BAY AREA AIR QUALITY MANAGEMENT DISTRICT

Bay Area 2009 Clean Air Plan

Public Workshop

June 11, 2009

Workshop Overview

Purpose of this workshop: present **Multi-Pollutant Evaluation Method** (MPEM)

- Part 1: Intro & background
- Part 2: Explanation of methodology
- Part 3: Examples
- Part 4: Summary & wrap-up

Purpose of 2009 Clean Air Plan

- **Improve air quality**
- **Protect public health,** esp in impacted communities
- **Protect our climate**
- Legal impetus: update 2005 Ozone Strategy
  - Continue progress toward attaining standards
  - Reduce transport to neighboring air basins
  - Include all feasible control measures
- Coordinate CAP with transportation & land use plans
- What's new: address multiple pollutants in one plan

Multi-Pollutant Scope

- Existing approach: address each pollutant separately
- CAP: tackle multiple pollutants in one integrated plan
  - **Ozone precursors (ROG & NOx)**
  - **Particulate Matter (PM): both direct PM & PM precursors**
  - **Key Air Toxics**
  - **Key Greenhouse Gases: CO_2, methane, etc.**
- Many control measures reduce multiple pollutants
  - maximize co-benefits
  - identify and minimize trade-offs

Multi-Pollutant Challenges

There are significant advantages, but…

- Multi-pollutant (MP) planning is more complex
- Lack of guidelines or completed examples
- Pollutants differ in important ways:
  - sources, precursors, formation
  - range & severity of health effects
  - scale: local / regional / global
  - seasonal peaks: winter (PM) / summer (O_3)
  - timeframe: short-term v. long-term
- How to evaluate control measures on MP basis?

Purpose of MPEM

Use MPEM to help analyze control measures:

- Capture benefits across all pollutants
- Evaluate impacts on public health
- Quantify health & climate protection $ benefits
- Help evaluate trade-offs

Base MPEM on best available tools & data

Potential MPEM Applications

- Evaluate & compare individual measures
- Estimate benefit of control strategy as a whole
- Help guide priorities as to which pollutants we should focus on
- Estimate cost of overall air pollution burden in Bay Area: past, present, future
- Evaluate climate protection measures in terms of their impact on criteria air pollutants

A Few Caveats

MPEM does not:

- Perform emission reduction estimates
- Include all pollutants: subset of toxics & GHGs
- Fully capture all health effects:
  - only health effects that are well-documented
  - no synergistic interactions among pollutants
  - does not consider downwind benefits
- Consider other non-air quality benefits
- MPEM is Bay Area-specific

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Questions / Public Comment

Multipollutant Evaluation Methodology

Idea:

➔Estimate the effect of control measures on multiple pollutants

➔Start with estimates of a measure's emissions reductions (or increases) for each pollutant

➔End up with $ estimates of measure's benefits

Stages of Analysis

Ozone, PM, Toxics

ΔEmissions

⇩

ΔConcentrations

⇩

ΔExposure

⇩

ΔHealth effects

⇩

Δ$ benefits

GHGs

ΔEmissions

⇩

Δ$ benefits

Some Precedents

A number of studies have estimated the health benefits of reduced air pollution:

- South Coast AQMD: Benefits of air quality plan (ozone & PM2.5) (2008)
- CARB: Impacts from ports and goods movement (2006)
- EPA: Benefits and Costs of Clean Air Act (1999)
- BAAQMD: Benefits of reaching ozone and PM10 standards (1994)

Comparison with our methodology

Our approach based on established methods in the precedents described above.

