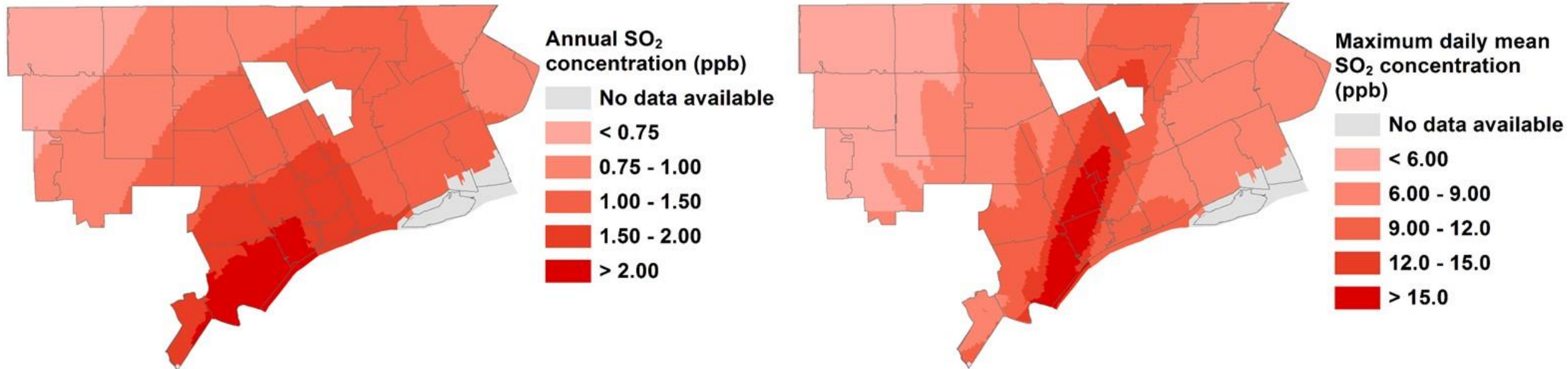






# Quantitative Health Impact Assessment: Example for SO<sub>2</sub> and asthma

Annual and daily mean SO<sub>2</sub> concentrations from AERMOD dispersion modeling  
Selected health outcomes attributable to SO<sub>2</sub> exposure --- **Baseline case (existing)**



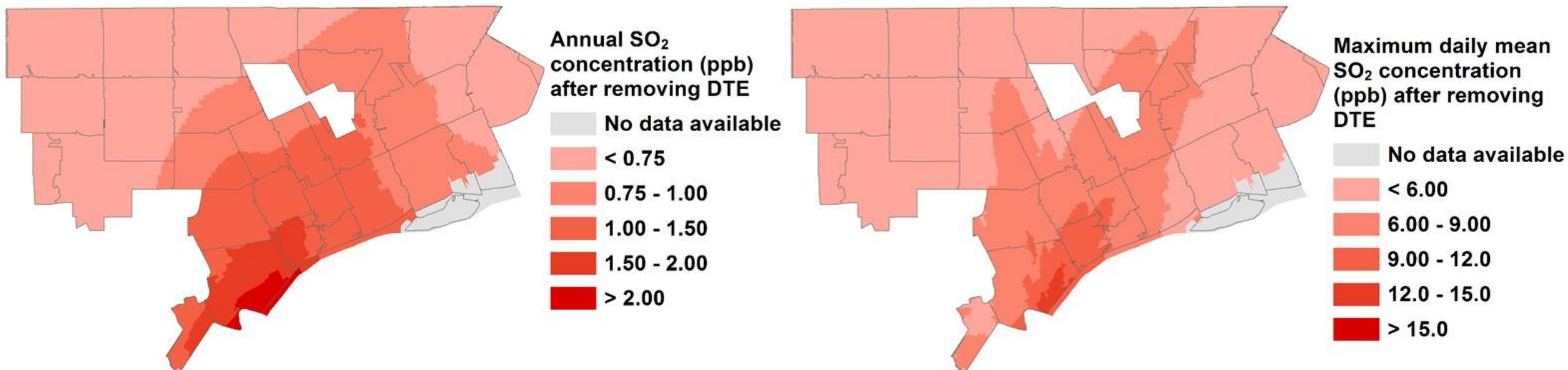
Asthma-related outcome (age group)	Number of attributable cases	Percent of total	DALYs (years)	Monetized impacts
Exacerbations (6-14 years)	3965	0.26%	4.36	\$229,975
ED visits (<18 years)	65	0.96%	0.09	\$27,858
Hospitalization (<65 years)	7	0.23%	0.04	\$115,961
<b>Total</b>			<b>4.49</b>	<b>\$373,794</b>

