Detroit Multi-pollutant Pilot Project: Summary

CLARCs Kick-off Meeting
April 8, 2011

Clean Air Centers (CLARCs) Kick-off Meeting

PROJECT GOALS AND RESULTS

Detroit Multi-pollutant Pilot Project: Overview

- NRC report recommended "Air Quality Management in the United States (2004)":
  - … that the United States ***transition from a pollutant-by-pollutant approach to air quality management to a multi-pollutant, risk-based approach . . .***

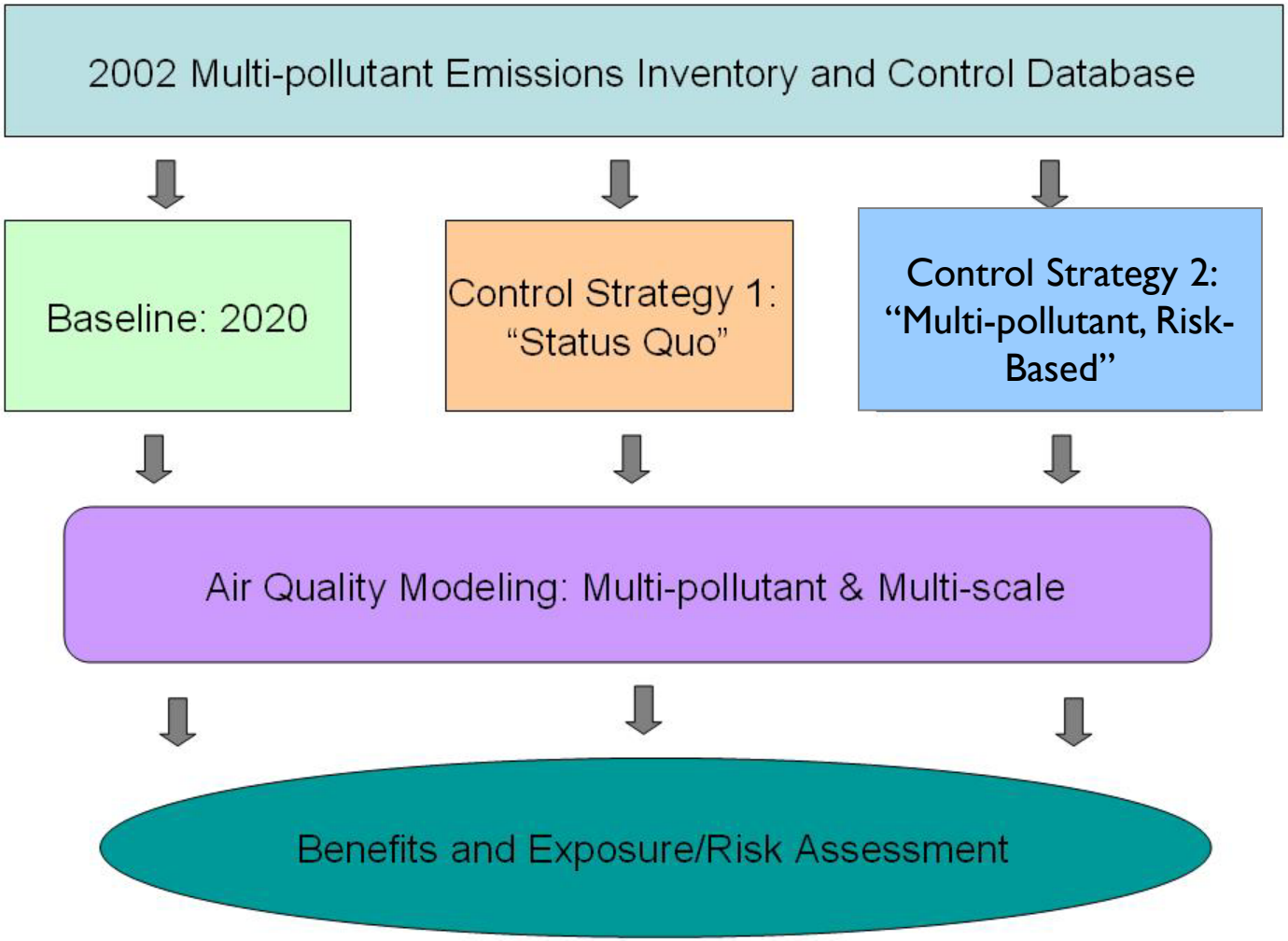
- In response, EPA investigated the application of our technical tools/methods in a multi-pollutant, risk-based approach to control strategy development.

