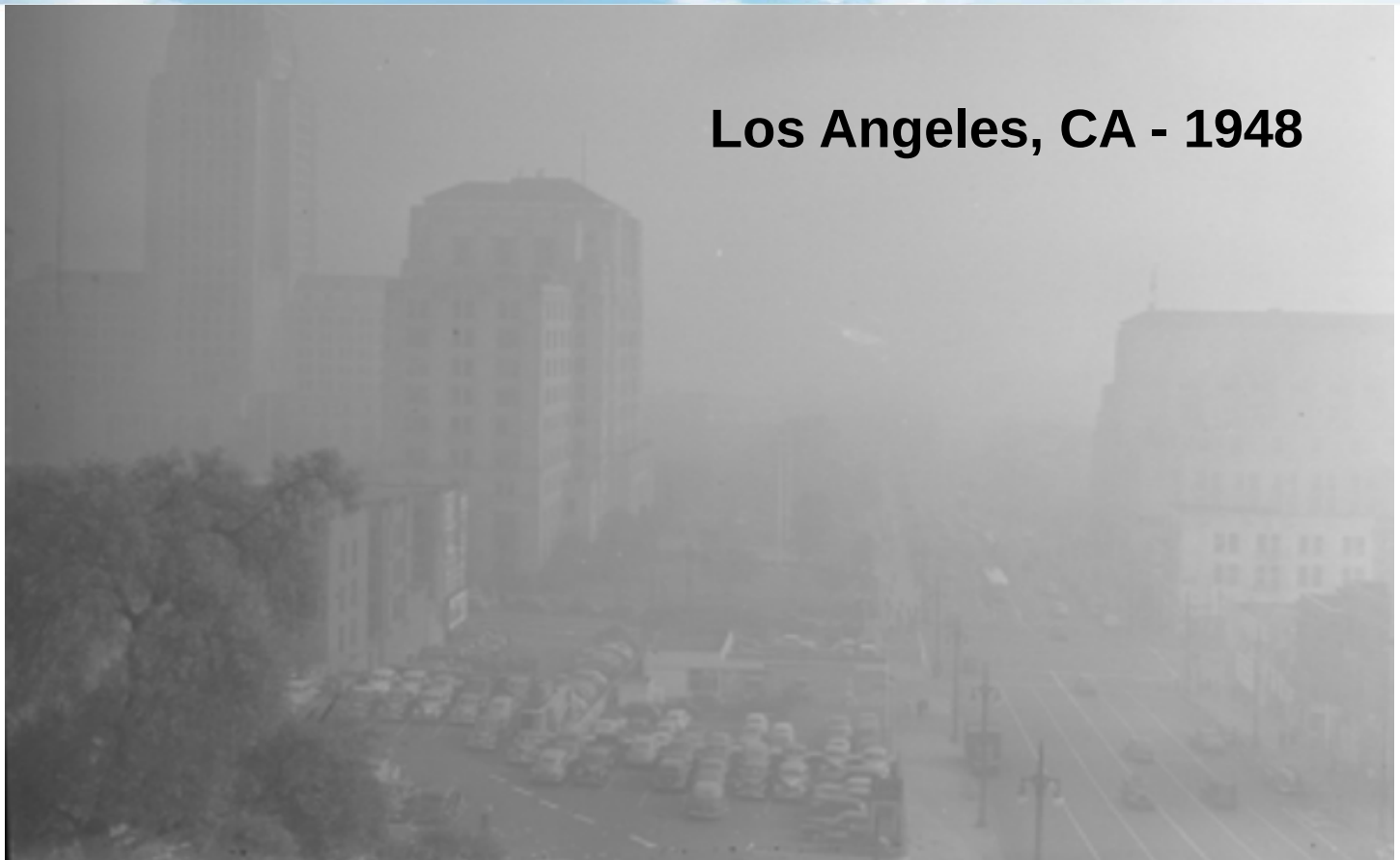
What Does It All Mean?

URBAN AIR INITIATIVE

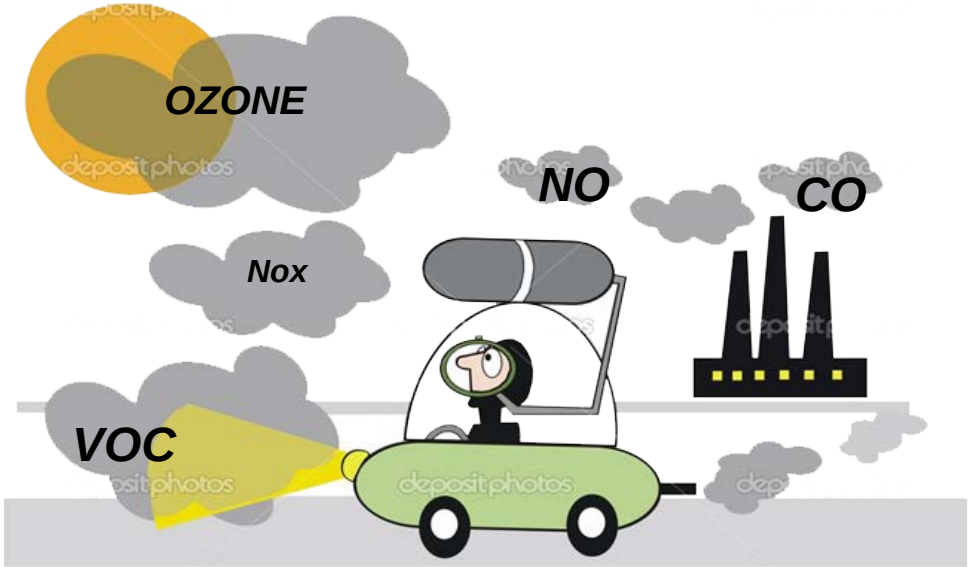
Sustainable?

URBAN AIR INITIATIVE



What is Creating Pollution?

