Public Health Aspects of Ethanol use in Gasoline: Report to CT Legislature

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Background on DPH Evaluation

- Builds on Prior Evaluation:
  - NEIWPCC/NESCAUM, 2001 report
    - – main focus was ethanol as gw contaminant
- Focus of current DPH analysis – Does EtOH ……
    - 1. Cause the release of unique toxic chemicals into
    - the atmosphere or groundwater?
    - 2. Increase or decrease the release of existing toxic chemicals
    - into these media; and
    - 3. Increase or decrease public health risks associated with the
    - use of gasoline in Connecticut.

Framework for Assessment

- Gasoline emissions are toxic – must start with a baseline
- Comparison across gasoline blends:
  - 11% MTBE oxyfuel
  - Non-oxygenated fuel
  - 10% ethanol oxyfuel

Ethanol Impacts on Evaporative Emissions: ***Fugitives***

- Fugitive emissions from gas tank and fuel lines
    - Ethanol increases RVP
    - Would get more release of VOCs but:
        - RVP cap (7psi)
            - » prevents EtOH to increase fuel RVP above acceptable limits

Ethanol Impacts on Evaporative Emissions: ***Permeation***

- Permeation Emissions
  - Ethanol ↑s permeation of VOCs across hoses, seals
  - CRC studies (2004, 2006) - California conditions
    - modest increase – up to 3 g/d
  - Mitigating factors
    - Ethanol permeate 30% lower O_3 reactivity
    - Permeation currently a relatively small source of evaporative emissions (26%?)
    - As new cars come on line, permeation % may increase, but other fuel changes may also occur
    - Ethanol displaces more toxic constituents (BTEX)
  - Ongoing and new studies need to be evaluated

Ethanol Impacts on Evaporative Emissions: ***Continued***

- Earlier modeling studies by CARB (1999)
  - Ethanol in gasoline, no major effect on BTEX
    - Increased evap emissions balanced by replacement of other VOCs in the fuel
- Ethanol levels in atmosphere well below PH concern
  - Daily inhaled dose well below EtOH in glass of OJ
  - Actually monitoring data from high EtOH use areas (Brazil) support this

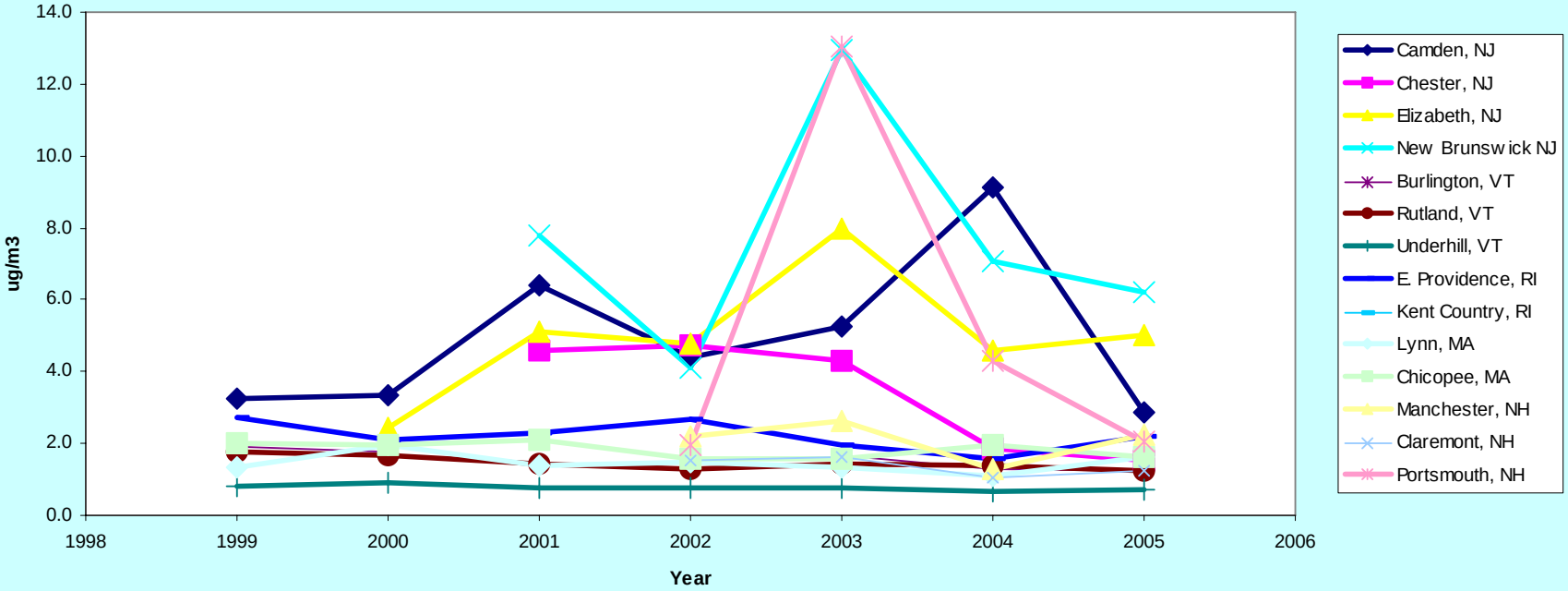
Ethanol Impacts on Exhaust Emissions: ***Aldehydes, PAN, Butadiene, NOx***