→ We selected the Detroit urban area as a testbed to apply and evaluate MP tools & compare a MP-based control strategy to a SIP-based control strategy.

- Collaboration across OAQPS and across EPA (e.g. ORD, CAMD, OTAQ). Also worked with MDEQ, LADCO & SEMCOG.

- For more detailed information: Wesson, K., N. Fann, M. Morris, T. Fox, B. Hubbell, *Atmospheric Pollution Research*, 1 (2010) 1296-304.

Control Strategy Development & Assessment Overview



Control Strategies

- "Status Quo" because controls were selected to achieve separate O_3 and $PM_{2.5}$ attainment goals based on least-cost criteria
  - $PM_{2.5}$ Controls from EPA $PM_{2.5}$ NAAQS RIA 15/35
  - O_3 Controls from MDEQ Draft O_3 SIP Strategy Plan for 85 ppb NAAQS
- "Multi-pollutant, Risk-Based" (MPRB) controls were selected to:
  1. Meet or exceed AQ improvements at monitors
  2. Population oriented reductions to more broadly improve AQ throughout the region & decrease risk/exposure
  3. Maximize co-control potential, especially for air toxics
  4. Find more cost-effective reductions ($ per $\mu g/m^3$ & ppb)

Identifying Detroit Populations Susceptible and Vulnerable to $PM_{2.5}$ Air Pollution

