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Cleaner Fuels for Latin America with MTBE and ETBE Advanced Gasoline Components

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Fuel Ethers Are The Answer to Latin America's Energy & Air Quality Challenges

LyondellBasell has been a pioneer in the development of gasoline components based on tertiary butyl alcohol (TBA) . Since the 1970s, these components have been incorporated into gasoline to help meet increasing standards for cleaner burning fuels.

Further improvements in air quality and engine performance will require cleaner-burning fuels with lower metal, sulfur, and aromatic contents and improved compatibility with other gasoline components.

LyondellBasell offers methyl tertiary butyl ether (MTBE) and ethyl tertiary butyl ether (bio-ETBE) to improve fuel efficiency and air quality. Both MTBE and bio-ETBE are fully compatible with the existing fuel infrastructure in Latin America.

MTBE Delivers Cost-Effective Energy and Improved Air Quality

- Provides high octane & improved engine performance
- Provides formulation flexibility for refiners
- Helps lower gasoline sulfur & aromatic content
- Improves combustion to reduce tailpipe emissions
- Helps meet low vapor pressure standards to reduce fugitive emissions

ETBE is the First Choice for Renewable Bio-Fuels

- Provides 3 times more energy than ethanol*
- Contributes twice the octane value of ethanol*
- Replaces 10 vol.% more aromatics in gasoline*
- Does not absorb water, cause engine damage, or form azeotropes with gasoline components
- Reduces tailpipe hydrocarbon and PM emissions

*at the same oxygen specification

MTBE is the #1 Fuel Ether Globally and a Great Fit for Latin America

MTBE fits perfectly in the existing gasoline infrastructure in Mexico, Asia, Europe, and Latin America. MTBE can be blended directly at the refinery and shipped via pipeline or vessel to local terminals. No separate blending or transportation assets are needed, resulting in lower capital and logistic costs and air pollution.

Cost-Effective Energy & Octane

- High octane index
- High energy content vs. ethanol
- 8% more can be blended in fuel

Fuel Formulation Flexibility

- Zero sulfur
- Zero aromatics
- Low RVP = more butane

Available Globally

- Produced and used by PEMEX in Mexico
- Produced and traded globally
- New LyondellBasell capacity announced on the US Gulf Coast