- Theoretical increase in:
  - Acetaldehyde – irritant gas from EtOH oxidation
  - Peroxyacetylnitrile (PAN) – irritant, byproduct of EtOH
  - NOx – irritant and ozone precursor, ↑ed from extra O
- Theoretical decrease in:
  - Formaldehyde – more toxic than acet; formed from MTBE
  - 1,3-Butadiene – carcinogen; ↓ due to more complete combustion

Possible Changes in Acetaldehyde

- CRC exhaust study suggest EtOH-10 doubles acet emission
- Modeling: thats only 12% ↑ in airborne acet
  - Many background acet sources
  - Acet short half-life in atmosphere
  - Monitoring data – Denver, Brazil support this
    - Data from E Htford 2003 vs 2005 support this
- Airborne levels below PH concern
  - Even for Asian descent – ALDH-2 polymorphism

Figure 5:
Trend in Acetaldehyde Concentrations 1999-2005
prepared by NESCAUM



Possible Changes in NOx

- CRC: possible NOx ↑ from EtOH-10
  - Variable finding, dependent upon fuel blend
- East Hartford Monitoring
  - Summer 2003 vs Summer 2005
  - 27% decrease in NOx – probably related to other reduction initiatives

Changes in Other Exhaust Emissions: 1,3-Butadiene, Formaldehyde, PAN

While theoretically possible, current evidence suggest the increases or decreases would be minor and difficult to document

Potential Change in Ozone

- Theoretical increase due to increases in:
  - VOC permeation
  - NOx exhaust emission
- VOC concern mitigated somewhat by
  - Lower reactivity of permeate emission
  - Major driver for O_3 is availability of NOx
- NOx concern mitigated somewhat by
  - Studies don't clearly show an E-10 ↑ relevant to CT

Ethanol in Groundwater

- Risk from Ethanol less than for MTBE
  - Breaks down faster in gw
  - Drinking water limit would be several times higher than for MTBE
  - Unlikely that EtOH is an impt gw pollutant
- Potential for Co-solvency Transport
  - High EtOH in gw can enhance plume transport
  - This is unlikely with E-10 fuel

DPH Summary Evaluation & Preliminary Findings

- A variety of changes in fuel-related emissions possible when using E-10
- Data directly relevant to CT not available
- Implications from Cal: changes relatively minor with no obvious impact on PH
- Does not appear that novel pollutants formed
- Groundwater not a significant concern
- More studies and updating of analysis needed