URBAN AIR INITIATIVE



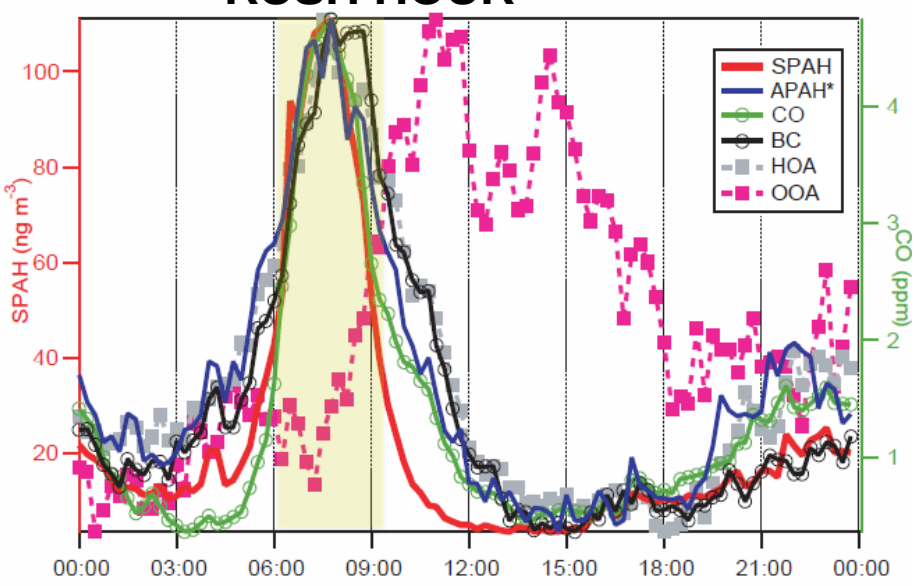
EPA has a mandatory duty to cut Mobile Source Air Toxics…"

-Clean Air Act § 202(*l*).

Mobile Source Air Toxics
Mexico City

URBAN AIR INITIATIVE

RUSH HOUR

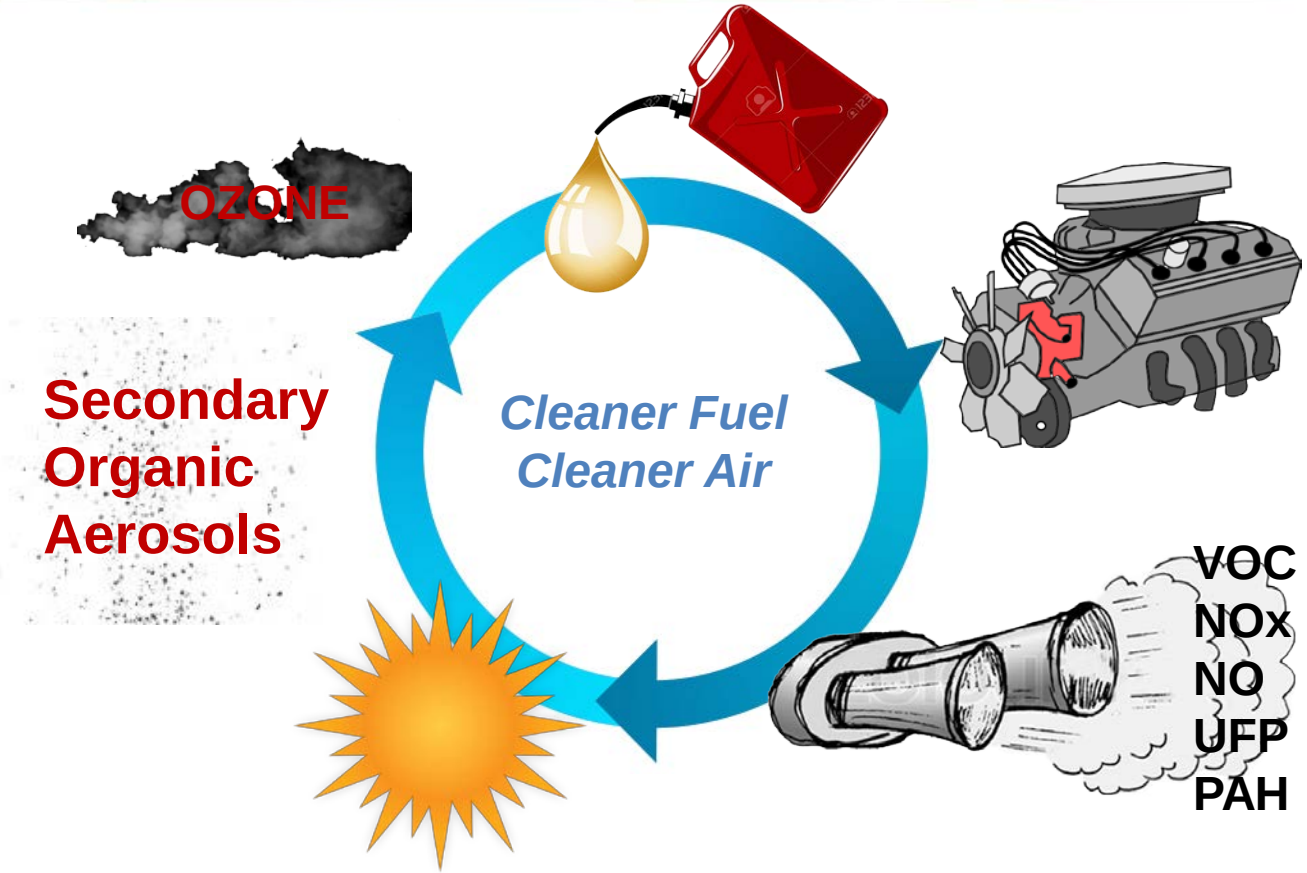


"…. motor vehicles are the major source of PAH [Polycyclic Aromatic Hydrocarbons]... responsible for 99% of CO emissions in the area."

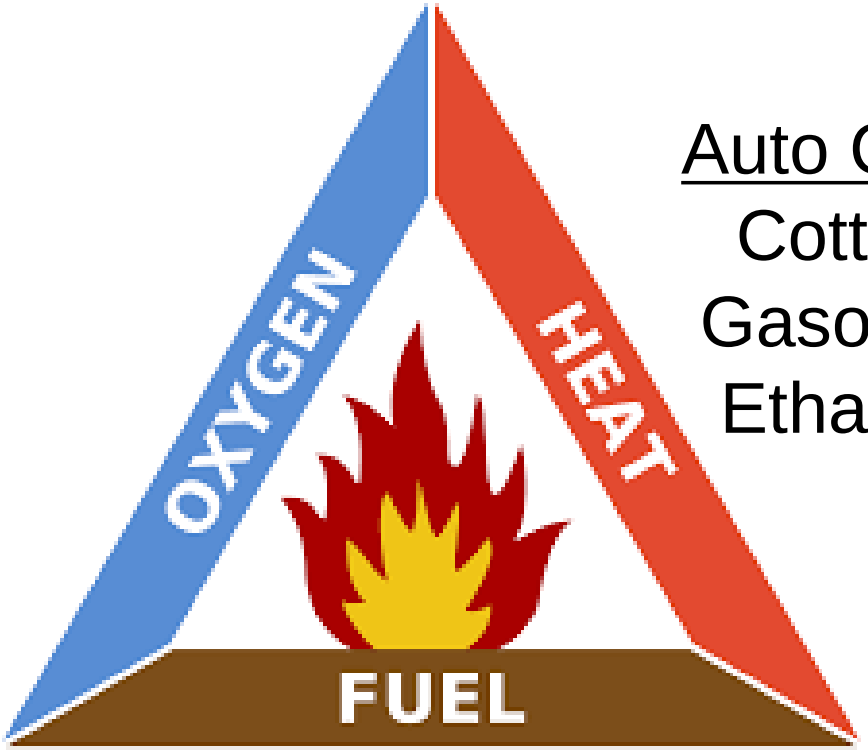
-Secretaria del Medio Ambiente, 2003, Atm. Chem. and Physics, 2006

