Ethanol Blending in Gasoline - Guatemala

June, 2023

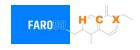# Ethanol Blending in Latin America

There are important fuel quality and environmental impact of vehicle emission challanges in the Region.

- The use of ethanol improves gasoline quality and creates flexibility in gasoline production.

- Ethanol use is a cost-effective way to increase gasoline octane and to replace more expensive gasoline components.

- Ethanol contributes to transport decarbonization and air quality improvement.

- There are opportunities across Latin America to increase the ethanol blend level and implement new policies on the use of gasoline-ethanol blends.

Sixteen countries with potential and additional use of ethanol were studied: 1) gasoline market profiles; 2) Optimization of gasoline blends with ethanol and 3) Environmental impact of gasolines blended with ethanol.
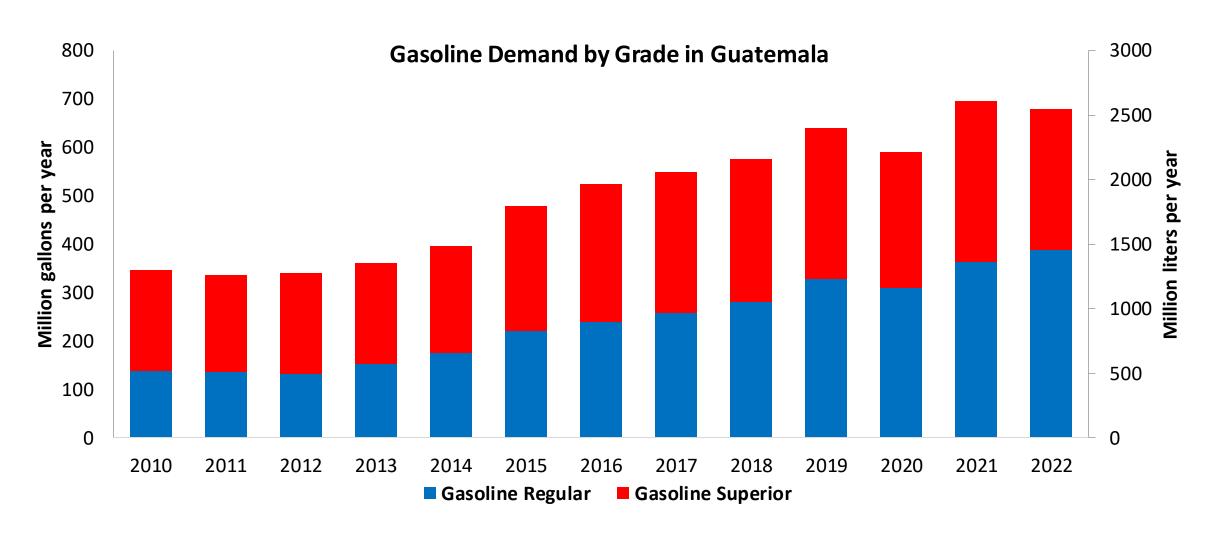
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E10

In 2022, gasoline consumption was 670 million galons (2,550 million liters). Gasoline is supplied only by imports, mainly from United States. There are two grades of gasoline: (RON 91 - AKI 85) and Superior (RON 95 - AKI 89). 60% of gasoline is gasoline Regular.

Guatemala allows for blends up to 10% v/v but no ethanol is blended in the country. It has local ethanol advanced ethanol production that is exported to Europe. Guatemala is the main ethanol producer in Central America. A E10 mandate for 2024 is currently under approval.