What's new is that we are:

- Applying the method to compare benefits and tradeoffs for individual control measures
- Using sophisticated models to predict concentrations from emissions
- Including values for reductions in greenhouse gases and toxics

Key MPEM Inputs

- *Emission reduction estimates* for each control measure
- Gridded model estimates of *change in concentrations with change in emissions*
- Gridded *population estimates*
- *Health effects estimates* from external studies
- Local *baseline incidence rates* for health effects
- *Health effects valuation* from external studies
- *Valuation of GHG social costs* from ex. studies

Pollutants & Effects Considered

Ambient Pollutant	Effect
PM2.5	Range of health effects
Ozone	Range of health effects
Toxics: DPM, benzene, 1,3-butadiene, acetaldehyde, formaldehyde	Cancer
Greenhouse gases (GHGs)	Health, Environment & Economic Effects

Category	Emitted Pollutants		Ambient Pollutants
TOXICS	Benzene	→	Benzene
	1,3-Butadiene	→	1,3-Butadiene
	Formaldehyde	→	Formaldehyde
	Acetaldehyde	→	Acetaldehyde
OZONE	ROG NOx	→	Ozone
PM2.5	Ammonia NOx ROG	→	Ammonium Nitrate
	Ammonia SO_2 Sulfate	→	Ammonium Sulfate
	Carbonaceous PM2.5	→	Carbonaceous PM2.5

Stages of Methodology

#1) ΔEmissions

#2) ΔEmissions → ΔConcentrations

#3) ΔConcentrations→ΔExposure

#4) ΔExposure → ΔHeath effects

#5) ΔHeath effects → ΔEconomic Valuation

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#1) ΔEmissions

For a proposed control measure or rule:

- Estimate changes in:
  - Direct emissions: Carbonaceous PM2.5, sulfate, toxics, GHGs
  - Precursor emissions: NOx, ROG, SO2, Ammonia
- Estimate uncertainties in these emissions

#2) ΔEmissions ➔ ΔConcentrations

- Use ozone, PM, and toxics modeling to estimate how changes in emissions affect ambient concentrations:

➔Run model for base case and with 10% reductions in each emitted pollutant. Take difference.

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Example: Reduction in Benzene Concentrations from 10% reduction in emissions

#3) ΔConcentrations➔ΔExposure

- Match population with concentrations, grid square by grid square
- ΔExposure
  = Population-weighted ΔConcentration

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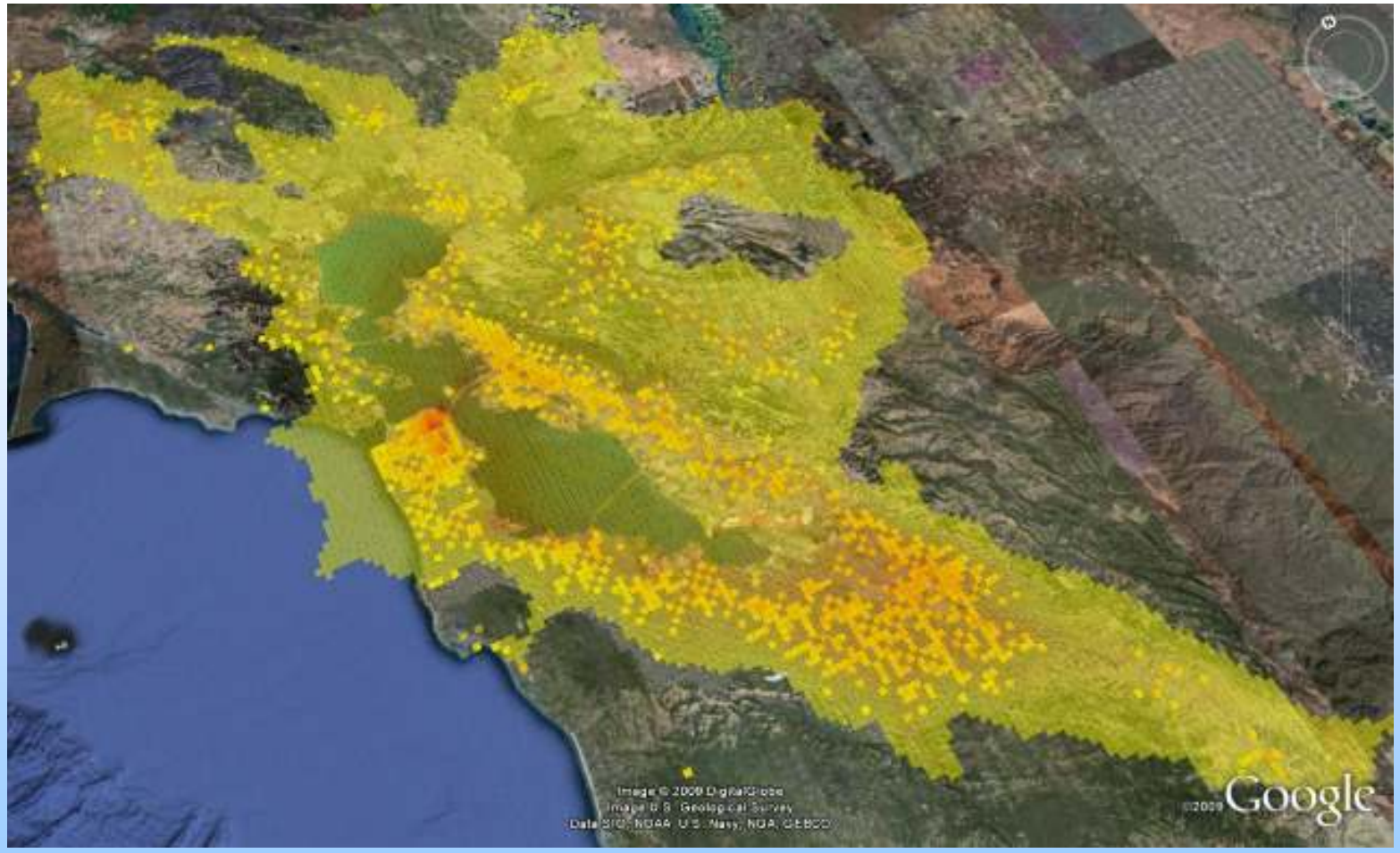
Example: Reduction in Benzene Concentrations shown with population