Populations susceptible to $PM_{2.5}$ impacts

Asthma hospita

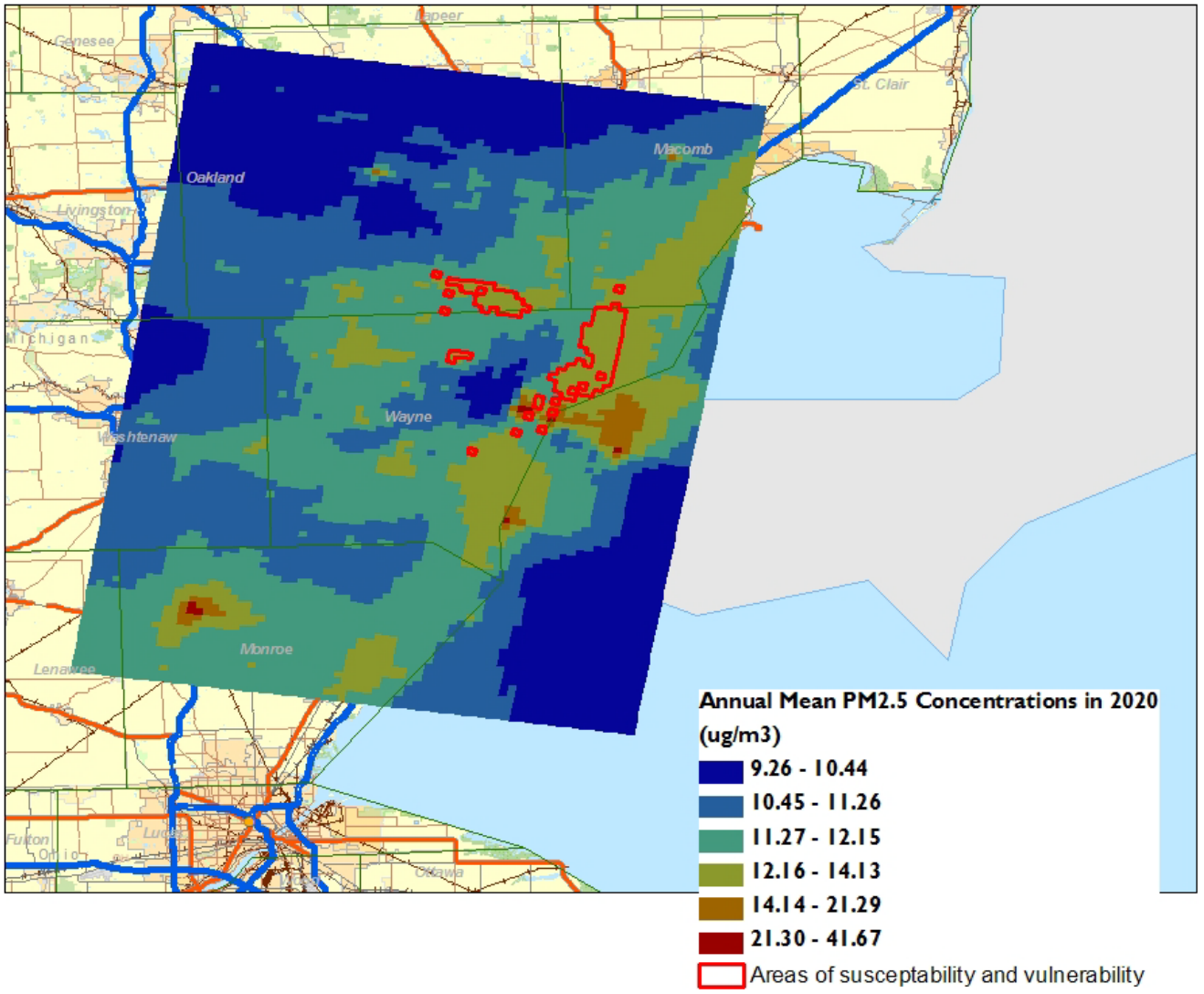
↓

Populations vulnerable to $PM_{2.5}$ impacts

Annual mean $PM_{2.5}$ air quality levels

↓

Populations susceptible and vulnerable to $PM_{2.5}$ impacts



The MP/RB Strategy Provides the Greatest Air Quality Benefits to Vulnerable and Susceptible Populations and Reduces Risk Inequality

	Per-person change in $PM_{2.5}$ exposure	
	Among susceptible and vulnerable populations	*Among rest of population*
Status-quo strategy	0.33	0.28
Risk-based, multi-pollutant strategy	1	0.5
Percentage difference	***300%***	***180%***

- Risk inequality analysis confirms that the MP/RB strategy produces a more equitable distribution of PM mortality and asthma hospitalization risk

Benefit-Cost Comparison

		"Status Quo"	"MP Risk-Based"
Total $PM_{2.5}$ & O_3 Benefits (M 2006$)		**$1,127**	**$2,385**
Change in pop-weighted $PM_{2.5}$ Exposure (ug/m^3)	*Regional*	*0.16*	*0.1666*
	Local	*0.2703*	*0.7211*
Change in pop-weighted O_3 Exposure (ppb)	*Regional*	*0.0005*	*0.0006*
	Local	*0.0318*	*0.0583*
Total Costs (M 2006$)		**$56**	**$66**
Cost per $\mu g/m^3$ $PM_{2.5}$ reduced		*$0.50*	*$0.32*
Cost per ppb O_3 reduced		*$2.6*	*$0.58*
Net Benefits (M 2006$)		**$1,071**	**$2,319**
Benefit-Cost Ratio		**20.1**	**36.1**

"MP, Risk-Based" approach met all "Criteria for Success"

- Same or greater reductions at all monitors for $PM_{2.5}$& O_3, including greatest reductions at Michigan projected nonattainment monitors
- Improved air quality regionally and in urban core for O_3, $PM_{2.5}$, and selected air toxics
- Greater benefits (~2x) for $PM_{2.5}$&O_3 with "MP, Risk-Based" Control Strategy
- Reduction in non-cancer risk, though no significant change in cancer risk
- More cost effective and beneficial

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FUTURE WORK

Extend MPRB Efforts to Additional Areas

- Working to find 1 – 3 willing to partner to do MPRB analytics and planning for their SIPs and state/local risk reduction initiatives.
- Would demonstrate the applicability of the MPRB approach in other areas with different pollutants of interest, policy constraints, and geographical concerns (e.g., land use, meteorology, pollutant transport and chemical formation).
- State and local agencies would lead with EPA assisting with technical analysis, where appropriate.
- Technical work would be initial phase of multi-year effort to inform MPRB approach to AQ planning as part of their SIP processes for O3 and PM2.5.