Source: MEM, 2023
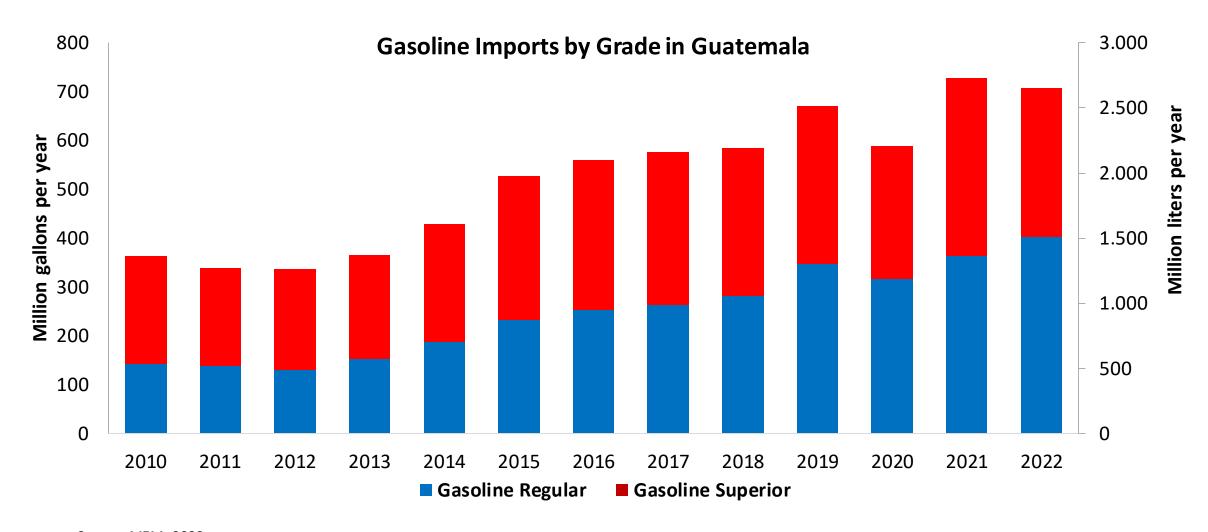
Gasoline Demand in Guatemala

Gasoline Demand by Grade in Guatemala

Source: MEM, 2023

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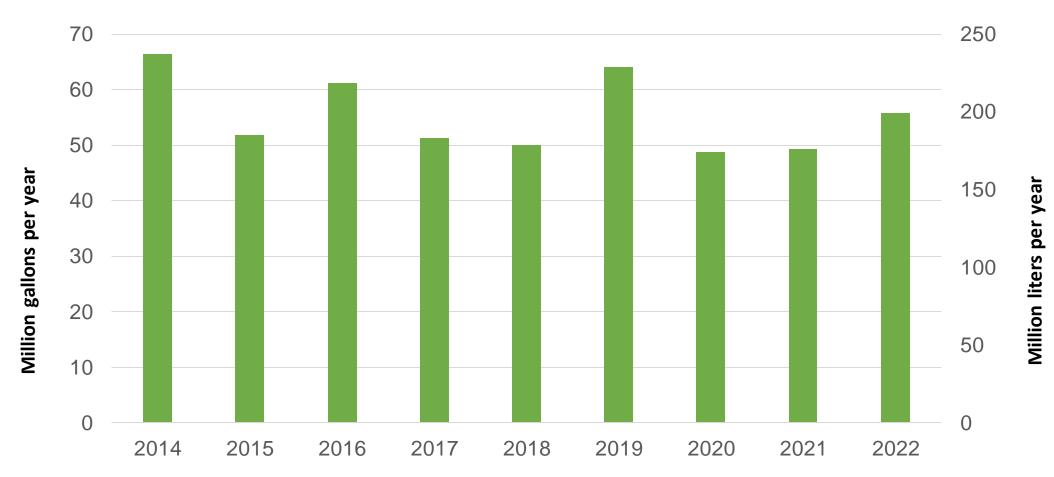
Gasoline Imports in Guatemala

