Emerging Air Quality and Health Science Interaction

Public Health and Air Quality Study of Fuel Additives

NARSTO Executive Assembly Meeting
Ottawa, Canada
May 9, 2006
Jim Vickery, US EPA
Emphasis on Diesel and Renewable Fuels

- Renewable fuels
  - Ethanol
    - 10% ethanol / 90% gasoline in use since 1978
    - 20% ethanol / 80% gasoline commonly used in Brazil desired by MN
    - Flexible fuel vehicles >> 85% ethanol / 15% gasoline
  - Renewable fuel standards requiring 7.5 Billion gallons of ethanol use by 2012 (up from 4.0 in 2006)
    - Treating fuel pool, emission, air quality impacts
  - Gasoline ether blends, Biodiesel, CNG, Hydrogen fuel cells

- Diesel and other air quality provisions:
  - Emission model improvements
    - fuel effects on emissions for 2007 fleet
  - Diesel truck, school bus retrofits
  - Aircraft Emissions
  - Locomotive engine partnership
  - Clean coal technology research
  - Hybrid vehicles
Study Health Effects and Air Quality of Fuel Additives

- Conduct a study on the effects on public health (including the effects on children, pregnant women, minority or low-income communities, and other sensitive populations), air quality, and water resources of increased use of, and the feasibility of using as substitutes for methyl tertiary butyl ether (MTBE) in gasoline

  - ethyl tertiary butyl ether;
  - tertiary amyl methyl ether;
  - di-isopropyl ether;
  - tertiary butyl alcohol;
  - other ethers and heavy alcohols, as determined by the Administrator;
  - ethanol;
  - iso-octane; and
  - Alkylates, and

  - ethanol-blended reformulated gasoline
Partial Response: Rely on Ongoing Integrated Risk Information System (IRIS) Assessments

- Timing of report (2 years) and resource constraints dictate using existing research
  - Much of it from others like API

- Prioritize based on additives likely to be used

- IRIS Assessments now underway for MTBE, Ethanol, ETBE
  - MTBE: well studied, can produce a RfC leading to projected risk assessment at census track level
  - ETBE: mostly unpublished animal studies
Study Health Effects and Air Quality of Fuel Additives

• Conduct a study on the effects on public health (including the effects on children, pregnant women, minority or low-income communities, and other sensitive populations), air quality, and water resources of increased use of, and the feasibility of using as substitutes for methyl tertiary butyl ether (MTBE) in gasoline
  - ethyl tertiary butyl ether; (IRIS)
  - tertiary amyl methyl ether; (IRIS)
  - di-isopropyl ether;
  - tertiary butyl alcohol;
  - other ethers and heavy alcohols, as determined by the Administrator;
  - ethanol; (IRIS)
  - iso-octane; and
  - Alkylates, and

  ---------------------------------

  - ethanol-blended reformulated gasoline
The Integrated Risk Information System (IRIS),

- An electronic database containing information on human health effects that may result from exposure to various chemicals in the environment.

- Collection of computer files covering individual chemicals. Files contain descriptive and quantitative information on:
  - Oral reference doses and inhalation reference concentrations (RfDs and RfCs, respectively) for chronic noncarcinogenic health effects.
  - Hazard identification, oral slope factors, and oral and inhalation unit risks for carcinogenic effects.

http://www.epa.gov/iris/intro.htm#ref
Source-Exposure-Dose-Effects Continuum

- **Source / Stressor Formation**
  - Chemical
  - Physical
  - Microbial
  - Magnitude
  - Duration
  - Timing

- **Transport / Transformation**
  - Dispersion
  - Kinetics
  - Thermodynamics
  - Distributions
  - Meteorology

- **Environmental Characterization**
  - Air
  - Water
  - Diet
  - Soil & dust

- **Exposure**
  - Pathway
  - Route
  - Duration
  - Frequency
  - Magnitude
  - Activity Patterns
  - Individual
  - Community
  - Population
  - Statistical Profile
  - Reference Population
  - Susceptible Individual
  - Susceptible Subpopulations
  - Population Distributions

- **PBEK Models**
  - Transport, Transformation & Fate Models

- **Early Biological Effect**
  - Absorbed
  - Target Internal
  - Biologically Effective
  - Molecular
  - Biochemical
  - Cellular
  - Organ
  - Organism

- **Disease**
  - Cancer
  - Asthma
  - Infertility
  - Edema
  - Arrhythmia
  - Enzymuria
  - Necrosis
  - etc.

---

Atmospheric Science

IRIS

**RESEARCH & DEVELOPMENT**

Building a scientific foundation for sound environmental decisions
EPA Air Monitoring Network

Toxicological Studies
Animal inhalation studies, cell biology & real time telemetry measurements in rodents

Clinical Studies
Human inhalation studies; Cardiopulmonary testing; in vitro exposure facilities

Epidemiological Studies
Acute / chronic & panel epidemiologic studies; biomarker development; imputation of exposures

Emission Source Characterization
Source emission profiles for source attribution in ambient fine PM. Validate multi-pollutant controls.

Exposure, Atmospheric Measurement & Modeling, and Source Apportionment
Exposure characterization; receptor modeling tools to assist regulators identify and effectively target sources

Concentrator (CAPs)
Supplemental Approach: Begin Research and Assessment Effort

Report likely to point to research need.

- **Effects**
  - Many additives not in the IRIS pipeline at present

- **Exposure**
  - IRIS produces dose-response, not exposure-dose –response
  - Human exposure based on census track modeling (1999)

- **Risk Assessment**
  - Prospective estimates, not retrospective studies

- **Air Quality**
  - Most additives not routinely monitored
  - Based largely on Mobile Source and Air Quality modeling that is under development
  - Not dealing with mixtures, adsorption, transformation products

- **Water Quality – Air Quality Interface?**
Linking specific sources or PM attributes to adverse health effects?

In-Vehicle North Carolina Highway Patrol Trooper study (COP Study)

- Measured in vehicle, roadside, and ambient air pollutants

- Evaluated pollution source signatures
  - Soil and Roads
  - Fuel Combustion
  - Stop and Go Traffic

- Found:
  - Pro-inflammatory & thrombotic(?)
  - HRV Changes: pre-arrhythmia(?)
  - Stop-and-go traffic pollutants appear to be the most potent.

Riediker et al., 2004
End of Briefing

Supplemental Slides
1999 Estimated County Median Ambient Concentrations
Benzene – United States Counties

Distribution of U.S. Ambient Concentrations

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Lowest in U.S. (0.063)</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>95</th>
<th>98</th>
<th>99</th>
<th>Highest in U.S. (4.93)</th>
</tr>
</thead>
</table>

County Median Ambient Pollutant Concentration (micrograms / cubic meter)

Source: U.S. EPA / OAQPS
1999 NATA National-Scale Air Toxics Assessment
1999 NATA: Non-Cancer Respiratory Hazard

Hazard Index: Respiratory
- 0 to 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- 1 to 2.5
- 2.5 to 5
- 5 to 7.5
- 7.5 to 10
- 10 to 25
- 25 to 50
- 50 to 75
- 75 to 100
- 100 to 250
- 250 to 500
- 500 to 600

RESEARCH & DEVELOPMENT
Building a scientific foundation for sound environmental decisions