ATTACHMENT B

ACHIEVING SUBSTANTIAL REDUCTIONS IN URBAN AMBIENT PM, ULTRAFINE PARTICLES, BLACK CARBON, & TOXIC EMISSIONS BY IMPROVING GASOLINE QUALITY

1. Scientists and regulators have identified soot (also known as black carbon, or BC) as a major contributor to climate change and harmful global warming, accountable for as much as 30 – 40% of the rise in global temperatures. Nations are proposing aggressive remediation measures such as installing filters on diesel engines. http://www.nytimes.com/2012/02/18/opinion/a-second-front-in-the-climate-war.html?_r=2&nl=todaysheadlines&emc=tha211
2. In addition to its global warming effects, press reports have identified BC as "perhaps the most deadly widespread air pollutant." EPA has proposed a new rule, to be finalized in December 2012, to reduce the level of BC from 15 micrograms per cubic meter to 12 – 13 micrograms. http://www.washingtonpost.com/national/health-science/epa-to-tighten-national-soot-standards/2012/06/14/gJQABYsPdV_story.html
3. In a recent draft report to Congress, EPA said that approx. 69% of all non-wildfire BC emissions in the U.S. originate from mobile sources. [Source: EPA Draft Report to Congress, 3/18/11, p. 4-11]. In that same report, EPA noted that: "For some gasoline vehicles, it should be noted that the introduction of new engine technologies…in recent model years has increased some BC/PM ratios… which may change the warming profile from these vehicles." [footnote 2, p. 2-33]
4. A recent Ford Motor study found that gasoline direct injection (GDI) vehicle exhaust PM is dominated by EC/BC, rather than organic carbon (OC), contrary to what EPA concluded in its 2008 Kansas City study which found that OC accounted for 80% of PM emissions. Ford explains this discrepancy stems from the differences between port fuel injection (PFI) and GDI engine technologies. [Source: "The Impact of Ethanol Fuel Blends on PM Emissions from a Light-Duty GDI Vehicle," Maricq, et al., Aerosol Science and Technology, 2012, 46.5, 576-583, p. 582]
5. Contrary to EPA's conclusions in its draft report on BC to Congress, numerous experts have concluded that spark ignition gasoline-powered engines are a larger source of urban BC emissions compared to diesel engines (96% of the U.S. vehicle fleet is gasoline powered). In one recent study based upon CalTrans vehicle data, SI gasoline emissions were a factor of 8 to 10 greater than heavy duty diesel emissions. http://aaqr.org/VOL10_No1_February2010/6_AAQR-09-05-IR-0036_43-58.pdf, Table 1, p. 46
6. In a December 2011 PM study for its LEV III rule, CARB stated "recent studies show that gasoline engines also play a key role" in PM emissions, and that EC/BC "dominates PM". http://www.arb.ca.gov/regact/2012/leviighg2012/levappp.pdf, p. 88, p. 11, Fig. 4
7. BC and polycyclic aromatic hydrocarbons (PAHs, which are oxidative derivatives of gasoline aromatics, byproducts of incomplete combustion of the fused aromatic rings, and found in both gaseous and particulate phases) are major threats to both climate and human health. PAHs are often used as markers of BC using radiocarbon techniques. http://www.nrs.fs.fed.us/pubs/jrnl/2010/nrs_2010_shrestha_001.pdf
8. "Contrary to the perception diesel vehicles are the main vehicular source of PAHs, light-duty gasoline vehicles have been found to be the most important source of PAH emissions in some urban areas." BC has high porosity and a large surface area, and thus easily adsorbs the carcinogenic and mutagenic PAHs, and transports them to the lungs and organs. http://earthjustice.org/sites/default/files/black-carbon/jiang-et-al-2005-mexico-city.pdf, p. 3378
9. A May 2010 UCLA study presented to the American Association for Aerosol Research stated that "Taking into consideration that SI (spark ignition) engines constitute 96% of the estimated 28 million California vehicle fleet…reductions of NAP [naphthalene] from SI fuels may constitute

an effective means of reducing the emissions of a major SOA-forming precursor to the atmosphere of large urban centers."[1]

10. Ford tests found that E30+ clean octane blends reduced BC emissions by approximately 45%, and PN/PM emissions by 30 – 45%. [#4 Supra., p. 861] Emissions of other criteria pollutants, such as HC and NOx, were reduced by 20%.
11. CARB reports that each 2.5 X 10^{12} of particle number emissions (SPN) equals approx. 1 microgram of EC/BC. http://www.arb.ca.gov/regact/2012/leviiighg2012/levappp.pdf, p. 125
12. Ford studies found that GDI vehicles fueled by E0 (gasoline with no ethanol) emit an approximate range of from 8 – 15 X 10^{12} per mile, and that E30+ blends reduce BC emissions by 45%. [#4 Maricq Supra., p. 579, FIG. 3]
13. American Lung Association officials have made it known they would prefer EPA's new soot rule to reduce BC levels to 11 micrograms/cubic meter from the current limit of 15 micrograms. http://green.blogs.nytimes.com/2012/06/14/e-p-a-proposes-crucial-rule-limiting-soot/
14. Consequently, based upon EPA, CARB, Ford Motor, and other citations listed above, a nationwide clean octane program could achieve a significant share of the EPA's targeted emissions of urban BC in a cost-effective, technologically proven, and consumer-friendly manner. A nationwide clean octane program based upon E30+ blends could reduce urban mobile source BC levels by up to 45%, and would save tens of billions per year in reduced health costs.

[1] "Reducing Polycyclic Aromatic Hydrocarbons (PAH) Content of Fuels: An Avenue to Reduce SOA Formation in Urban Centers?", Miguel, et al., UCLA, American Association for Aerosol Research, Abstract Number: 804, May 16, 2010.