Ethanol Blending in Gasoline - Perú

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.
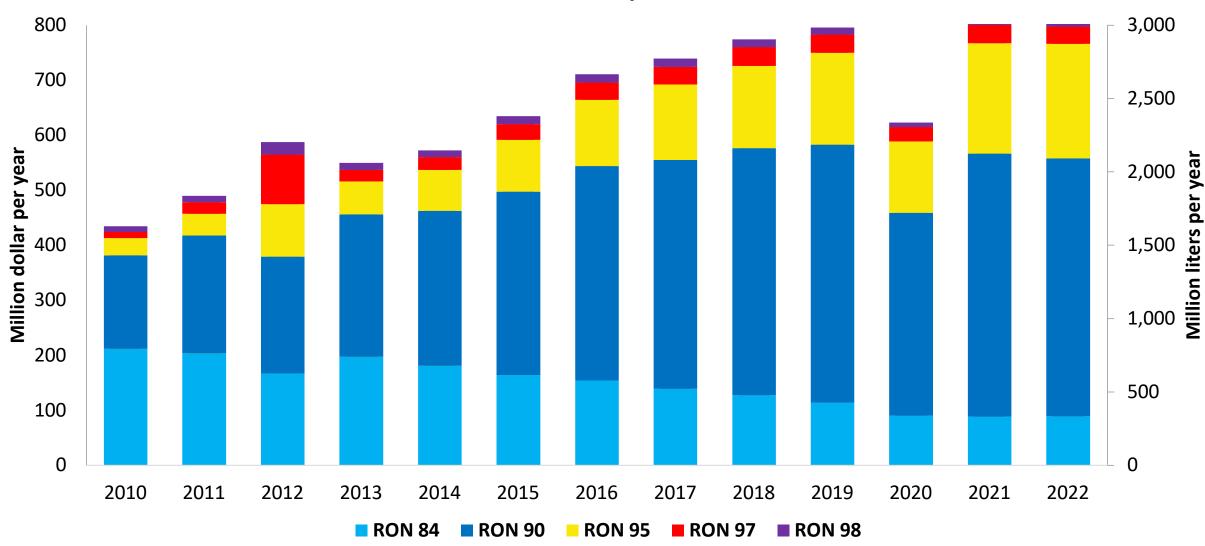
Ethanol Blending in Gasoline - Perú

E7.8

In 2022, Perú gasoline consumption surpassed 800 million gallons (3,000 millons liters). Starting in 2023, RON84 and RON 90 gasoline are commercialized as Regular gasoline (RON 91) with a 70% market participation. RON 95, RON 97 and RON 98 gasolines are now marketed as Premium gasoline (RON 96) with a 30% market share.

Blends with 7.8% v/v are allowed. Peru produces ethanol from sugarcane; however, its destination is mainly the EU market. Ethanol imports from the United States and to a lesser degree from Brazil are used for the national blend.

Source: MEM, 2023

Gasoline Demand in Perú

Gasoline Demand by Grade in Perú

Source: MINEM, 2023
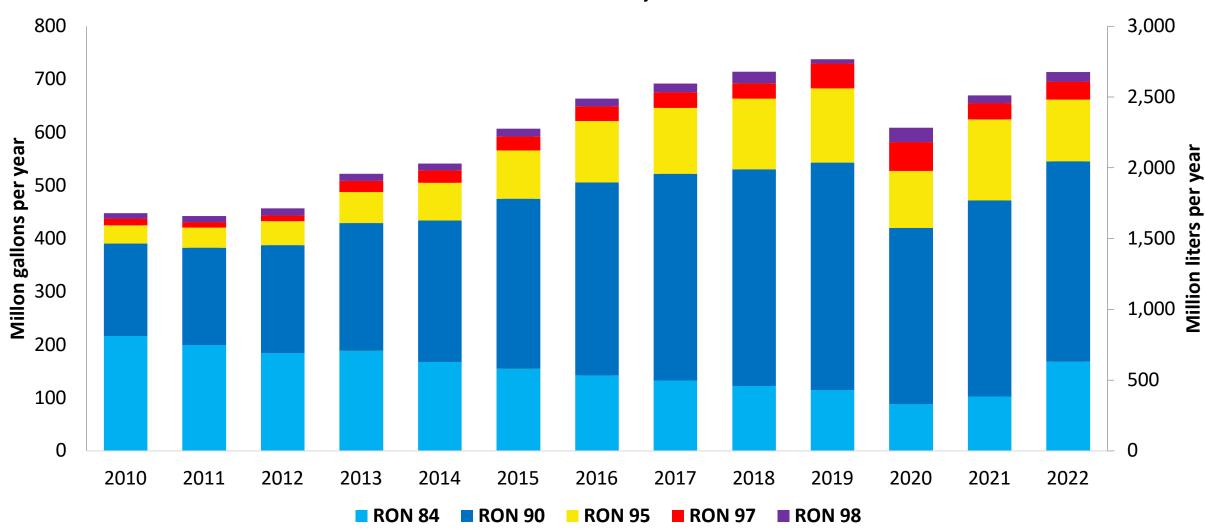
Gasoline Production in Perú