*PRILIMINARY RESULTS. Shows existing (2012) conditions, including SO<sub>2</sub> non-attainment zone in southern portion of Detroit*



# Quantitative Health Impact Assessment: Example for SO<sub>2</sub> and asthma

*Annual and daily mean SO<sub>2</sub> concentrations from AERMOD dispersion modeling  
Selected health outcomes attributable to SO<sub>2</sub> exposure --- **Low power plant emissions***



Asthma-related outcome (age group)	No. of attributable cases (% Diff)	Percent of total	DALYs (years)	Monetized impacts
Exacerbations (6-14 years)	2849 <b>(-28.1%)</b>	0.18%	3.13	\$165,228
ED visits (<18 years)	47 <b>(-27.7%)</b>	0.69%	0.06	\$20,056
Hospitalization (<65 years)	5 <b>(-28.6%)</b>	0.17%	0.03	\$83,255
<b>Total</b>			<b>3.23</b>	<b>\$268,540</b>

*PRELIMINARY RESULTS. Shows (2012) conditions in which emissions from two coal-fired power plants in S Detroit are reduced by 100%*





## Aim 3: Develop a multilevel, integrated & scientifically-informed public health action plan to reduce air pollutant exposures and adverse health effects

- Jan - June 2016: Core Team + Steering Committee develop recommendations
- Discuss with key groups & decision makers

Based on discussions:

- Finalize Recommendations
- Develop Action Strategies

Photo: Playground next to industrial land use in Detroit





## Aim 4: Develop & implement campaigns, interventions & policies to promote recommendations in the public health action plan

• June – Sept. 2016







# Aim 5: Evaluate process, effectiveness & impact of Aims 1- 4

- Process Evaluation
  - Capacity in working together
  - Group process dynamics/Collaborative engagement
  - Creation of public health action plan
  - Development of implementation strategy
- Impact Evaluation
  - Raise awareness
  - Promote implementation of the public health action plan
  - Mini-Grants to promote action on the action plan
  - Policy education trainings



# Health Equity Evaluation

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- Analyze process and products focused on equity
- Assess the extent to which CAPHE:
  - Strengthens capacity and ability of communities facing inequities to engage in analysis and decision making
  - Shifts power benefiting communities facing inequities
  - Creates changes that reduce inequities in the social and environmental determinants of health



# Summary & Lessons Learned

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- Public health action to improve air quality in Detroit is critical
  - Large exposed & vulnerable population
  - Disproportionate levels of adverse health outcomes associated with air pollutants
  - Opportunity to improve air quality and reduce health inequities
- Partnerships that engage community, academic and practice partners have potential to create innovative solutions to public health issues



# Summary & Lessons Learned

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- To effectively engage those most adversely affected by environmental concerns, partnerships must attend to process and equity:
  - Mutually agreed-upon principles, process and roles support potential to promote environmental justice and health equity
  - Advance planning, shared values (e.g., equity, mutual respect), strong relationships and trust
  - Pre-existing relationships & shared power
  - Commitment to listening & responding
  - Commitment to strengthen capacity & create opportunities for engagement in decision making





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Thank you!

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