Gasoline Imports by Grade in Guatemala

■ Gasoline Regular ■ Gasoline Superior

Source: MEM, 2023

Ethanol Exports from Guatemala

Source: Asociación de productores de etanol de Guatemala
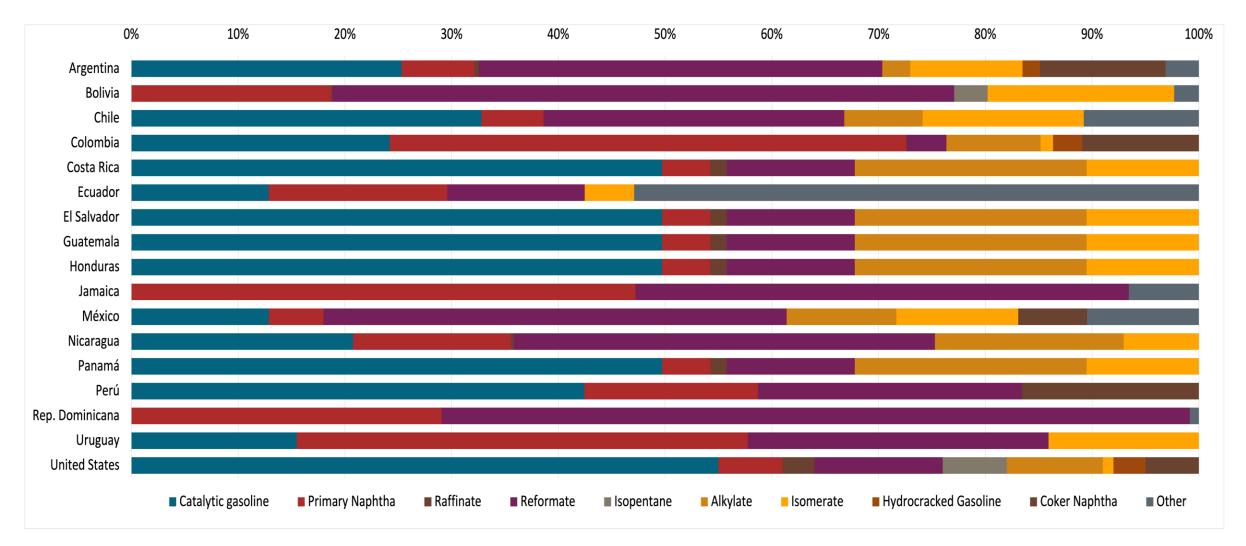
Gasoline Quality in Guatemala

Name	Ministerial Accord Number 320-2022		EN 228:2012 + A1:2017 (Euro 6 enabling)			
Implementation Date	2022		2017			
Applicability	Whole country	Whole country	All countries			
Selected Grade	Gasoline Regular	Gasoline Superior	RON 95 E5	RON 95 E10	RON 98 E5	RON 98 E10
Benzene Content	< 2,5% v/v	< 2,5% v/v	< 1 %v/v	< 1 %v/v	< 1 %v/v	< 1 %v/v
Aromatics	- / < 50% v/v	- / < 50% v/v	< 35 %v/v	< 35 %v/v	< 35 %v/v	< 35 %v/v
Olefins	- / < 30% v/v	- / < 30% v/v	< 18 %v/v	< 18 %v/v	< 18 %v/v	< 18 %v/v
Lead Content	< 0,013 g/l	< 0,013 g/l	< 5 mg/l	< 5 mg/l	< 5 mg/l	< 5 mg/l
Manganese	< 2,5 mg/l	< 2,5 mg/l	< 2,0 mg/l	< 2,0 mg/l	< 2,0 mg/l	< 2,0 mg/l
RON	> 91	> 95	> 95	> 95	> 98	> 98
MON	-	-	> 85	> 88	> 85	> 88
AKI						
Sulfur Content	< 500 mg/kg	< 500 mg/kg	< 10 mg/kg	< 10 mg/kg	< 10 mg/kg	< 10 mg/kg
Oxygen Content	-	-	<2,7 % m/m	<3,7 % m/m	<2,7 % m/m	<3,7 % m/m
Ethanol (EtOH)	< 10 %v/v	< 10 %v/v	<5 %v/v	<10 %v/v	<5 %v/v	<10 %v/v
RVP 37.8°C (Summer)	< 69 kPa	< 69 kPa	<> 60 - 70 kPa *Depends on the country, RVP is regulated in the EU Fuel Quality Directive			
RVP 37.8 °C(Winter)						
RVP 37.8°C (Transition)						
MTBE	10% v/v	10% v/v	-	-	-	-
Ehters 5 or more C Atoms	-	-	Based on oxygen content	<22 %v/v	Based on oxygen content	<22 %v/v