It Starts with the Fuel

URBAN AIR INITIATIVE



Fire Triangle



Auto Combustion

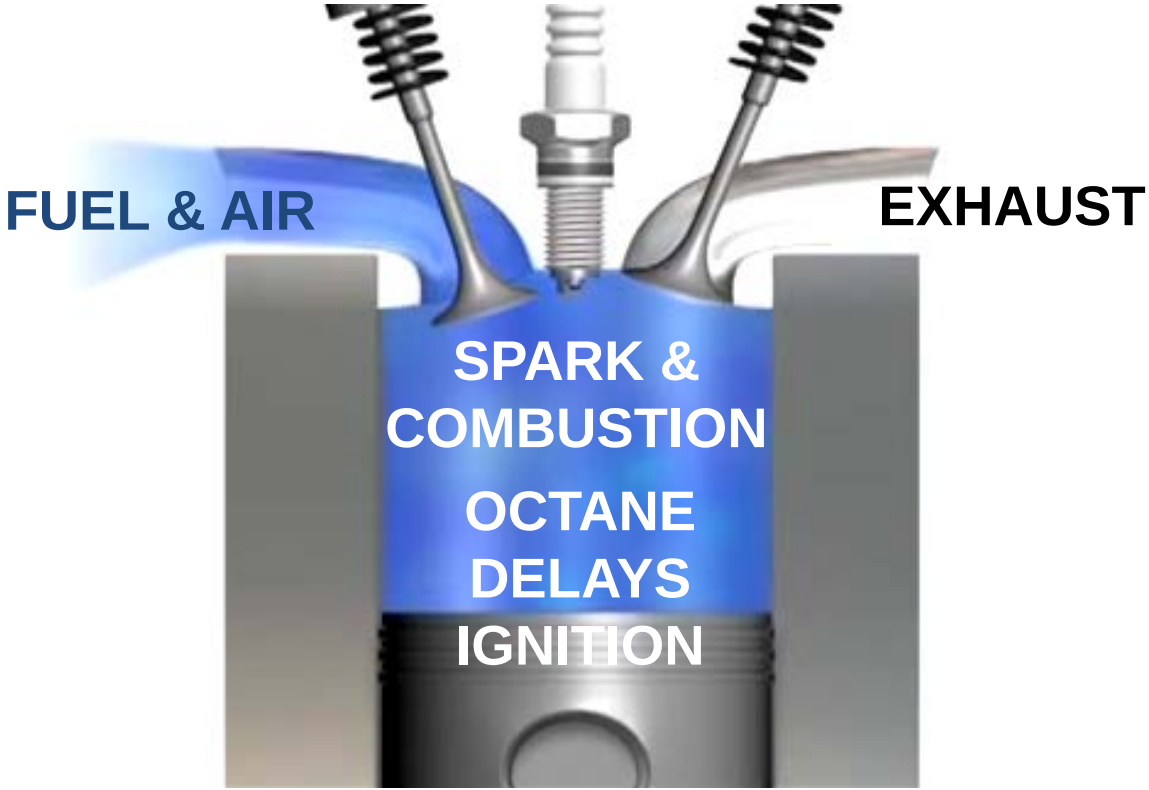
Cotton 205 ^{o}F

Gasoline 500 ^{o}F

Ethanol 700 ^{o}F

Combustion Inside an Engine

URBAN AIR INITIATIVE




2016 Chevrolet Colorado
(E30)
1946 Willys Jeep
(E10)
COLORADO

What's in Gasoline?

