



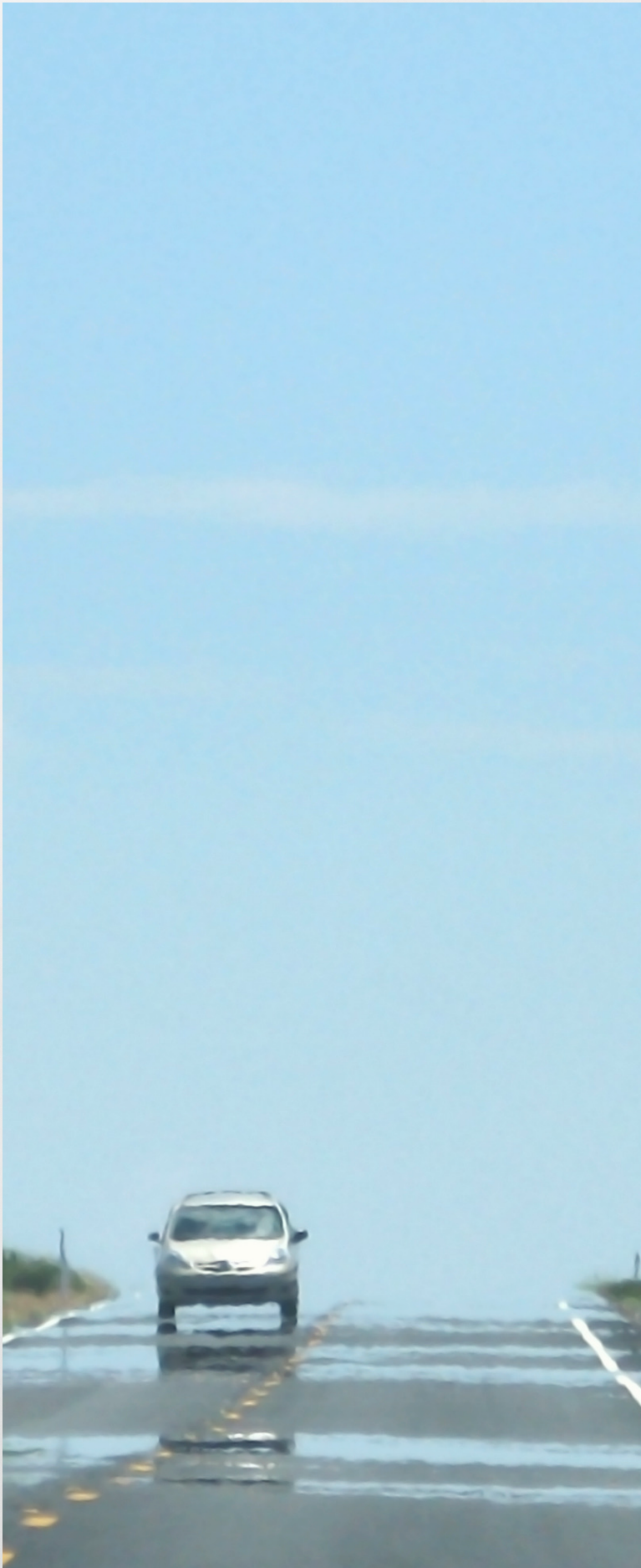
# FUELS TEAM

## SUMMARY: IMPACT OF FUEL ETHERS ON REDUCING VEHICLE PARTICULATE EMISSIONS

---

---

COMPARED TO  
OTHER OCTANE  
ENHANCING  
OPTIONS IN  
GASOLINE SUCH AS  
AROMATICS OR  
ETHANOL, HIGH  
OCTANE ETHERS  
ARE THE CLEANEST  
BURNING OCTANE  
ENHANCERS FOR  
REDUCING  
VEHICLE  
PARTICULATE  
EMISSIONS