Source: MEM, 2022

Gasoline Component Blending in Latin America

Gasoline is a blend of a base gasoline and other components. This blending is usually done at blending terminals as only 30% of the world's finished gasoline is distributed directly from refineries. Each component provides different properties to the final blend, for example, isomerates, alkylates and butanes increase the octane. The components commonly used in Latin America are:
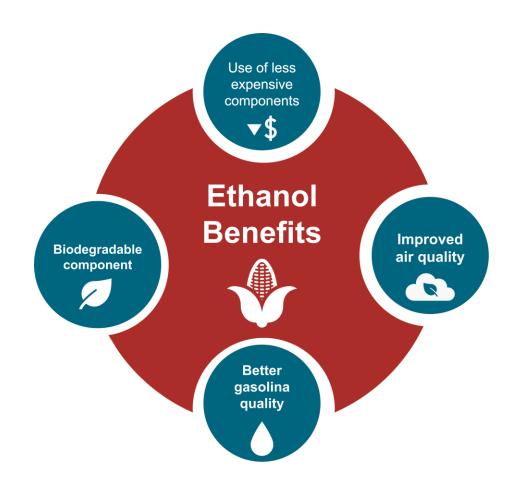

Legend: Catalytic gasoline, Primary Naphtha, Raffinate, Reformate, Isopentane, Alkylate, Isomerate, Hydrocracked Gasoline, Coker Naphtha, Other

Gasoline Blending Optimization

In some parts of the world, ethanol is added to gasoline as a blending component. The advantages of ethanol include that it is a renewable fuel made of biomass; that it is an octane booster that helps to dilute sulfur; and that it allows the fulfillment of environmental objectives. To determine the optimal components to be blended with ethanol, a **blending model** was used. This model selects the components to add in the gasoline/ethanol blend based on:

- Components prices,
- Properties each component affects,
- Quality parameters by country, and
- Component availability by country.
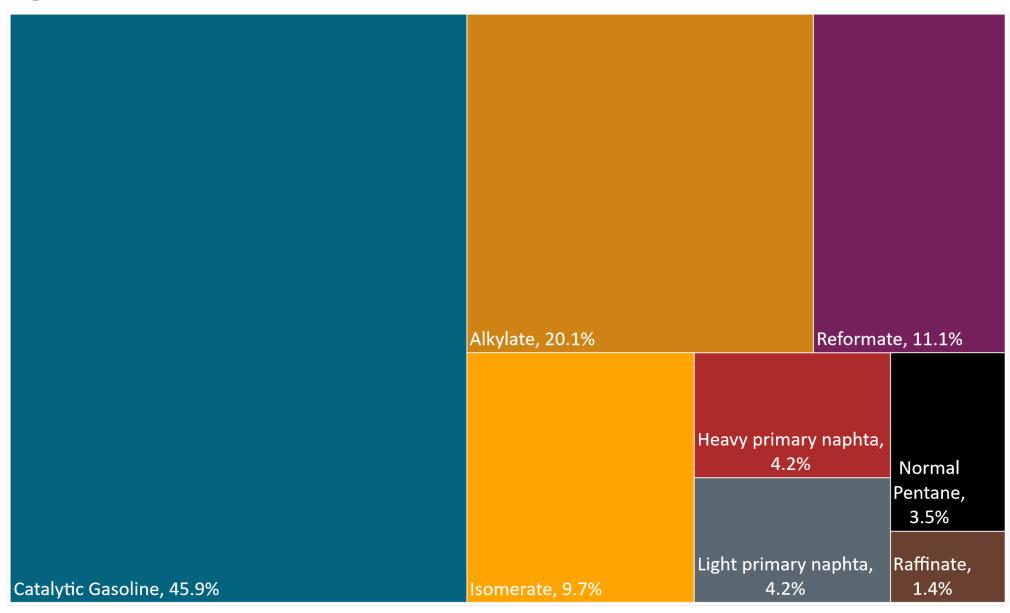
Through iterations, the model obtains the %v/v of the components to be blended with 10%, 15%, 20%, 25% and 30% of ethanol, in such a way that the final blend complies with the required properties of a finished gasoline by country.