URBAN AIR INITIATIVE

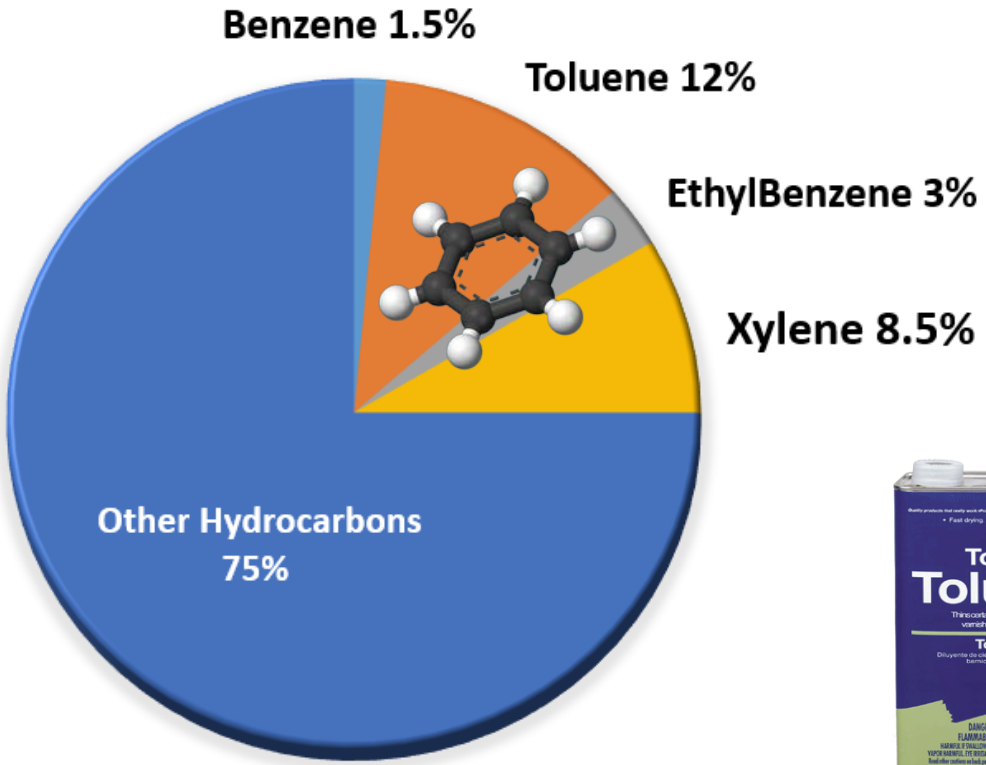
Benzene
Toluene
Xylene

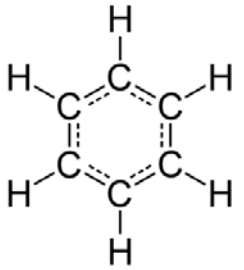
Aromatics
BTEX

Hexadiene, Dimethylhexene, Nonene, Octane, Decalin, 1,3-pentadiene, Tetrafluoroethane, Trimethylcyclohexane, Ethylidenebis-benzene, Trimethylnaphthalene, Dimethylcyclohexane, Isobenzofurandione, Pentadiene, Dinitronaphthalene, Dimethylphenanthrene, Hopane, Butane, Isobutene, Methylfluroene, Benzofuran, Dimethyl-1-hexene, Trimethylhexane, Dinitrophenol, Ethylcyclopentane, Trimethyltridecane, Dinitrofluroene, Ethylbutene, Hexanone, Methyl-phenyl-propene, Ethyloctane, Ethylheptane, Abietic acid, Acetic acid, Acetophenone, Ammonia, Azelaic acid, Sterane, Terpane, Cis-decalin, Cis-pinonic acid, Decanal, Decanoic acid, Decyclclohexane, Diethayl phthalate, Dimethyl dodecane, Docosane, Elaidic acid, Ethyl dimethyl benzene, Carbon tetrachloride, Cerium, Ethyl hexanol, Eugenol, Fluride, Formic acid, Furfural, Glutaric acid, Guaiacol, Henicosane, Heptanal, Heptanedioic acid, Heptylcyclohexane, Hexadecanoic acid, Hexadecane, Hexanoic acid, Icosane, Indanone, Isoamylbenzene, Isoeugenol, Lauric acid, Limonene, Maleic acid, Malonic acid, Methyl chloride, Methy dodecane, Octanal, Octanedioic acid, Octylcyclohexane,

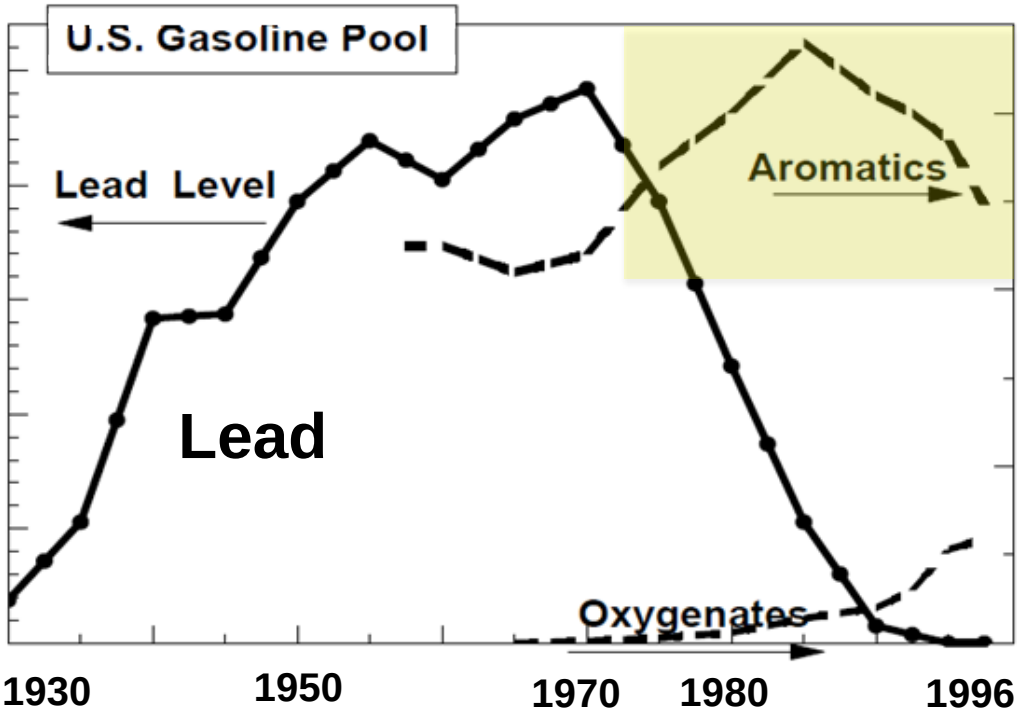
Aromatics in Gasoline
Ethanol Displaced 7.5M Gallons