# IMPACT OF FUEL ETHERS ON REDUCING VEHICLE PARTICULATE EMISSIONS.

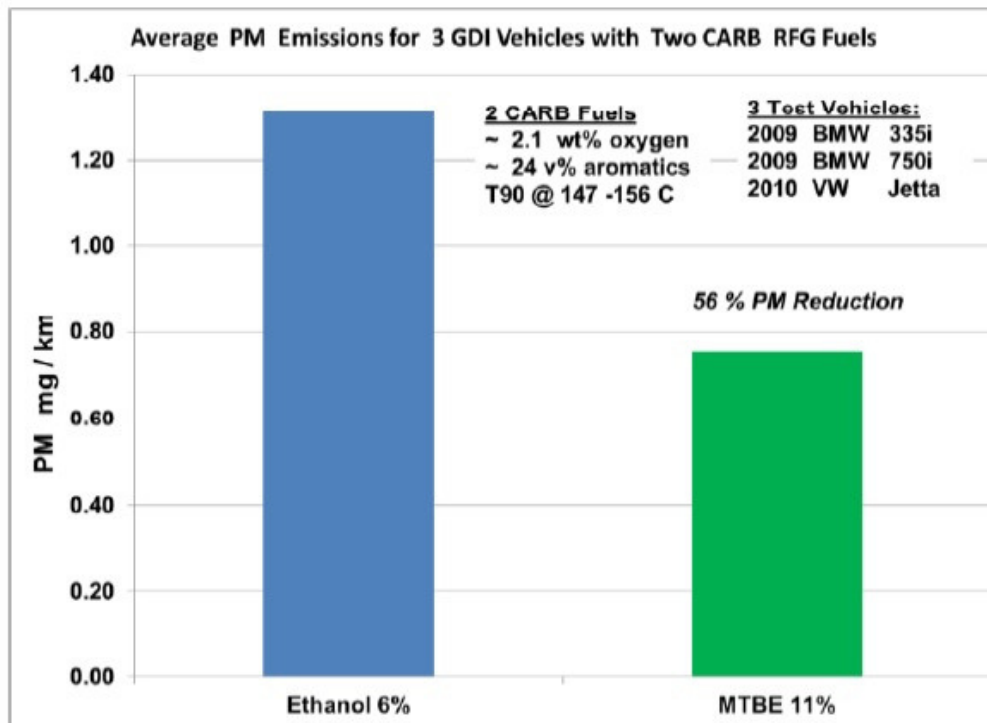
There is growing awareness and data to show that particulate matter is becoming one of the most significant pollution issues in Europe. This note highlights the positive impact that incorporating fuel ethers has on reducing PM emissions from vehicles.

Compared to using other octane enhancing options in gasoline such as aromatics or ethanol, the high octane ethers (such as MTBE and ETBE) are the cleanest burning octane enhancers for reducing vehicle particulate emissions mainly because of their very favourable vaporization properties of low boiling temperature and low latent heat of vaporization. Such favourable vaporization properties of the ethers in gasoline blending allow the whole distillation range of gasoline to vaporize completely during the engine's highest PM emission operating cycle (cold engine operation). Two separate vehicle emissions studies show that using 10% MTBE instead of aromatics or ethanol for adding octane in gasoline can reduce PM emissions from modern vehicles by at least 30% and possibly up to 50%.

## 1) California Air Resources Board

CARB (Calif Air Resources Board) evaluated the possible type of oxygenate effect on PM emissions in four vehicles as illustrated in Chart 1. As shown in Chart 1, the CARB Phase 2 Cert fuel made with 11%v/v MTBE produced significantly lower PM mass emission than the matched clean fuel made with 6%v/v ethanol which both provides 2.1 wt.% oxygen in gasoline. The other key fuel properties such as aromatic content and T90 were held relatively constant. The average PM emissions with the MTBE blend was about 50+ % lower than the matched ethanol blend. (Ref 1)