The blending model uses gasoline component spot average prices January 2022 – February 2023 and provides fuel prices that do not include country distribution costs, local taxes and subsidies and import or gas station margins.

Ethanol Benefits

- Use of less expensive components
- Improved air quality
- Better gasolina quality
- Biodegradable component

Blending Components- Guatemala
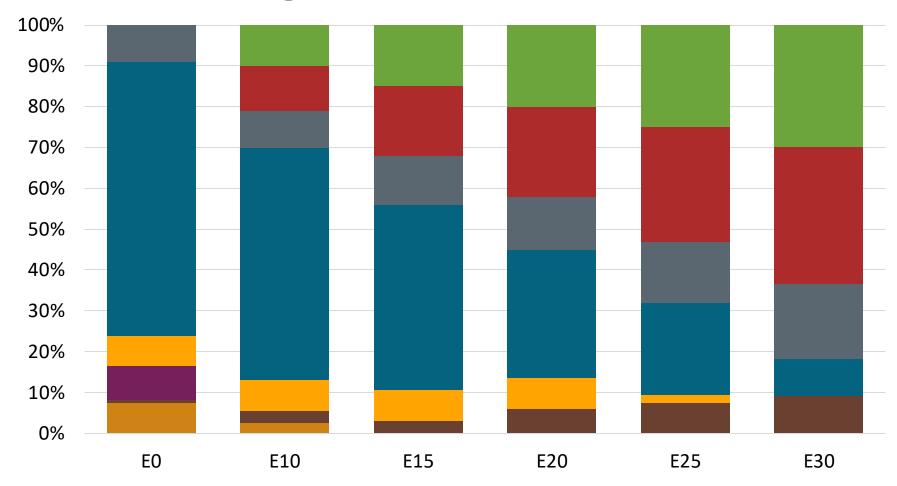
Guatemala – Regular – Constant Octane
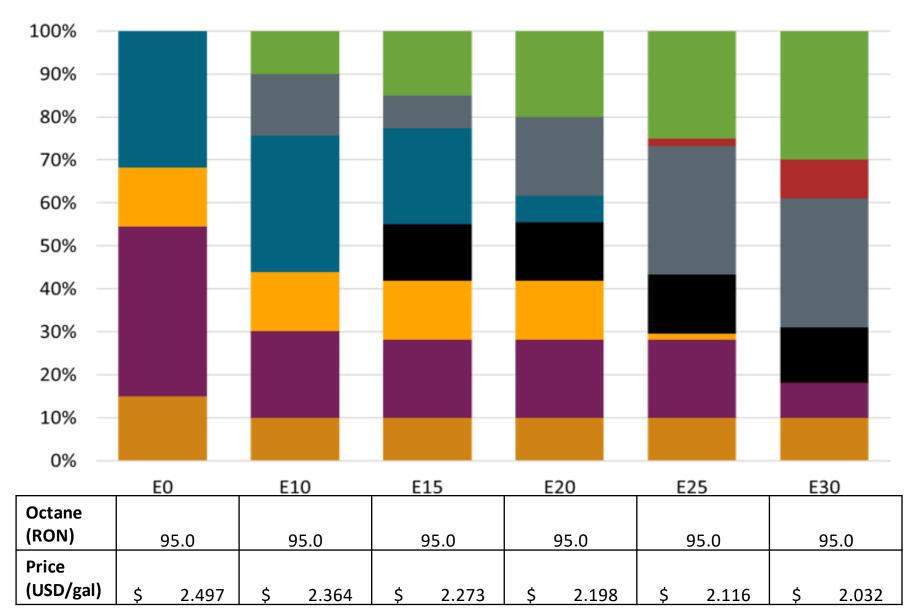
	E0	E10	E15	E20	E25	E30
Octane (RON)	91.0	91.0	91.0	91.0	91.2	91.3
Price (USD/gal)	$ 2.331	$ 2.189	$ 2.127	$ 2.067	$ 2.009	$ 1.945