Gasoline Production by Grade in Perú

Source: MINEM, 2023

Gasoline Imports in Perú

Naphta and Gasoline Imports in Peru

Source: MINEM, 2023

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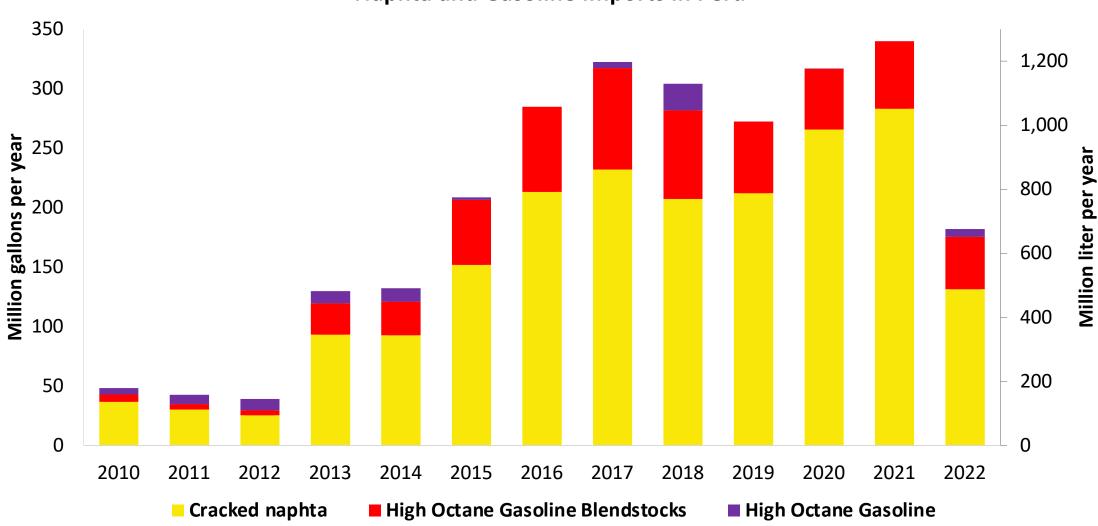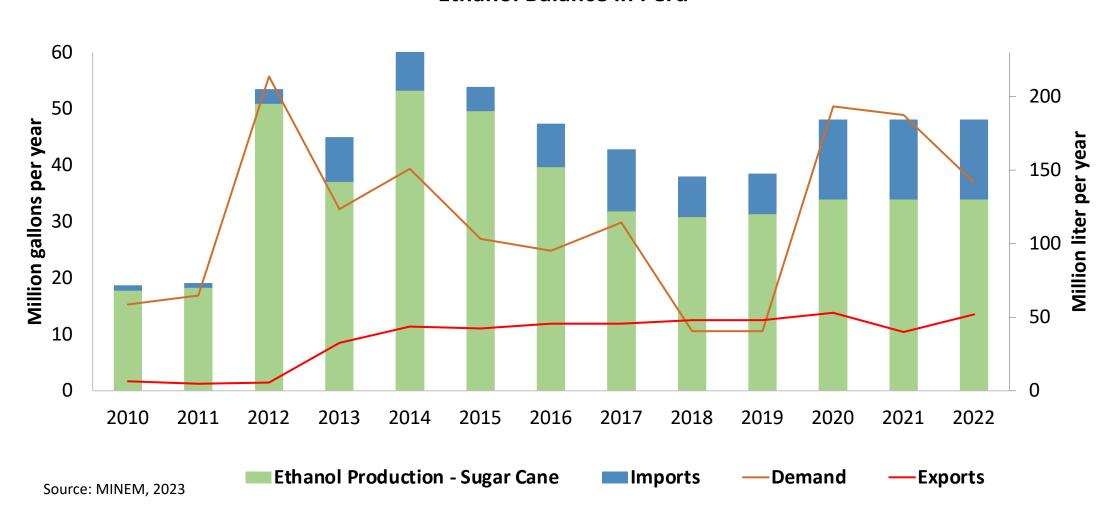
Ethanol Balance in Perú