URBAN AIR INITIATIVE





Aromatics and Octane

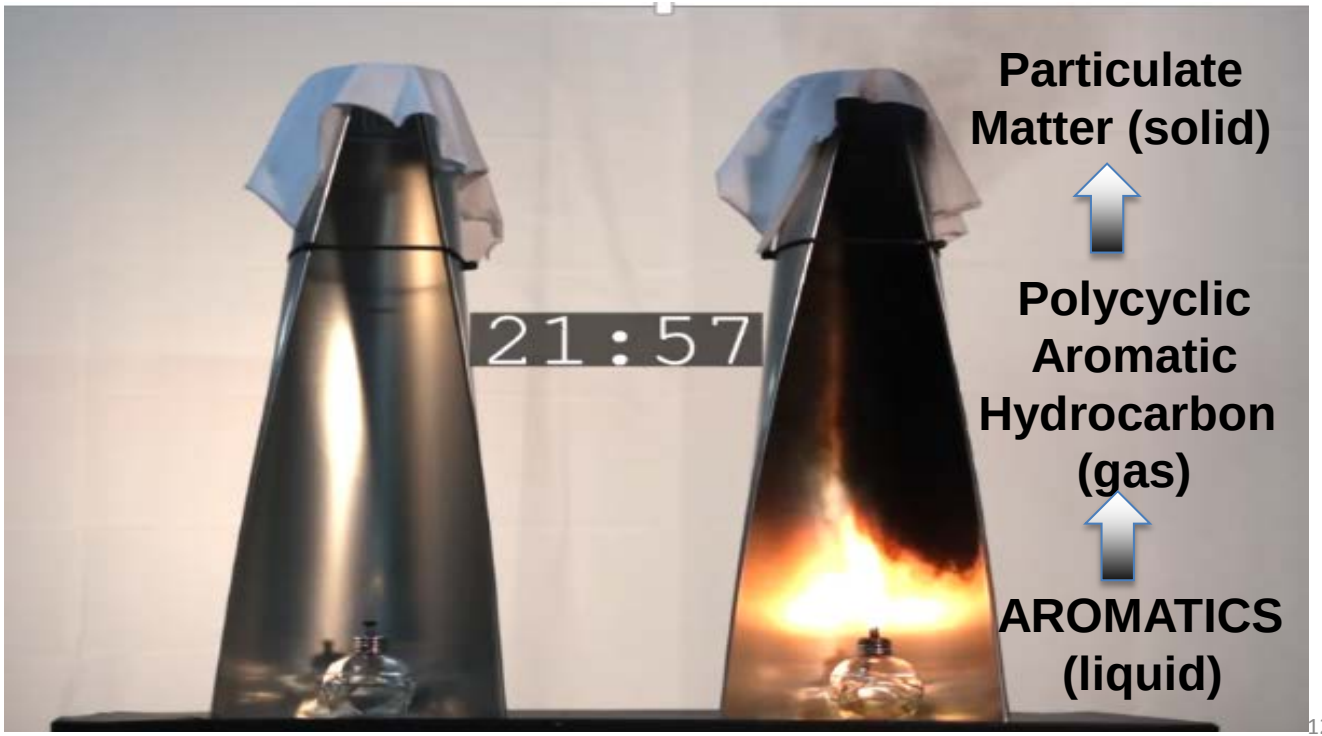


-William J. Piel, Lyondell Chemical Company, 1999

Incomplete Combustion
Goal is CO_2 and Water

URBAN AIR INITIATIVE

ETHANOL **GASOLINE**



Particulate Matter Causes Cancer

URBAN AIR INITIATIVE

- Particulate Matter (PM) classified as a class 1 carcinogen.

-International Cancer Agency 2013

Air Pollution causes cancer, confirms WHO

BY NALAKA GUNAWARDENE

Air pollution causes cancer, it is now medically confirmed.

The World Health Organization (WHO) has just classified outdoor air pollution as carcinogenic to humans.

Exposure to air pollution can cause cancer in lungs, and also increase the risk of cancer in the bladder, the International Agency for Research on Cancer (IARC), the specialized cancer agency of WHO, announced this week.

Close to a quarter million people already die every year from lung cancer caused by air pollution, WHO estimates.

In a statement, IARC said: "After thoroughly reviewing the latest available scientific literature, the world's leading experts convened by the IARC Monographs Programme concluded that there is sufficient evidence that exposure to outdoor

Depending on the level of exposure in different parts of the world, the risk was found to be similar to that of breathing in second-hand tobacco smoke.

"The air we breathe has become polluted with a mixture of cancer-causing substances," says Dr. Kurt Straif, Head of the IARC Monographs Section that ranks carcinogens. "We now know that outdoor air pollution is not only a major risk to health in general, but also a leading environmental cause of

provides an authoritative source of scientific evidence on cancer-causing substances and exposures.

IARC adds substances, mixtures and exposure circumstances to Group 1 only when there is sufficient evidence of cancer-causing ability (carcinogenicity) in humans. The Group 1 list – with definite links to cancer – now exceeds 100, and includes well known elements such as tobacco smoking, arsenic, asbestos, formaldehyde and ultraviolet rays in sunlight.

The link between tobacco smoking and lung cancer has long been established but now focus is on other cancer-causing air pollutants. In June 2012, IARC declared that diesel engine fumes can certainly cause cancer, especially lung cancer, and upgraded it to Group 1. Earlier, diesel fumes were in group 2A of probable carcinogens for over two decades.

"Classifying outdoor air pollution as carcinogenic to humans is an important step," says IARC Director Dr. Christopher Wild. "There are effective ways to reduce air pollution and, given the scale of the exposure affecting people worldwide, this report should send a strong signal to the international community to take action without further delay."

A basket term

Although the composition of air pollution and levels of exposure can vary dramatically between locations, the conclusions of the IARC Working Group apply to all regions of the world.

Air pollution is a basket term, which covers dozens of individual chemical compounds and particulates. These vary around the world due to differences in the sources of pollution, climate and weather. But IARC now confirms that the mixtures of ambient air pollution "invariably contain specific chemicals known to be carcinogenic to humans."

It is only in recent years that the true magnitude of the disease burden due to air pollution has been quantified. According to WHO, exposure to ambient fine particles contributed 3.2 million premature deaths worldwide in 2010. Much of this was due to heart disease triggered by bad air, but 223,000 deaths were from lung cancer.

More than half of the lung cancer deaths attributable to ambient fine particles are believed to have been in China and other East Asian countries.

In the past, IARC evaluated many individual chemicals and specific mixtures that occur in outdoor air

Vehicle exhaust emissions cause most of Sri Lanka's air pollution

- "Benzopyrene is considered as one of the most carcinogenic PAH's. …[and] are generally associated with particulate matter [PM]."

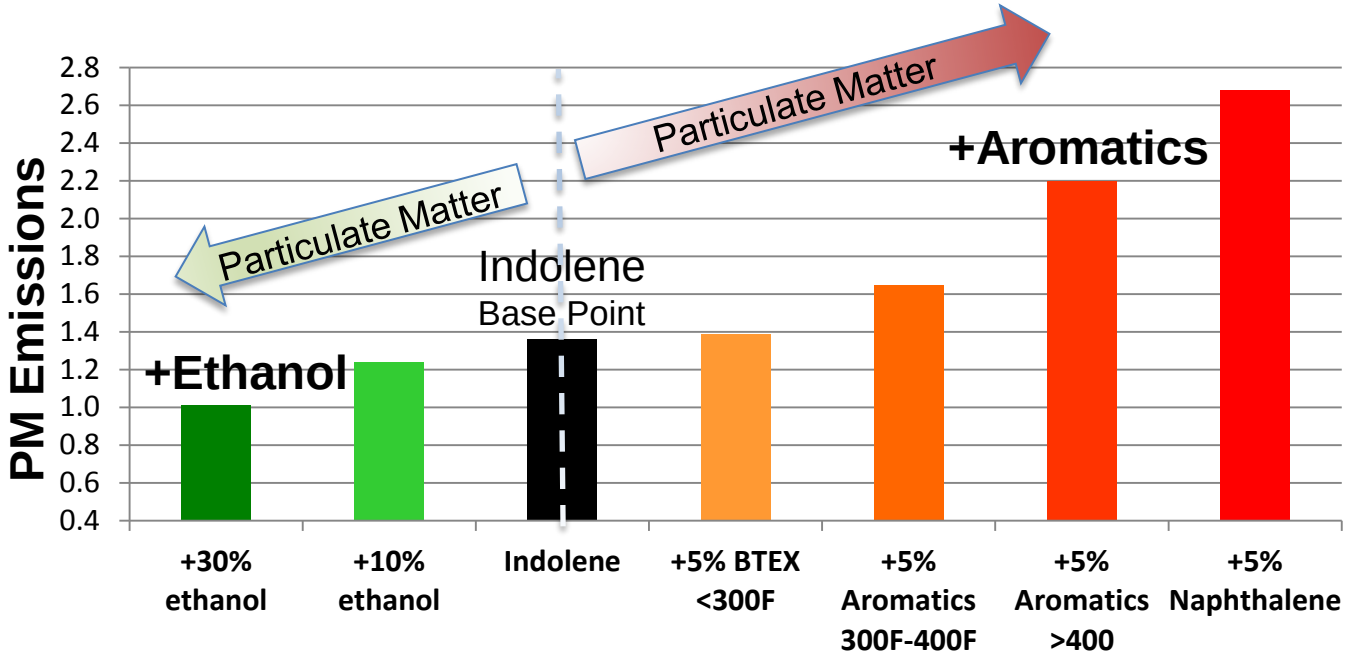
- Pol. J. Environ. Stud. Vol. 22, No. 2 (2013), 553-560