Prices are average Jan 22 – Feb 23.
They do not include local distribution costs, import or gas station margins, taxes and subsidies.

Legend:
- Ethanol
- Alkylate
- Raffinate
- Reformate
- Isomerate
- Catalytic Gasoline
- Light Primary Naphtha
- Heavy Primary Naphtha

Guatemala – Premium – Constant Octane

	E0	E10	E15	E20	E25	E30
Octane (RON)	95.0	95.0	95.0	95.0	95.0	95.0
Price (USD/gal)	$ 2.497	$ 2.364	$ 2.273	$ 2.198	$ 2.116	$ 2.032

Prices are average Jan 22 – Feb 23.
They do not include local distribution costs, import or gas station margins, taxes and subsidies.
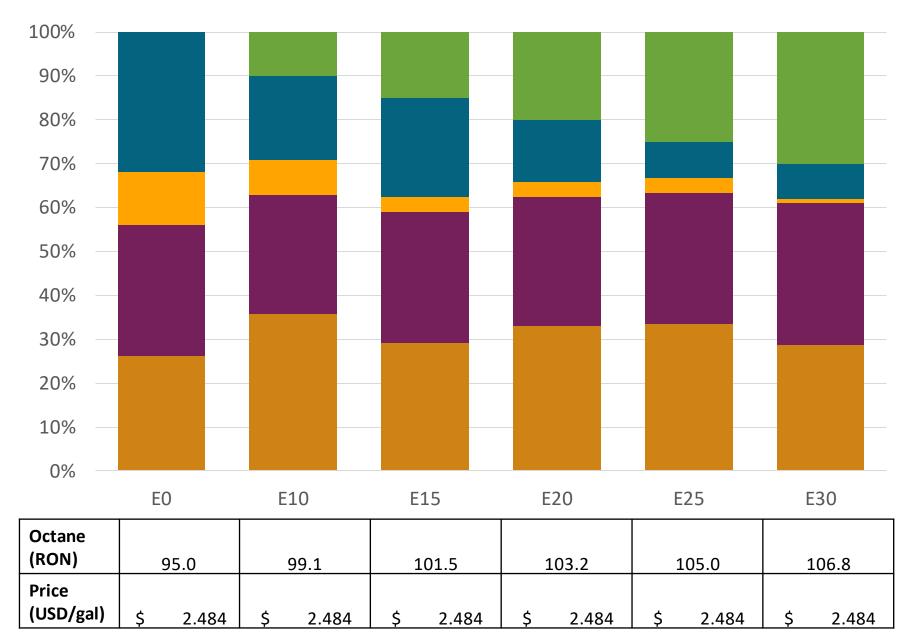
Guatemala – Regular – Octane Increment

Legend:
- Ethanol
- Alkylate
- Raffinate
- Reformate
- Isomerate
- Catalytic Gasoline
- Light Primary Naphtha

	E0	E10	E15	E20	E25	E30
Octane (RON)	91.0	95.7	97.8	99.7	101.6	103.8
Price (USD/gal)	$ 2.326	$ 2.326	$ 2.326	$ 2.326	$ 2.326	$ 2.326

Prices are average Jan 22 – Feb 23.
They do not include local distribution costs, import or gas station margins, taxes and subsidies.