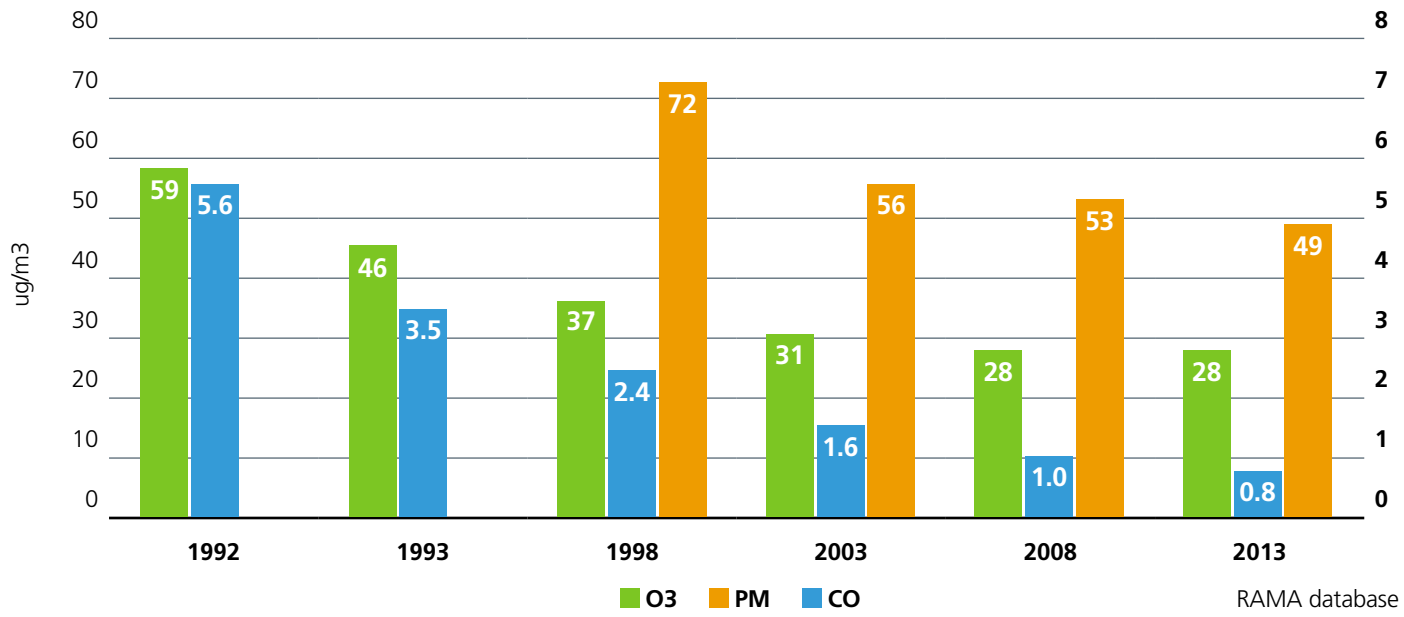
Compatible with Gasoline

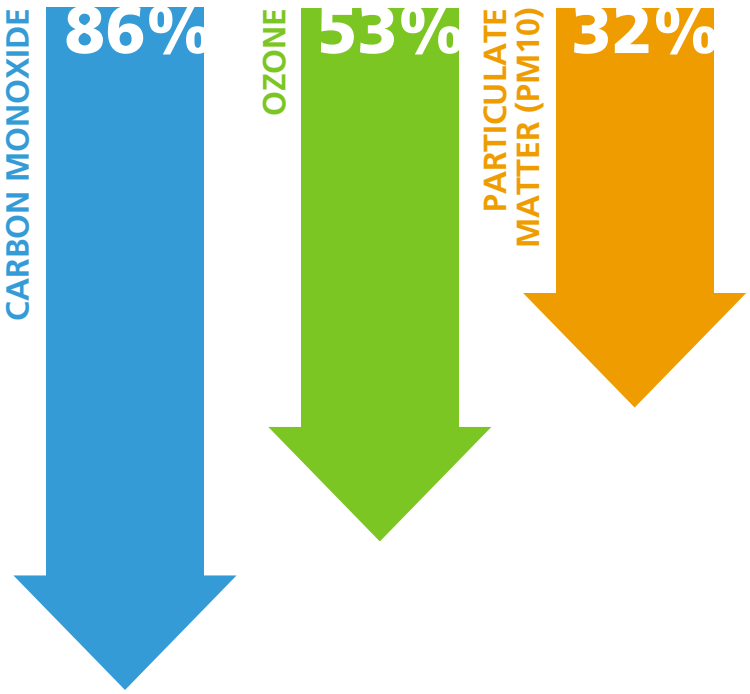
- Will not phase separate
- Can be blended at the refinery
- Finished fuel transportable by pipeline and vessel*

*Alcohols must be blended at terminal and shipped by truck to gas station

MEXICO: A 20-Year Success Story
Pollutant Reduction Since MTBE Introduction

Reduction in CO, Ozone, and PM10 in Mexico City





1992 - UN declares Mexico City "Most Polluted in the World"

1993 - Mexico chooses MTBE to reduce pollution in all Metropolitan Zones (MZs)

2013 - Key air quality factors significantly reduced despite a doubling of the number of vehicles on the road

MTBE: A Key to Future Air Quality Improvements

MTBE allows refiners to meet stricter specifications for sulfur, aromatics, and RVP, all of which have been shown to significantly improve air quality.

MTBE also improves octane and fuel combustion which improves fuel efficiency and reduces tailpipe emissions especially during cold starts.

Cleaner Burning Fuels

- Lower Fuel RVP*
- Improved cold start combustion
- Less sulfur
- Less aromatic content
- Improved distillation properties
- Better overall combustion

Improve Air Quality

- Keeps evaporative emissions low
- Less CO from older vehicles
- Improved converter efficiency
- Lowers PM and Ozone formation
- Better fuel efficiency
- Lower overall pollution

Bio-ETBE: The First Choice in Renewable Biofuels

- ETBE is a renewable gasoline component made from bio-ethanol and natural gas
- ETBE is used throughout Europe and in Japan as the preferred bio-fuel
- ETBE is compatible with MTBE and provides improved octane and RVP

ETBE provides significant advantages over ethanol:

3X more energy*

2X the octane*

5X lower Blending Vapor Pressure (BRVP)

10% less aromatics in gasoline*

Fully Compatible with fuel infrastructure

Low Water Sensitivity no phase separation

No Azeotropes with gasoline components

Lower hydrocarbon and PM **emissions**[2]

*at the same oxygen content

MTBE & ETBE Properties Close to Gasoline

		Magna Gasoline	Premium Gasoline	m-xylene	Butane	MTBE	ETBE	Ethanol
Energy Source		Crude oil	Crude oil	Crude oil	Nat. Gas	**Nat. Gas**	**Nat. Gas & Biomass**	Biomass
Octane	RON	report	95 min.	117	94	**119**	**120**	130
	MON	82 min.	report	101	91	**101**	**102**	96
	AKI (R+M)/2	**87 min.**	**92 min.**	109	93	**110**	**111**	116
BRVP	kPa	**54-79 max.**		3	379	**54**	**28**	138
	psi	6.5-11.5 max.		0.4	55	**8**	**4**	20
Boiling Point	°C	**77-121**		139	0	**55**	**72**	78
	°F	171-250		282	31	**131**	**161**	173
Net Energy Content	BTU/gal	114,500		127,144	102,032	**93,583**	**96,069**	76,300
Oxygen Content	Wt%	2.7 max.		0.0%	0.0%	**18.2%**	**15.7%**	34.8%
Oxygenate Content	WT% max.					**14.9%**	**17.2%**	7.3%
Specific Gravity		**0.745**		0.869	0.584	**0.743**	**0.745**	0.794
Water Solubility	Wt%	0.0%		0.0%	0.0%	**4.3%**	**1.1%**	100%
Sulfur Content	ppm	30 ave.		0	0	**0**	**0**	0
Aromatic Content	vol%	25% max.		100%	0%	**0%**	**0%**	0%

MTBE and ETBE: Optimal Properties For Octane Blending

- Higher octane than aromatics
- Low RVP, no waivers needed
- Excellent distillation properties
- Higher energy than alcohols
- Low water affinity
- Lower oxygen than alcohols

Additional Information

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About LyondellBasell

LyondellBasell is one of the world's largest plastics, chemical and refining companies. We are the largest producer of polypropylene and polypropylene compounds; a leading producer of propylene oxide, polyethylene, ethylene and propylene; a global leader in polyolefins technology; and a producer of refined products, including biofuels.

LyondellBasell products and technologies are used to make items that improve the quality of life for people around the world including packaging, electronics, automotive components, home furnishings, construction materials and biofuels.

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