Aromatics Increase Particulate Matter

URBAN AIR INITIATIVE

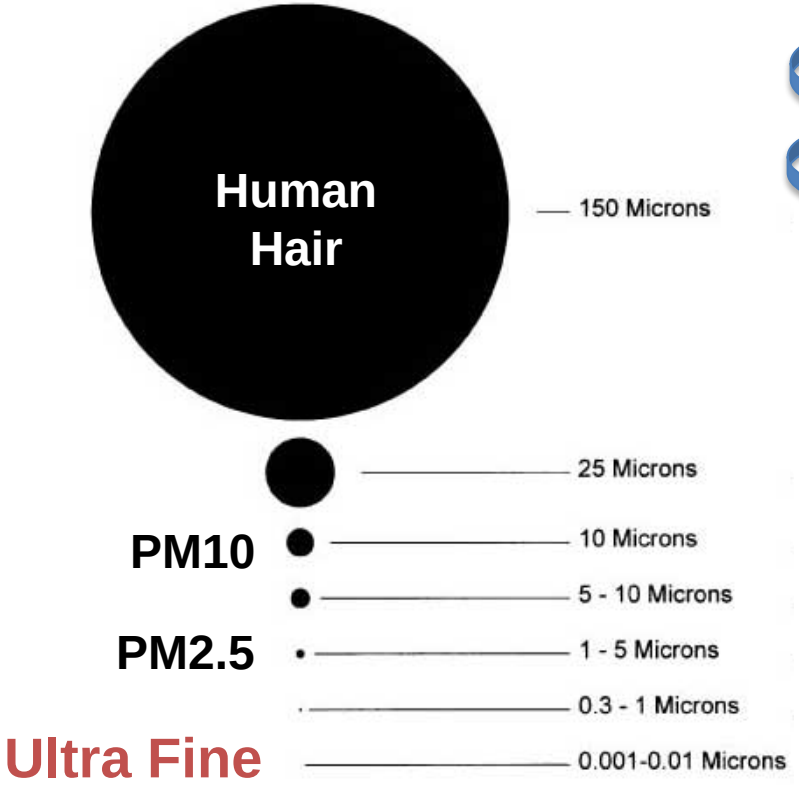
Honda's Predictive Model Index

indicates the potential of PM emissions - SAE 2010-01-2115



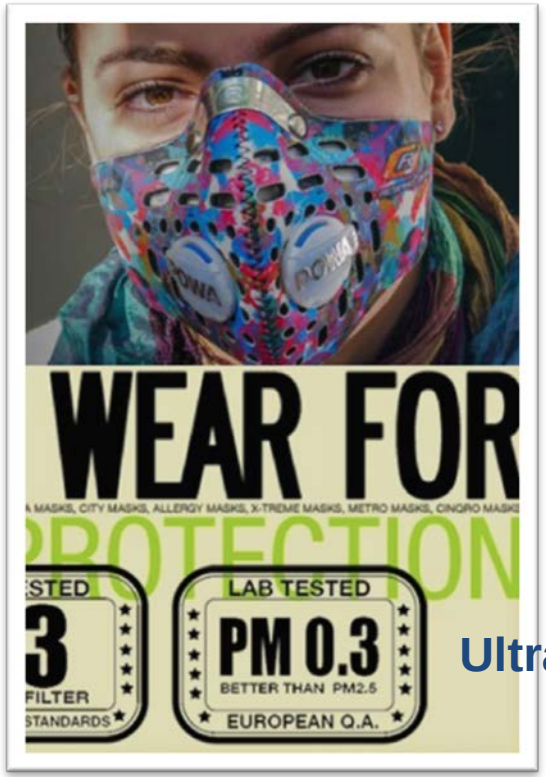
Aromatics Increase Ultra Fine Particles

URBAN AIR INITIATIVE



- Aromatics in Fuel (liquid)
- Aromatics in Exhaust (gas)
- Ultra Fines we Breath (solid)

Aromatics Increase Ultra Fine Particles

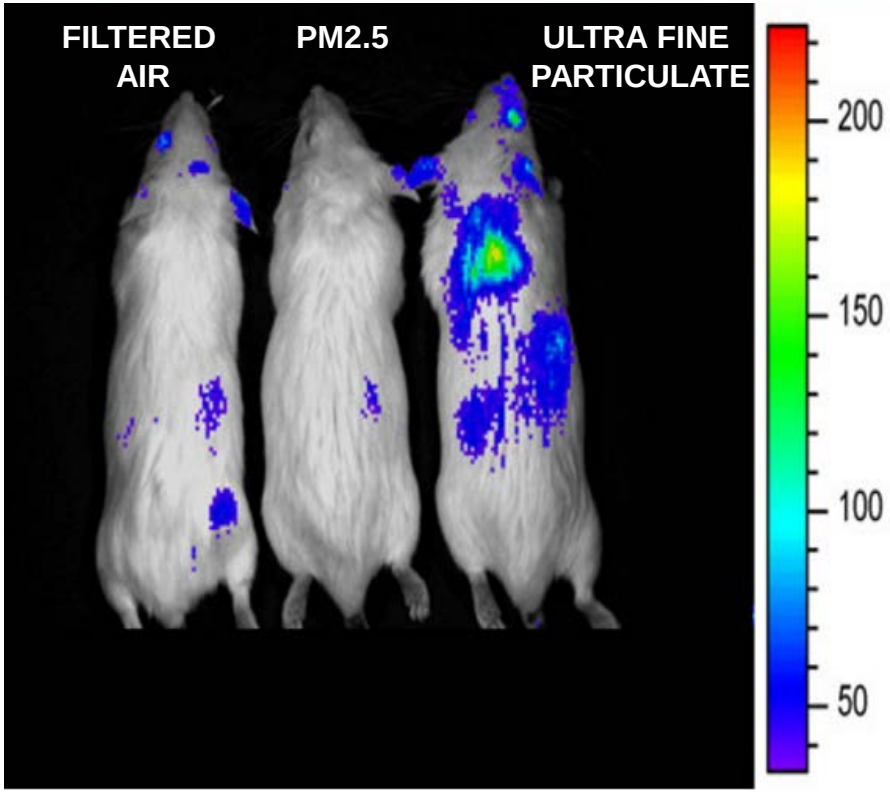


The particulate masks "will not help reduce exposure to gases and vapors such as ozone, sulphur dioxide and nitrogen dioxide." -3M

Ultra Fines are half this size

Aromatics Increase Oxidative Stress

URBAN AIR INITIATIVE



-Contag, (Stanford) Zhao, Vreman, Hajdena-Dawson, Wong, Stevenson, *J Mol Med2002,80(10):655–664. 10.1007/s00109-002-0375-x*

Mice exposed in Los Angeles Mobile Lab 300 meters away from the I-110 freeway.