#4) ΔExposure ➔ ΔHeath Effects

- Effects from Ozone: Mortality, respiratory hospital admissions, asthma emergency room visits, restricted activity days, school absences

- Effects from PM2.5: Mortality, resp. & cardio. hosp. admissions, chronic and acute bronchitis, non-fatal heart attacks, respiratory symptoms, work loss days, restricted activity days

- Effects from toxics: Cancer death and morbidity

#5) ΔHeath Effects ➔ ΔEconomic Valuation

Two methods to value health effects:

- Willingness to pay (WTP) – use surveys to capture both direct & indirect costs
- Cost of illness (COI) - based solely on direct costs to treat the illness
- WTP preferred: "WTP will reflect all the reasons an individual might want to avoid a health effect, including financial and quality-of-life concerns."
- Use COI if WTP is not available

Examples (in 2009 dollars)

Health Effect	Valuation	Basis
Acute bronchitis attack	$534	WTP
Asthma emergency room visit	$468	COI
Mortality	$6.9 M	WTP

Putting it all together

- Computation for a given pollutant and health effect:

$ Benefit = Risk Function(ΔX)
* Population * Incidence Rate
* $ Cost Per Case

where Risk Function(ΔX) = change in incidence rate resulting from a change of ΔX in exposure.

Economic Valuation: GHGs

- Value of reductions = a dollar value per ton of CO2 equivalent reduced
- We're concerned about social cost, not market price
- GHG valuation is complicated:
  - Global in scale
  - Wide range of effects & costs (not just health)
  - Effects of today's emissions will be felt far into the future. How to value future benefits in current $$?
- We've chosen a value of $28 per ton of CO2-e based on meta-study by Richard Tol (2005/2008)

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Issues

- We assume that a rule's impact is spread uniformly (same as emissions inventory)
- We assume people are home & outside 24/7
- Ozone & PM modeling only from peak periods

➔ Need modeling representing full year

- Uncertainties at each stage:

➔ Working to develop a simulation method to quantify the uncertainties

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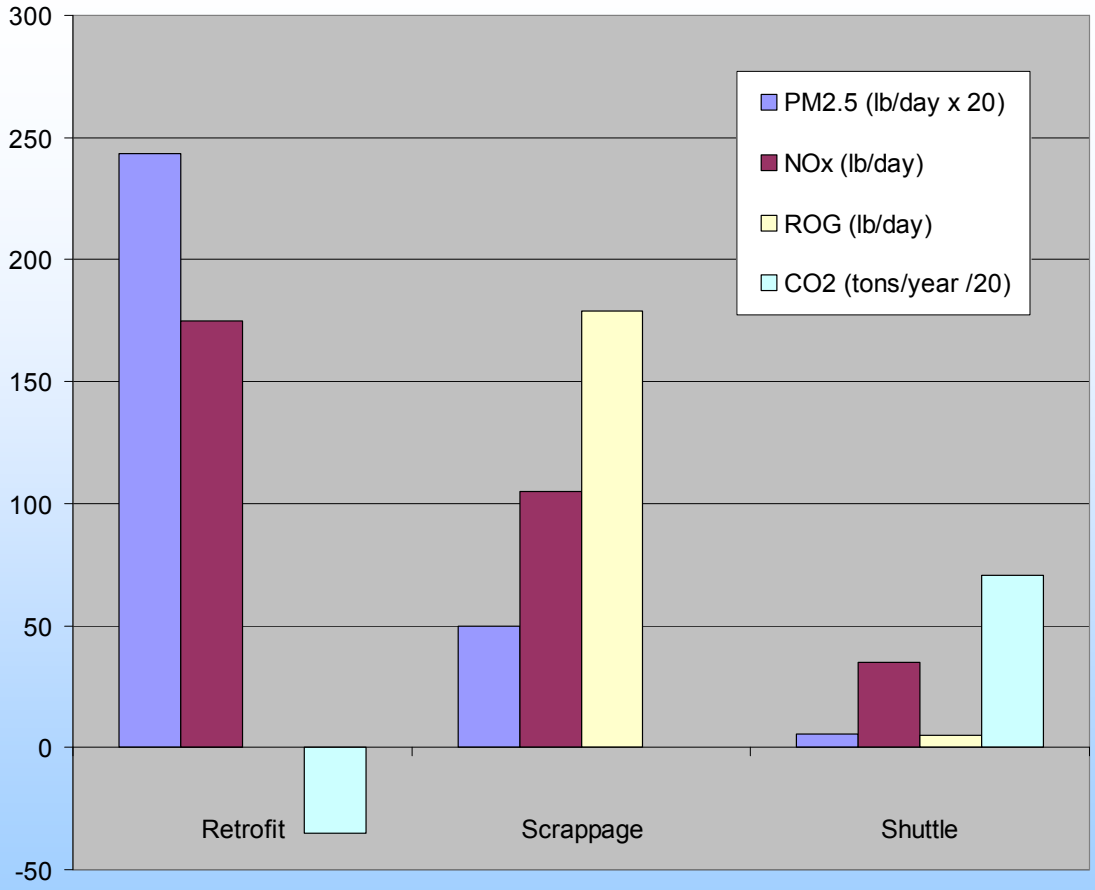
Example Application: 3 Ways to Spend $1,000,000