Ethanol Balance in Perú

Source: MINEM, 2023

Legend: Ethanol Production - Sugar Cane | Imports | Demand | Exports
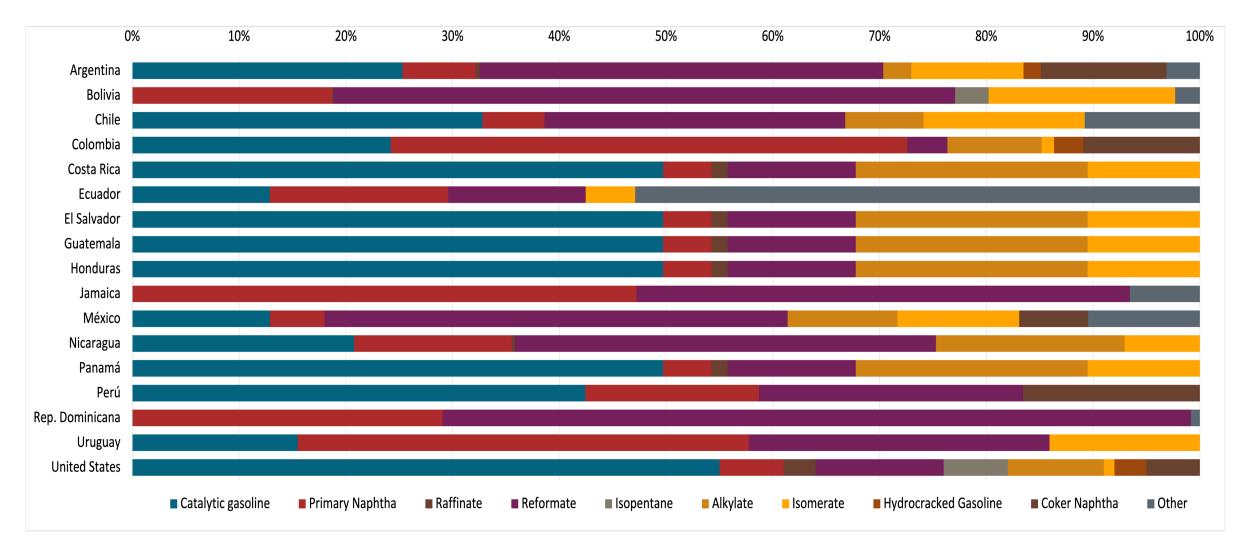
Gasoline Quality in Perú