"Urban Ultra Fines contain a higher content...of Aromatics, which…can induce oxidative stress..."

*-Barajas, Kleinman, Wang, Bennett, Gong, Navab, Harkema, Sioutas, Lusis, et al.: Circ Res2008,**102**(5): 589–596. 10.1161/CIRCRESAHA.107.164970*

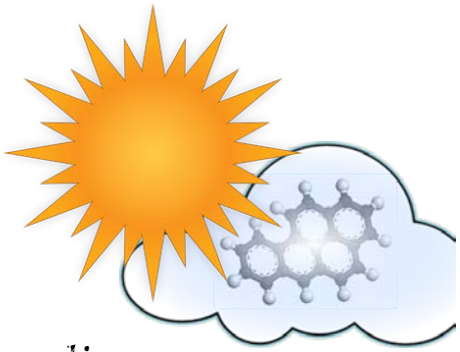
Aromatics Increase Secondary Pollution

URBAN AIR INITIATIVE

- "Limiting distillation temperatures and aromatic content are the most important parameters for controlling emissions…and build up of Combustion Chamber Deposits." *-William J. Piel – Lyondell Chemical Company 1999*

- "….The transformations of PAHs on particles have the potential to affect the particles' toxicity through the formation of species that are more toxic…." *-Sasaki et al., 1997, Atmospheric Chemistry, 2006*

- SOAs are a major component of fine particle pollution (PM.2.5)." *–EPA Website 2016*



- "…. PM2.5 formation potential of whole gasoline vapor can be accounted for solely in terms of the aromatic fraction of the fuel."

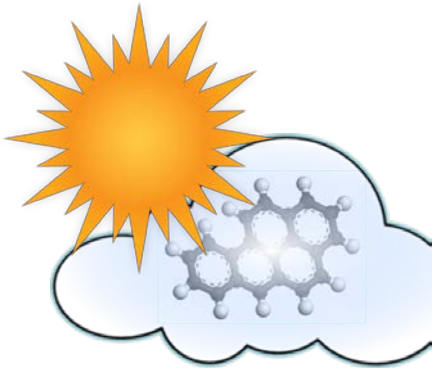
- Odum JR, Science. 1997;276:96–99

Ethanol Reduces Secondary Pollution

URBAN AIR INITIATIVE

VOCs – CARB MIR Reactivity Values

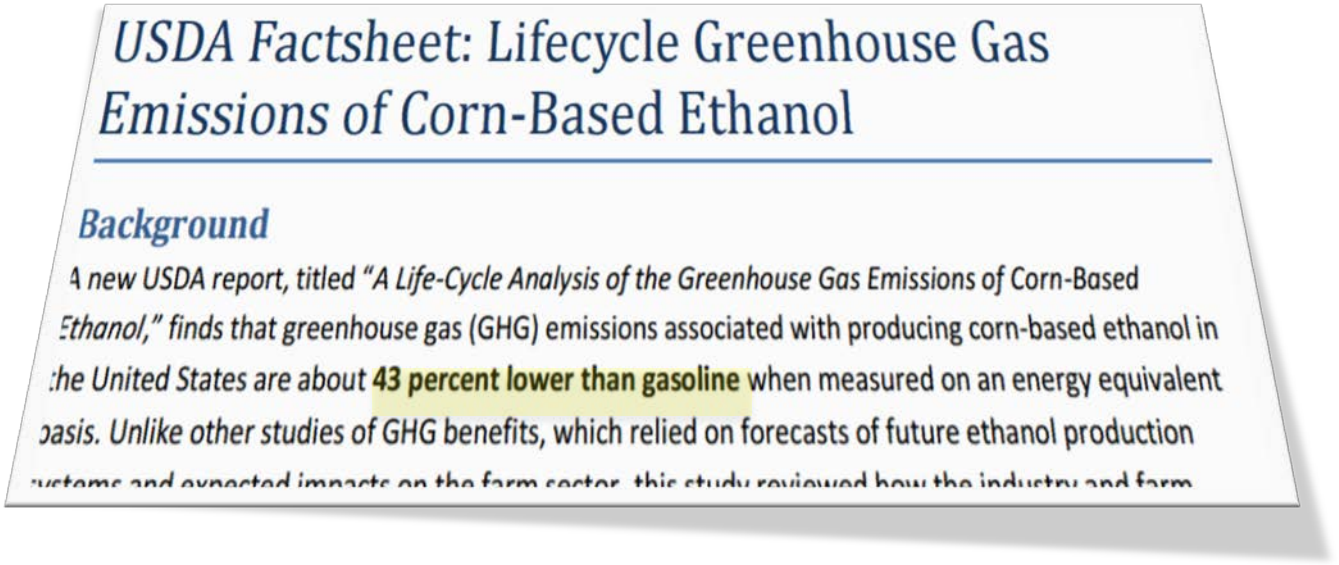
Ethanol	1.53
Ethyl Benzene	3.04
Toluene	4.00
p-Xylene	5.84
Unspeciated Aromatics	6.95
o-Xylene	7.64
m-Xylene	9.75



-University of California, Riverside 2010

Ethanol Reduces Green House Gas

URBAN AIR INITIATIVE



USDA Factsheet: Lifecycle Greenhouse Gas Emissions of Corn-Based Ethanol

Background

A new USDA report, titled "*A Life-Cycle Analysis of the Greenhouse Gas Emissions of Corn-Based Ethanol*," finds that greenhouse gas (GHG) emissions associated with producing corn-based ethanol in the United States are about **43 percent lower than gasoline** when measured on an energy equivalent basis. Unlike other studies of GHG benefits, which relied on forecasts of future ethanol production systems and expected impacts on the farm sector, this study reviewed how the industry and farm

Aromatics Increase Black Carbon

URBAN AIR INITIATIVE

- ..[Black carbon is a] component of Particulate Matter, and is formed by the incomplete combustion of fossil fuels…BC can absorb a million times more [sun] energy than carbon dioxide (CO_2). BC is a major component of "soot". – U.S. EPA Website 2016