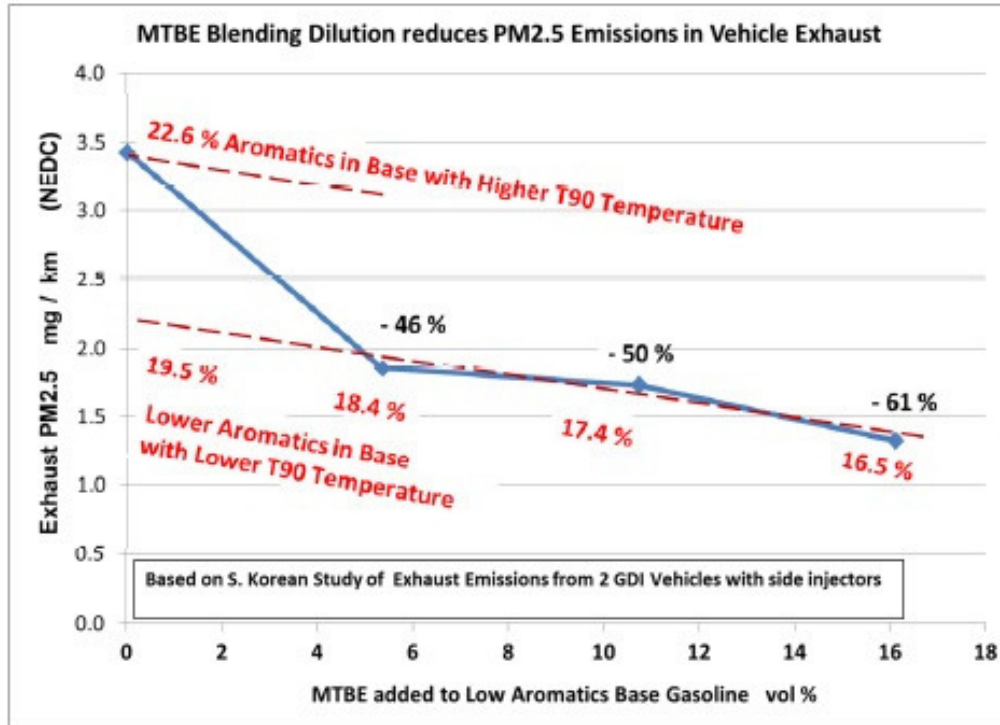
Chart 1



## 2) International Journal of Automotive Technology

A PM vehicle emissions study was conducted with increasing amounts of MTBE blending in the fuels using two GDI vehicles (EURO 5 emission equivalent vehicles). The average PM emissions results are shown in the following Chart 2. The MTBE blends appear to generate significantly less PM emission compared to the oxy-free base fuel. Much of the reduction can be explained by the cleaner base fuel that was possible to use thanks to MTBE high-octane properties which enabled a significantly lower aromatic content and a T90 temperature when compared to the base fuel. (Ref 2)

Chart 2



1 "REVIEW OF FUEL EFFECTS ON PM EMISSIONS," pg 88, APPENDIX P, LEV III PM, TECHNICAL SUPPORT DOCUMENT DEVELOPMENT OF PARTICULATE MATTER MASS STANDARDS FOR FUTURE LIGHT-DUTY VEHICLES, Staff of California Air Resources Board, December 7, 2011

2 "Influence of Oxygenate Content on Particulate Matter Emission in Gasoline Direct Injection Engine," Oh, C. and Cha, .G, International Journal of Automotive Technology, V.14, No.6 pp. 829-836 (2013)



# ABOUT FUEL ETHERS

FUEL ETHERS, INCLUDING MTBE, (BIO)-ETBE, TAME AND TAE, ARE KEY COMPONENTS FOR THE PRODUCTION OF HIGH OCTANE FUELS. THEY ARE THE CLEAN REPLACEMENT FOR COMPOUNDS THAT POSE A PROVEN RISK TO HEALTH AND THE ENVIRONMENT. WHETHER MANUFACTURED FROM TRADITIONAL HYDROCARBONS OR RENEWABLE BIOMASS, FUEL ETHERS ARE MORE ENERGY DENSE THAN ALCOHOLS. THEY THEREFORE INCREASE PETROL'S PERFORMANCE, WHILE REDUCING THE EMISSIONS OF AIR POLLUTANTS AND CO<sub>2</sub> ACROSS THEIR LIFE-CYCLE.