Guatemala – Premium – Octane Increment

	E0	E10	E15	E20	E25	E30
Octane (RON)	95.0	99.1	101.5	103.2	105.0	106.8
Price (USD/gal)	$ 2.484	$ 2.484	$ 2.484	$ 2.484	$ 2.484	$ 2.484

Legend: Ethanol, Alkylate, Reformate, Isomerate, Catalytic Gasoline

Prices are average Jan 22 – Feb 23.
They do not include local distribution costs, import or gas station margins, taxes and subsidies.

Vehicle Emission Impact for Ethanol Gasoline Blending

The model used in this analysis takes as a reference the **International Vehicle Emissions Model (IVE).**
The model uses the Base Emission Rates from IVE model, as well as its Adjustment Factors based on:

- Vehicle technology (cars, trucks, buses, motorcycles),
- Vehicle fleet average age,
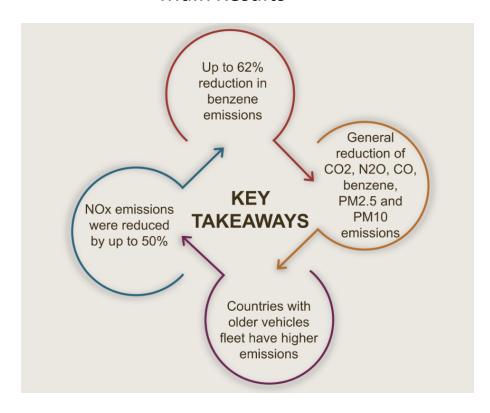- Average traveled distance per vehicle by country, as well as
- Geographical and climatic conditions (altitude, humidity, temperature).

Emissions of criteria pollutants, toxic pollutants, and greenhouse gases (GHG) were calculated and calibrated with emission inventories, using real gasoline quality data. The reduction rates for gasoline/ethanol blends were obtained from various sources (IPCC, US Grains, among others).
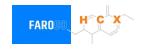
Emission estimations for different pollutants for gasoline and gasoline/ethanol blends (10%, 15%, 20%, 25% and 30% ethanol) were determined using the IVE Model. A comparison between the results and the European (Euro 6) requirements is made. Results are also compared with real emissions of the United States vehicle fleet*.

Main Results

Up to 62% reduction in benzene emissions

General reduction of CO2, N2O, CO, benzene, PM2.5 and PM10 emissions

KEY TAKEAWAYS

NOx emissions were reduced by up to 50%
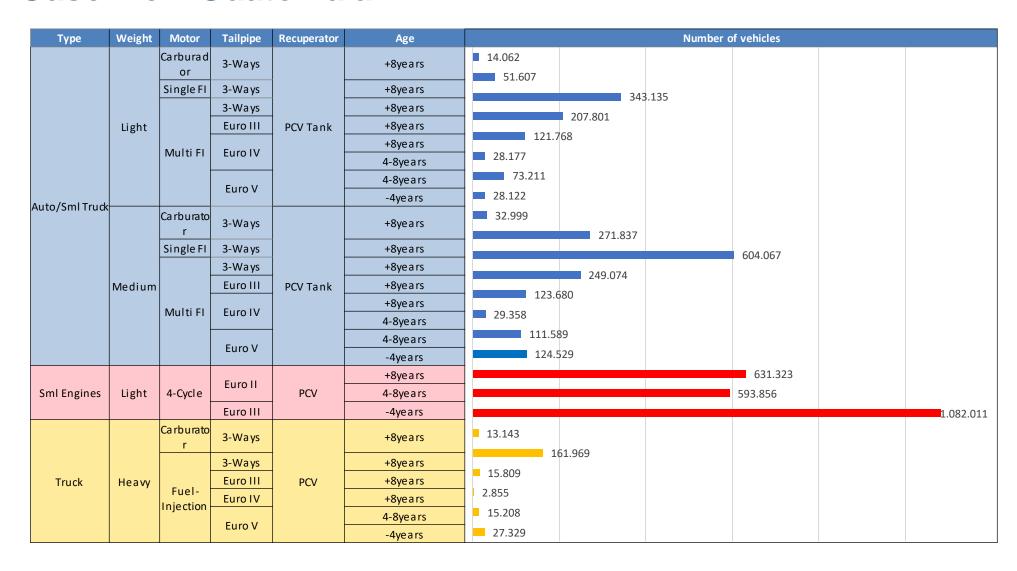
Countries with older vehicles fleet have higher emissions