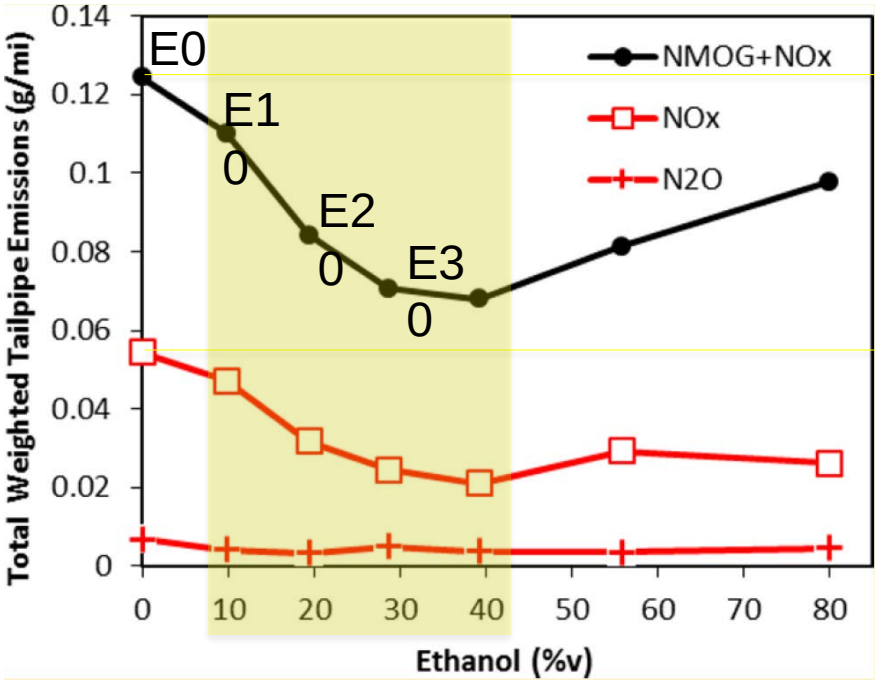
- This study showed Black Carbon increasing 350% from fuels with 15% aromatics compared to 35%. "Our results show that reduced aromatic concentrations are associated with reduced Particulate mass and reduced Black Carbon from Gasoline... Thus, increasing the ethanol fraction in gasoline could help to reduce climate and human health impacts attributed to particle emissions..."

- Riverside/Karavalakis – Durbin 2015

Ethanol Reduces Emissions

URBAN AIR INITIATIVE

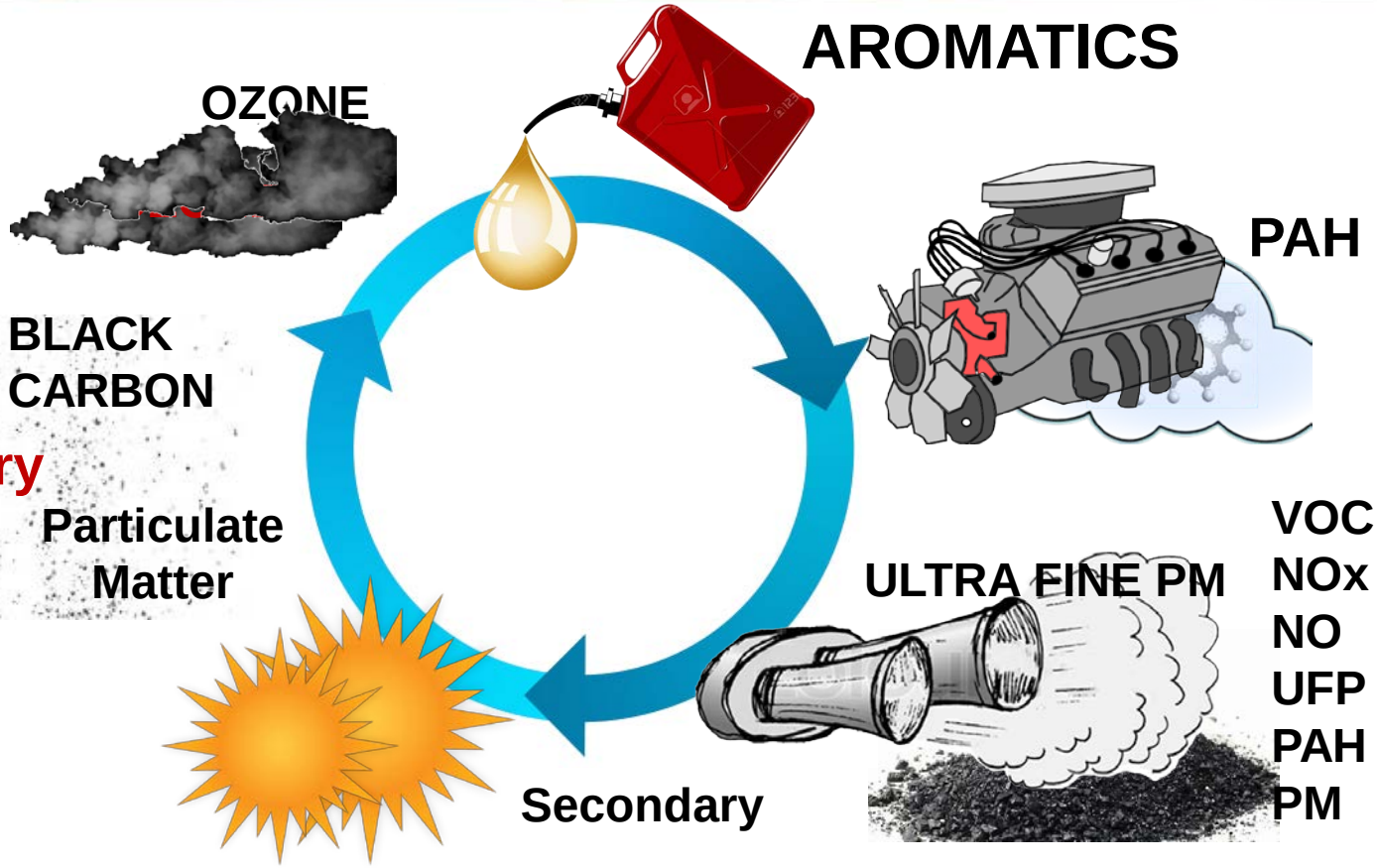
Primary Emissions



- Environmental Science and Technology 2013

Ethanol Reduces Aromatics

URBAN AIR INITIATIVE



Ethanol Reduces Pollution

URBAN AIR INITIATIVE