Useful Data Improvements

Analytical component	Improvements
Emissions modeling	--Updated multi-pollutant control information and speciated emissions --Detailed local-scale emissions information (more refined temporally and spatially) --Explicit consideration of population susceptibility and vulnerability in control scenario development
Air quality modeling	--Improved local scale modeling techniques
Exposure assessment	--Perform exposure modeling
Health impact assessment	--Incorporate spatially resolved baseline health data for a wider array of health endpoints
Risk characterization	--Integrated characterization of criteria pollutant and air toxics risks

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APPENDIX

Control Strategy Selections

"Status Quo"

Area Sources

- Residential Wood Combustion
  - Education & Advisory
  - Trade-out for NSPS compliant stoves
- Charbroiling (ESP for Commercial Cooking)
- Solvent usage and Consumer/Commercial Products (reduce emissions)
- Autobody refinishing (Education and Training Program)

Point sources

- Coal washing for Trenton Channel (EGU)
- EGU's (coal washing, CEMS upgrade & ESP)
- Cement manufacturing (CEMS upgrade & fabric filter)
- Steel Mills (CEMS upgrade)
- Chemical manufacturing (RTO)

Mobile Sources

- Reduce vapor fuel pressure

"Multi-pollutant, Risk-Based"

Area Sources

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  - Education & Advisory
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- Autobody refinishing (Education and Training Program)

Point sources

- Coal washing for Trenton Channel (EGU)
- Steel Mills (Fabric filter, ESP, Capture hood)
- Marathon Petroleum (Electrostatic Precipitator)

Mobile Sources

- Diesel retrofits
- OBD I/M

Example of MP Control Effectiveness

- EGU: Coal Washing

SO_2	$PM_{2.5}$	PM_{10}	Metal HAPS
35%	35%	45%	25-75%

- Autobody refinishing: Education & Training

Inorganic HAPS	Organic HAPS/VOC	PM_{10} & $PM_{2.5}$
92.0%	18.6%	92.0%

- Mobile Controls: Diesel Retrofits (Example Reductions)

$PM_{2.5}$	VOC	CO	Diesel PM
7.5%	0.5%	0.12%	13.7%

- Residential Wood Combustion: Education & Advisory

$PM_{2.5}$	SO_2	VOC	NO_x	CO
50%	50%	50%	50%	50%

"Status Quo" vs. "Multi-pollutant, Risk-Based":

Criteria Pollutant Emissions Changes

- Traded SO_2 reductions for direct $PM_{2.5}$ reductions
- Also controlled slightly more tons VOC
- NO_x and CO reductions (& air toxics) were co-benefit pollutant reductions

Pollutant	2020 Base (tons)	"Status Quo"		"MP, Risk-Based"		Total tons Difference
		Tons Reduced	% Change from Base	Tons Reduced	% Change from Base	
$PM_{2.5}$	31,485	1,747	6%	3,183	10%	+ 1,436
SO_2	187,525	10,297	5%	2,429	1%	- 7,868
VOC	104,872	5,814	6%	8,623	8%	+ 2,808
NO_x	118,432	31	0.03%	2,016	2%	+ 1,985
CO	424,426	1546	0.4%	64,187	15%	+ 62,641

"Status Quo" vs. "Multi-pollutant, Risk-Based":

Toxic Pollutant Emissions Changes

Pollutant	"Status Quo" Reductions (tons)	"MP, Risk-Based" Reductions (tons)	Total Tons Difference
Acetaldehyde	18.35	38.72	+ 20.38
Benzene	130.25	138.73	+ 8.84
1,3-Butadiene	41.52	13.19	- 28.33
1,4-Dichlorobenzene	15.28	15.28	No Change
Formaldehyde	19.16	44.50	+ 25.34
Methylene Chloride	1.63	0	- 1.63
Naphthalene	16.74	4.24	- 12.50
Manganese	0.86	8.50	+ 7.64
Cadmium	9x10-4	2x10-4	- 7x10-4
Nickel	0.19	0.05	- 0.14
Diesel PM	0	30.70	+ 30.70

MPRB > Reductions

SQ > Reductions