Name	Ministerial Resolution N° 469-2021-MINEM/DM				EN 228:2012 + A1:2017 (Euro 6 enabling)			
Implementation Date	2021				2017			
Applicability	Whole contry	Whole contry	Whole contry	Whole contry	All countries			
Selected Grade	Gasolina Regular	Gasolina Premium	Gasohol Regular	Gasohol Premium	RON 95 E5	RON 95 E10	RON 98 E5	RON 98 E10
Benzene Content	< 2% v/v	< 2% v/v	< 2% v/v	< 2% v/v	< 1 %v/v	< 1 %v/v	< 1 %v/v	< 1 %v/v
Aromatics	< 45% v/v	< 45% v/v	< 45% v/v	< 45% v/v	< 35 %v/v	< 35 %v/v	< 35 %v/v	< 35 %v/v
Olefins	< 25% v/v	< 25% v/v	< 25% v/v	< 25% v/v	< 18 %v/v	< 18 %v/v	< 18 %v/v	< 18 %v/v
Lead Content	< 0,013 g/l	< 0,013 g/l	< 0,013 g/l	< 0,013 g/l	< 5 mg/l	< 5 mg/l	< 5 mg/l	< 5 mg/l
Manganese	< 0,25 mg/l	< 0,25 mg/l	< 0,25 mg/l	< 0,25 mg/l	< 2,0 mg/l	< 2,0 mg/l	< 2,0 mg/l	< 2,0 mg/l
RON	> 90	> 95	> 91	> 96	> 95	> 95	> 98	> 98
MON	-	-	-	-	> 85	> 88	> 85	> 88
AKI								
Sulfur Content	< 50 mg/kg	< 50 mg/kg	< 50 mg/kg	< 50 mg/kg	< 10 mg/kg	< 10 mg/kg	< 10 mg/kg	< 10 mg/kg
Oxygen Content	Reportar	Reportar	< 3,45 %m/m	< 3,45 %m/m	<2,7 % m/m	<3,7 % m/m	<2,7 % m/m	<3,7 % m/m
Ethanol (EtOH)			< 7,8 %v/v	< 7,8 %v/v	<5 %v/v	<10 %v/v	<5 %v/v	<10 %v/v
RVP 37.8°C (Summer)	< 76 kPa	< 76 kPa	< 76 kPa	< 76 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					-	-	-	-
Ehters 5 or more C Atoms	-	-	-	-	Based on oxygen content	<22 %v/v	Based on oxygen content	<22 %v/v

Source: MINEM, 2023

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
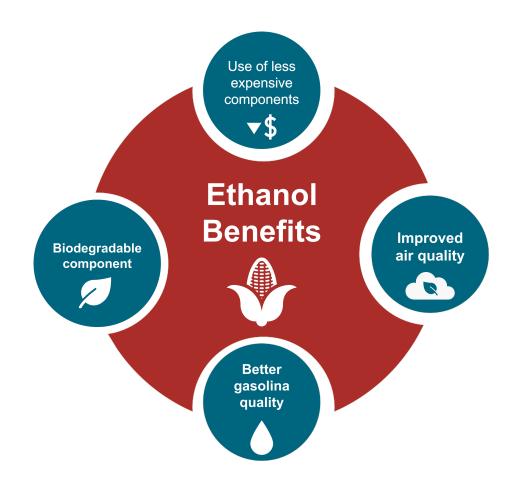
Gasoline Blending Optimization

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.
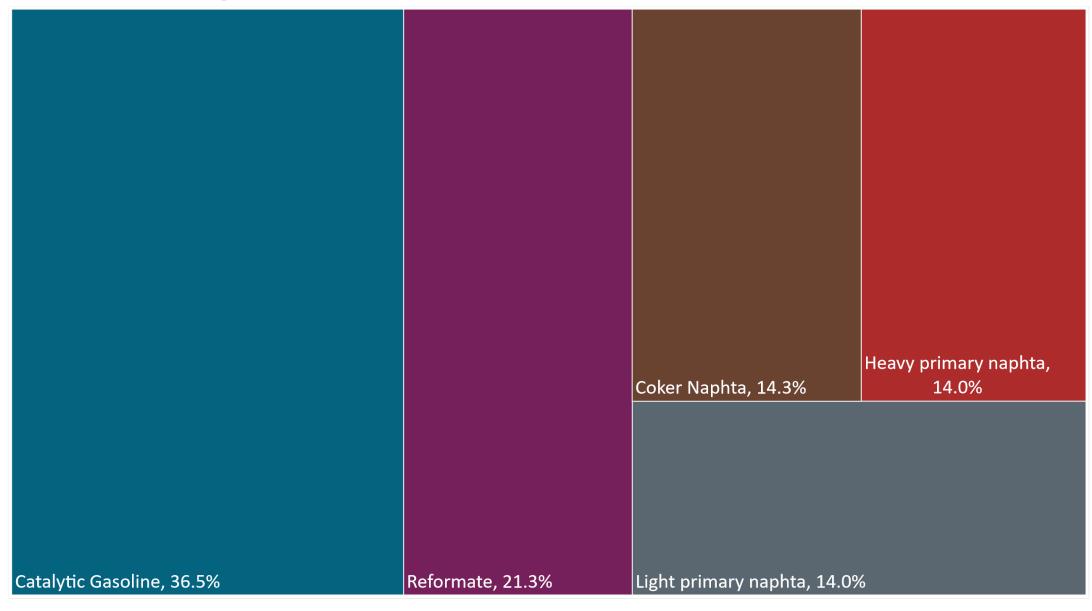
Through iterations, the model obtains the %v/v of the components to be blended with 10%, 15%, 20%, 25% and 30% of ethanol, in such a way that the final blend complies with the required properties of a finished gasoline by country.