*Source: Bureau of transportation statistics.

Gasoline VGuatemala

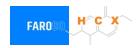| Type	Weight	Motor	Tailpipe	Recuperator	Age	Number of vehicles
Auto/Sml Truck	Light	Carburador	3-Ways	PCV Tank	+8years	14.062
		Single FI	3-Ways		+8years	51.607
		Multi FI	3-Ways		+8years	343.135
			Euro III		+8years	207.801
			Euro IV		+8years	121.768
					4-8years	28.177
			Euro V		4-8years	73.211
					-4years	28.122
	Medium	Carburator	3-Ways	PCV Tank	+8years	32.999
		Single FI	3-Ways		+8years	271.837
		Multi FI	3-Ways		+8years	604.067
			Euro III		+8years	249.074
			Euro IV		+8years	123.680
					4-8years	29.358
			Euro V		4-8years	111.589
					-4years	124.529
Sml Engines	Light	4-Cycle	Euro II	PCV	+8years	631.323
					4-8years	593.856
			Euro III		-4years	1.082.011
Truck	Heavy	Carburator	3-Ways	PCV	+8years	13.143
		Fuel-Injection	3-Ways		+8years	161.969
			Euro III		+8years	15.809
			Euro IV		+8years	2.855
			Euro V		4-8years	15.208
					-4years	27.329

Vehcle Fleet: **4,958,519**
Average Age: **12 years**

Guatemala – Gasoline Vehicle Emissions

Emissions	E0 g/km	E10 g/km	E15 g/km	E20 g/km	E25 g/km	E30 g/km	E10 - E0	E20 - E0	E30 - E0	Euro 6	TIER USA
CO	10.53	9.28	8.80	8.34	7.99	7.53	-12%	-21%	-29%	1	3.5
VOC	0.95	0.88	0.86	0.84	0.83	0.81	-7%	-11%	-15%	95	255
VOCevap	0.57	0.57	0.58	0.60	0.61	0.62	0%	4%	7%	0.1	0.273
NOx	0.61	0.43	0.40	0.38	0.36	0.33	-30%	-38%	-46%	0.06	0.203
SOx	0.01	0.00	0.00	0.00	0.00	0.00	-15%	-28%	-41%		
NH3	0.06	0.05	0.05	0.06	0.06	0.06	-2%	0%	1%		
Butadiene	0.01	0.01	0.01	0.01	0.01	0.01	-6%	-9%	-11%		
Acetaldehyde	0.02	0.03	0.04	0.06	0.07	0.08	68%	249%	372%		
Formaldehyde	0.06	0.06	0.07	0.08	0.09	0.09	13%	39%	68%		
Benzene	0.04	0.04	0.04	0.04	0.04	0.03	-9%	-11%	-18%		
CO2	241.54	229.47	224.85	222.57	220.40	216.33	-5%	-8%	-10%		
N2O	0.01	0.01	0.01	0.01	0.01	0.01	-1%	2%	4%		
CH4	0.22	0.22	0.22	0.23	0.23	0.23	0%	4%	7%		
PM 2.5	0.02	0.01	0.01	0.01	0.01	0.01	-22%	-43%	-65%		
PM10	0.03	0.02	0.02	0.01	0.01	0.01	-22%	-43%	-65%	0.005	0.007
THC	0.34	0.36	0.38	0.41	0.43	0.45	4%	19%	31%		