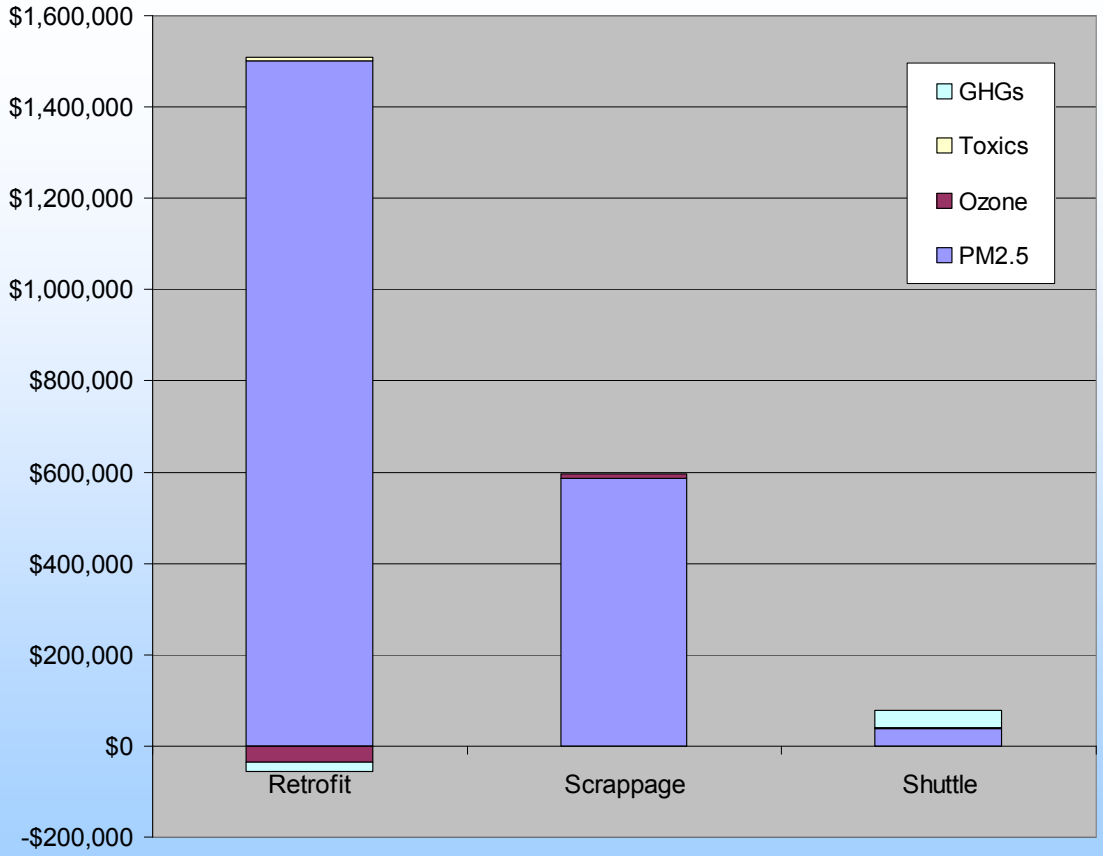
- Retrofit 40 HD trucks with PM & NOx controls:
  - Reduce PM by 85%, NOx by 25%
  - Assume MY 2005 trucks, driven 50,000 mi/yr
- Scrap MY 1989 vehicles via District's VBB program: 833 cars @ $1,200 each
- Operate shuttle program for one year:
  - 700 boardings/day; 20 mile commute length

Which option would provide the greatest benefit on a multi-pollutant basis?