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
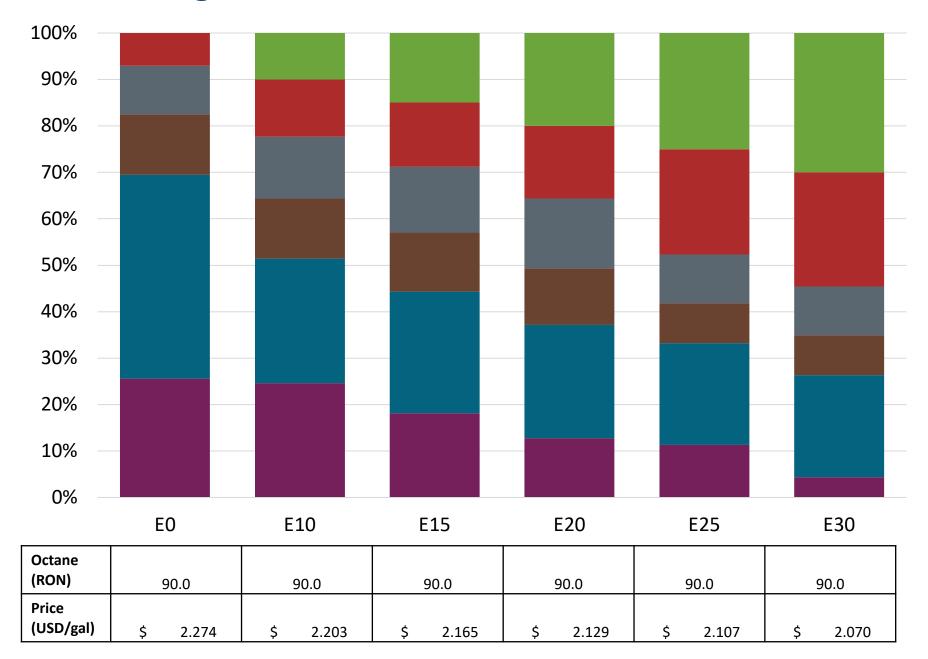
Available Blending Components

Catalytic Gasoline, 36.5%
Reformate, 21.3%
Coker Naphta, 14.3%
Heavy primary naphta, 14.0%
Light primary naphta, 14.0%

Perú – Regular – Constant Octane

Legend:
- Ethanol
- Reformate
- Catalytic Gasoline
- Coker Naphtha
- Light Primary Naphtha
- Heavy Primary Naphtha

	E0	E10	E15	E20	E25	E30
Octane (RON)	90.0	90.0	90.0	90.0	90.0	90.0
Price (USD/gal)	$ 2.274	$ 2.203	$ 2.165	$ 2.129	$ 2.107	$ 2.070

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

Source: Faro90

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Perú – Premium – Constant Octane

Octane (RON)	95.0	95.0	95.0	95.0	95.0	95.0
Price (USD/gal)	$ 2.419	$ 2.327	$ 2.288	$ 2.251	$ 2.214	$ 2.179

