Urban Air Initiative PM Rule Comments
Attachment C

Cigarette Smoke PAHs' Link to Gasoline Exhaust PAHs Provides Scientific Justification for EPA to Improve Gasoline Quality Standards

GASOLINE EXHAUST PAHs & CIGARETTE SMOKE PAHs ARE LINKED

- Failure to synchronize fuel composition changes with vehicle hardware changes could inadvertently exacerbate one of the nation's greatest health threats: particle-borne PAHQ toxics
- The PAHQ (polycyclic aromatic hydrocarbons/quinones) toxics that coat fine, ultrafine, and are absorbed by black carbon particles are some of the same toxics found in secondhand cigarette smoke (SHS)
- The primary source of urban PAHQs is a set of gasoline compounds known as aromatics, or the BTX (benzene, toluene, xylene) Group, whose fused rings lead to incomplete combustion

PM IS NATION'S GREATEST HEALTH THREAT

- In March 2011, EPA projected that by 2020, 85% of $2+ trillion in savings from the Clean Air Act will come from reductions in particulate matter (PM)
- On 10/19/2011, EPA released a new version of its CMAQ model that will allow it to better measure "toxic components of particulate matter", esp. at the local level, e.g., near congested roadways
- EPA does not yet regulate the most pathogenic sub-group of PM, the much smaller UFPs, but scientific advances now enable such regulation
- Compared to other PM, UFPs are more pathogenic, due to their smaller size and larger particle numbers, larger content of reactive oxygen species, greater bioavailability, and greater lung retention http://www.particleandfibretoxicology.com/content/6/1/24/ref, pp. 6 - 7

UFPs ARE COATED WITH HARMFUL PAHQs (POLCYCLIC AROMATIC HYDROCARBONS + QUINONES)

- The gasoline BTX Group (BTX) includes low volatility, high boiling point/high double bond equivalency compounds that are a predominant source of both UFPs & PAHQs (see Honda 2010 SAE International paper, "Development of a Predictive Model for Gasoline Vehicle Particulate Matter Emissions", 2010-01-2115)
- Incomplete combustion of BTX Group compounds & PAH formation also occurs with cigarette smoke, which can damage human DNA http://www.businessweek.com/lifestyle/content/healthday/648898.html
- Quinones are oxidative derivatives of BTX Group compounds and more potent in inducing cell death [Nel, UCLA, 2004, "Particulate Hitchhikers Damage Mitochondria"]
- BTX Group compounds are thus largely responsible for both the carrier (UFPs and BC particles), and the carcinogen (PAHQs)
- California's OEHHA noted numerous parallels between secondhand smoke and gasoline exhaust emissions. They are both ubiquitous, present in low concentrations, have potential for high, intermittent exposure, and are carcinogenic http://www.oehha.ca.gov/public_info/pdf/GasOEHHA.pdf , p. 35

A MAJORITY OF AMERICANS ARE REGULARLY EXPOSED TO PAHQ-COATED UFPs & BC PARTICLES

- Tufts University researchers warned of the threat to the nation's most vulnerable sub-groups: "The most susceptible (overlooked) population in the US subject to serious health effects from air pollution may be those who live near very major regional transportation routes, especially highways. Policies that have been technology based and regional in orientation do not efficiently address the very large exposure and health gradients suffered by these populations. This is problematic because even regions that EPA has deemed to be in regional PM "attainment" still include very large numbers of near highway residents who currently are not protected. **There is a need for more research, but also a need to begin to explore policy options that would protect the exposed population."** http://www.ehjournal.net/content/6/1/23
- UCLA/USC researchers found that UFPs & PAHQs persisted for up to 1.5 miles from the freeway, 10 times farther than previously measured
- Environmental justice concerns include the fact that large portions of economically disadvantaged citizens live near congested roadways, and susceptible groups including the fetus, young, elderly, etc. are especially vulnerable to UFP/PAHQ emissions

PAHQ-COATED UFPs HAVE BEEN LINKED TO A MYRIAD OF DEBILITATING & COSTLY HEALTH CONDITIONS

- "Urban UFPs contain a higher content per unit mass of PAH, which are relevant organic constituents since they can induce oxidative stress and electrophilic chemistry in tissues after conversion to quinones…" [2009 Araujo and Nel, UCLA]
- New science indicates that PAH-bound UFPs are cytotoxic, genotoxic, and epigenic (endocrine disruptors), and that DNA damage can transfer to future generations
- Extensive epidemiological evidence links UFPs/PAHQs to mortality and morbidity from increased incidence of asthma, allergies, and other respiratory illnesses; cardiovascular disease; preterm births; a wide range of cancers; etc.
- UFPs are also among the most carbon intensive gasoline pollutants, and together with BC particles linked to PAHQs, are major contributors to U.S. GHG emissions

GASOLINE EXHAUST UFP/PAHQs ARE UBIQUITOUS & RESIST FILTERING

- There are no exhaust-free roadways, and no escape from UFP emissions, as they penetrate indoors (2009 UCLA study)
- UFP emissions are heaviest during cold start; start/stop; high speeds and heavy loads; and acceleration
- Gasoline UFPs are generally even smaller than diesel particles, so installing SIDI filters/traps would be cost prohibitive, and would compromise fuel efficiency and carbon reduction goals
- A 2009 American Heart Association study found that "Relatively low levels of fine particulate exposure from either air pollution or SHS are sufficient to induce adverse biological responses increasing the risk of cardiovascular disease mortality". ["Cardiovascular Mortality and Exposure to Airborne Fine Particulate Matter and Cigarette Smoke: Shape of the Exposure – Response Relationship", Pope, et al., AHA, Circulation 2009]

ADVANCED ENGINE DESIGNS ARE EXPECTED TO MAKE PARTICLE-BORNE PAHQ EMISSIONS WORSE UNLESS FUEL QUALITY IS IMPROVED

- Health Effects Institute's Fall 2011 newsletter: "Ultrafine particles…account for most of the particles in ambient air, though they contribute only a tiny fraction to mass…Concern has heightened recently, given evidence that UFP emissions might increase with greater use of gasoline direct-injection engines and other changes in fuels and technology."
- SAE papers from Honda, Ford, and other automotive experts cite the need for changes to fuel composition to complement advanced engine designs, specifically noting the direct linkage between the BTX gasoline compounds and increased UFP/PAHQ emissions
- Unless fuel composition changes are synchronized with vehicle hardware advances, one of the President's signature achievements—the new fuel efficiency and carbon reduction rules—could inadvertently worsen urban air quality and substantially increase health costs as the light duty vehicle fleet turns over during the 2012–2025 period