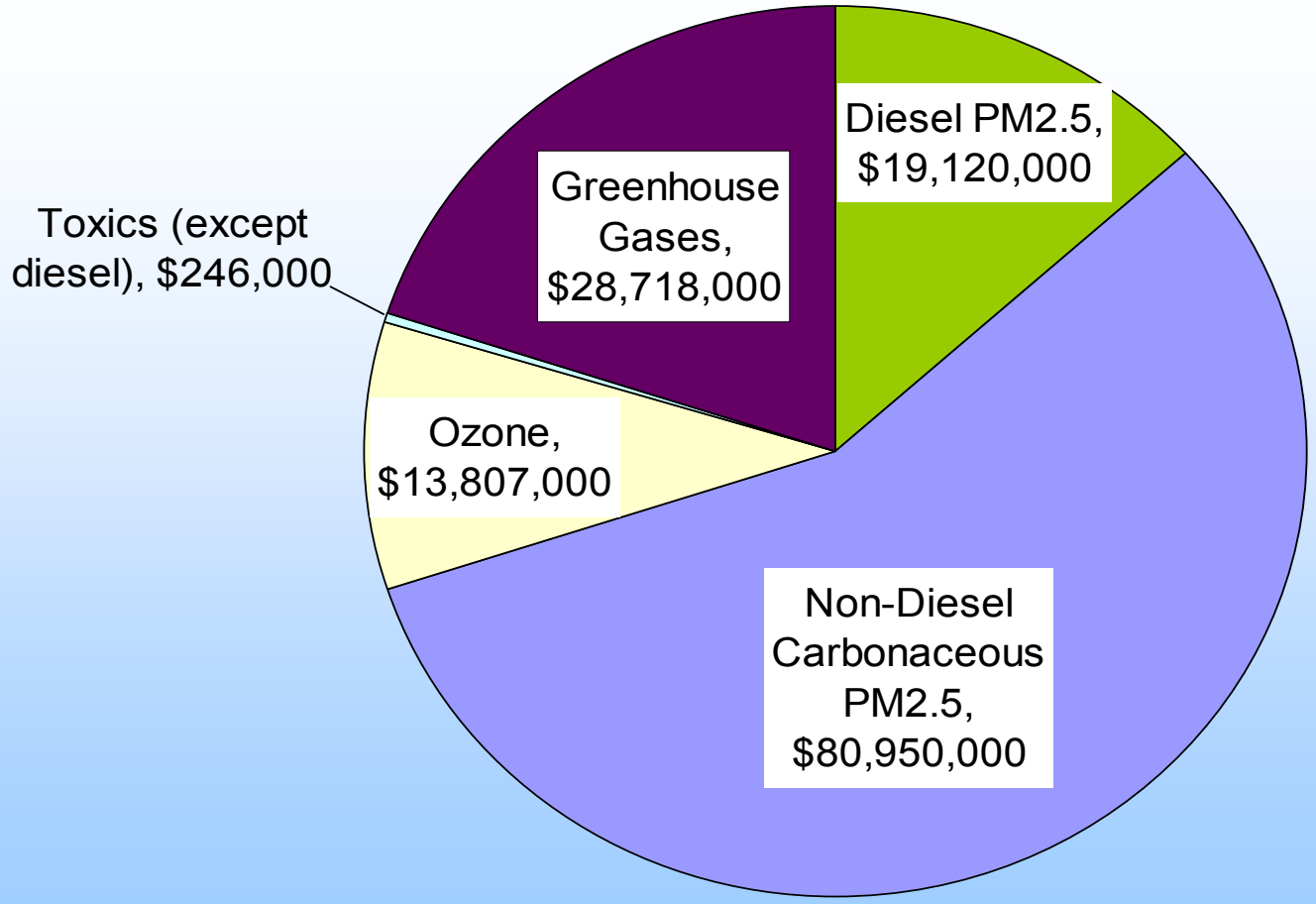
Emissions Reductions



Estimated Total $ Benefits



Benefits from 1% reduction in Bay Area Pollutants



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Some Potential Enhancements

- Base MPEM on full-year AQ modeling
- More realistic spatial distribution of emissions reductions – put reductions where they'll occur
- Refined exposure estimates:

  1) Have a sample of Bay Area residents fill out travel surveys
  2) Measure pollution in micro-environments (home, car, office, school, on street, etc.)

More Potential Enhancements

- Include more pollutants: acrolein, PAHs
- Include more health effects: toxics morbidity
- Address ecosystem impacts: water, species, etc
- Incorporate other impacts: mobility, safety, noise, reduced gasoline use, etc.
- Revise based on new info, e.g., differential effects of PM2.5 components, woodsmoke toxicity, ultra-fine particles

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Summary

- MPEM provides a means to evaluate measures on multi-pollutant basis
- Uses the best tools & data at our disposal
- Some simplifying assumptions had to be made
- Intended to help guide policy decisions
- Outputs should not be taken as precise #s
- Not the final word, but a big step forward

Take-away points

- PM2.5 is the key pollutant from public health standpoint
- Diesel PM is important, but so are wood smoke & other sources of fine PM
- GHGs are important as well, but it's tricky to compare value of GHGs relative to criteria pollutants

Next Steps on CAP

- Apply MPEM to help evaluate control measures
- Issue draft control strategy: by end of July
  - public workshop(s)
- Issue draft CAP: by end of September
  - CEQA doc & socio-economic analysis
  - public workshop(s)
- Adoption of CAP by Board: December 2009

Questions / Comments?

Bay Area 2009 Clean Air Plan website:

http://www.baaqmd.gov/pln/plans/ozone/2009_strategy/index.htm

David Burch

DBurch@BAAQMD.gov

415-749-4641