Legend:
- Ethanol
- Reformate
- Catalytic Gasoline
- Coker Naphtha
- Light Primary Naphtha
- Heavy Primary Naphtha

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

Source: Faro90

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Perú – Regular – Octane Increment

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

Source: Faro90

	E0	E10	E15	E20	E25	E30
Octane (RON)	90.2	92.9	94.3	95.7	97.1	98.4
Price (USD/gal)	$ 2.261	$ 2.261	$ 2.261	$ 2.261	$ 2.261	$ 2.261

Legend:
- Ethanol
- Reformate
- Catalytic Gasoline
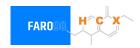- Coker Naphtha
- Light Primary Naphtha
- Heavy Primary Naphtha

Perú – Premium – Octane Increment

Legend:
- Ethanol
- Reformate
- Catalytic Gasoline
- Coker Naphtha
- Light Primary Naphtha
- Heavy Primary Naphtha

	E0	E10	E15	E20	E25	E30
Octane (RON)	95.0	96.4	97.8	99.4	100.8	102.1
Price (USD/gal)	$ 2.369	$ 2.369	$ 2.369	$ 2.369	$ 2.369	$ 2.369

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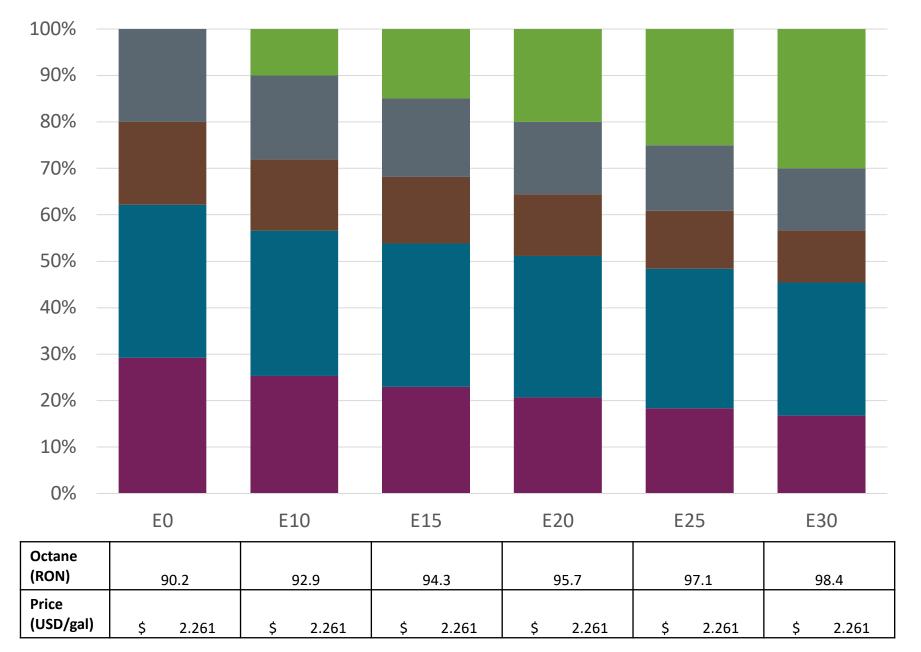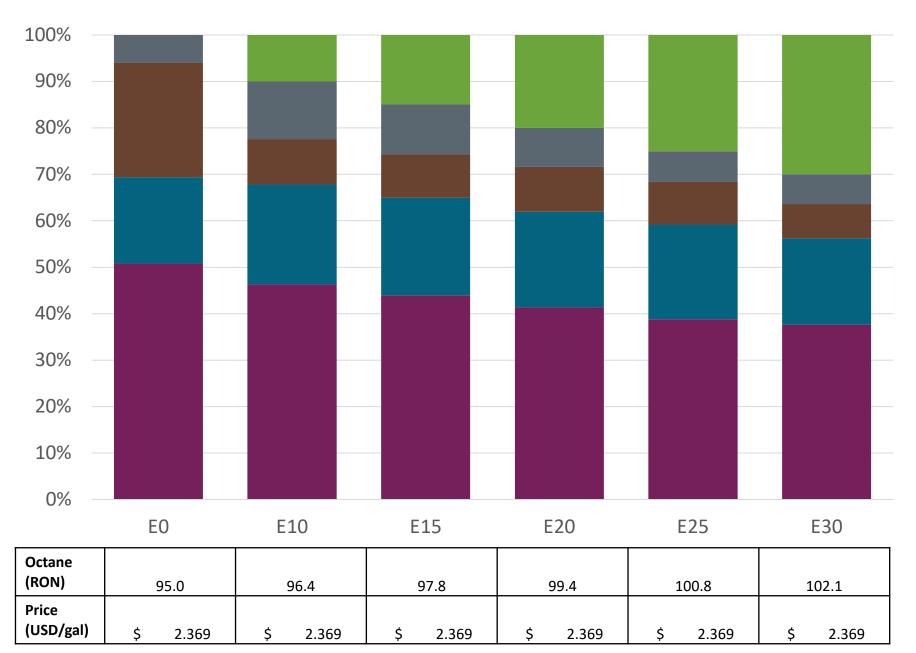They do not include local distribution costs, import or gas station margins, taxes and subsidies.

Source: Faro90

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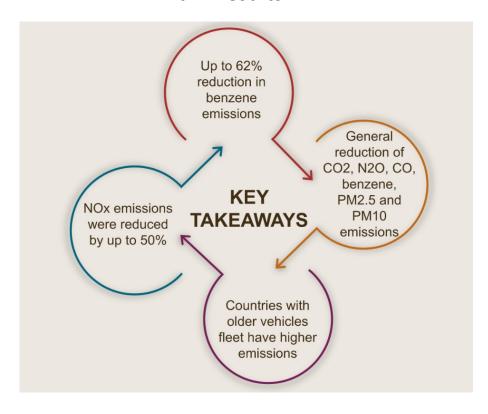
- Vehicle technology (cars, trucks, buses, motorcycles),
- Vehicle fleet average age,
- Average traveled distance per vehicle by country, as well as
- Geographical and climatic conditions (altitude, humidity, temperature).

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

KEY TAKEAWAYS

Up to 62% reduction in benzene emissions

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

Countries with older vehicles fleet have higher emissions

NOx emissions were reduced by up to 50%
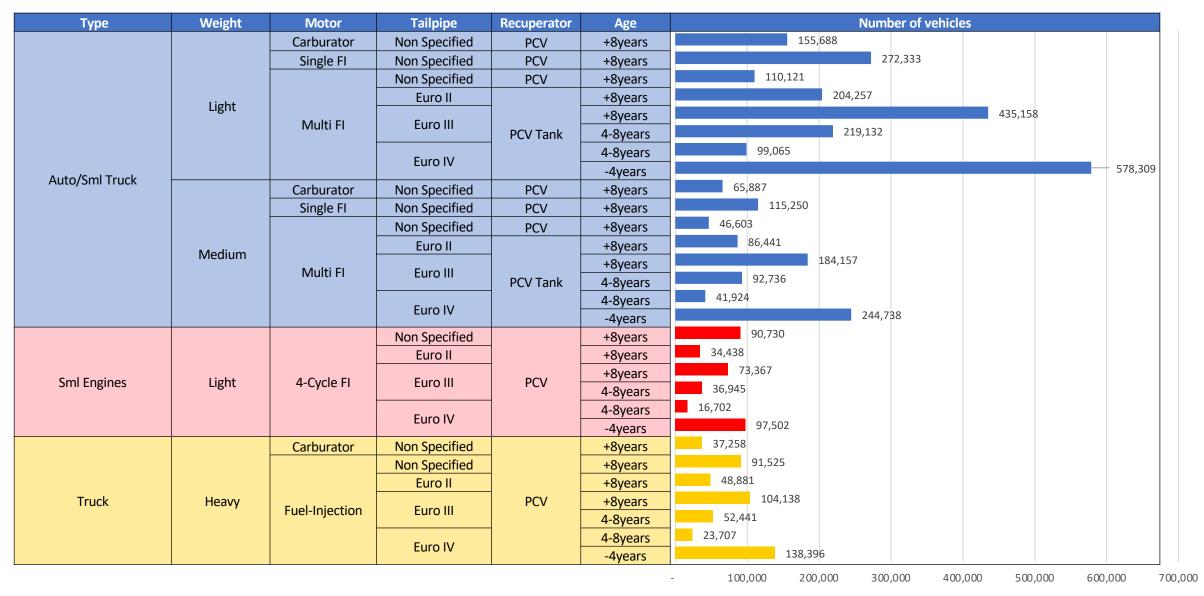
Source: Bureau of transportation statistics.

Perú – Gasoline Vehicle Fleet

Type	Weight	Motor	Tailpipe	Recuperator	Age	Number of vehicles
Auto/Sml Truck	Light	Carburator	Non Specified	PCV	+8years	155,688
		Single FI	Non Specified	PCV	+8years	272,333
		Multi FI	Non Specified	PCV	+8years	110,121
			Euro II	PCV Tank	+8years	204,257
			Euro III		+8years	435,158
					4-8years	219,132
			Euro IV		4-8years	99,065
					-4years	578,309
	Medium	Carburator	Non Specified	PCV	+8years	65,887
		Single FI	Non Specified	PCV	+8years	115,250
		Multi FI	Non Specified	PCV	+8years	46,603
			Euro II	PCV Tank	+8years	86,441
			Euro III		+8years	184,157
					4-8years	92,736
			Euro IV		4-8years	41,924
					-4years	244,738
Sml Engines	Light	4-Cycle FI	Non Specified	PCV	+8years	90,730
			Euro II		+8years	34,438
			Euro III		+8years	73,367
					4-8years	36,945
			Euro IV		4-8years	16,702
					-4years	97,502
Truck	Heavy	Carburator	Non Specified	PCV	+8years	37,258
		Fuel-Injection	Non Specified		+8years	91,525
			Euro II		+8years	48,881
			Euro III		+8years	104,138
					4-8years	52,441
			Euro IV		4-8years	23,707
					-4years	138,396

Vehicle Fleet: **3,797,829**
Average Age: **14.9** years

Source: Ministerio de Transporte y Comunicaciones, 2023

Perú – Gasoline Vehicle Fleet 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	31.80	25.76	23.17	20.52	18.46	16.03	-19%	-35%	-50%	1	3.5
VOC	3.20	2.82	2.67	2.53	2.43	2.28	-12%	-21%	-29%	95	255
VOCevap	0.45	0.45	0.46	0.47	0.48	0.48	0%	4%	7%	0.1	0.273
NOx	1.37	0.96	0.90	0.85	0.80	0.74	-30%	-38%	-46%	0.06	0.203
SOx	0.01	0.01	0.01	0.01	0.01	0.00	-15%	-28%	-41%		
NH3	0.06	0.06	0.06	0.06	0.06	0.07	-2%	0%	1%		
Butadiene	0.01	0.01	0.01	0.01	0.01	0.01	-12%	-20%	-28%		
Acetaldehyde	0.01	0.02	0.04	0.05	0.06	0.07	68%	249%	372%		
Formaldehyde	0.05	0.06	0.07	0.07	0.08	0.08	13%	39%	68%		
Benzene	0.18	0.16	0.16	0.16	0.15	0.15	-9%	-11%	-18%		
CO2	272.47	258.84	253.64	251.07	248.67	244.08	-5%	-8%	-10%		
N2O	0.01	0.01	0.01	0.01	0.01	0.01	-1%	2%	4%		
CH4	0.70	0.70	0.71	0.72	0.73	0.75	0%	4%	7%		
PM 2.5	0.02	0.02	0.01	0.01	0.01	0.01	-22%	-43%	-65%		
PM10	0.02	0.02	0.02	0.01	0.01	0.01	-22%	-43%	-65%	0.005	0.007
THC	0.95	0.95	0.98	1.01	1.03	1.05	0%	6%	11%		