



FARO90

Ethanol Blending in Gasoline - El Salvador

Ethanol Blending in Latin America

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

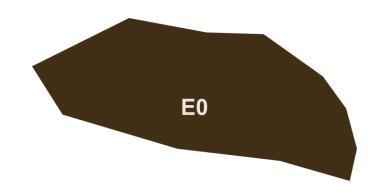
- The use of ethanol improves gasoline quality and creates flexibility in gasoline production.
- Ethanol use is a cost-effective way to increase gasoline octane and to replace more expensive gasoline components.
- Ethanol contributes to transport decarbonization and air quality improvement.
- There are 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 - El Salvador





In 2022, gasoline demand was 315 million galons (1,180 million liters). Regular gasoline RON 91 represented 50.6% of the volume consumed while Superior gasoline RON 95 reached 49.4%. Gasoline is supplied only by imports, distributed mainly by Chevron, Puma and Uno companies and imported mainly from the United States.

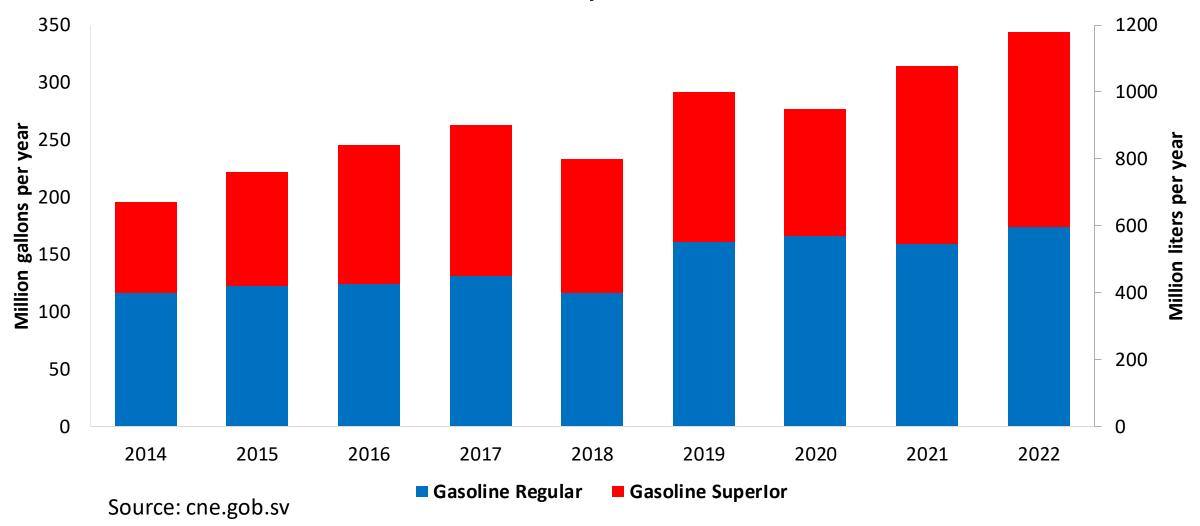
El Salvador has no national specifications for ethanol. It has the potential to produce ethanol from maize and sugar cane.

Sources: cne.gob.sv





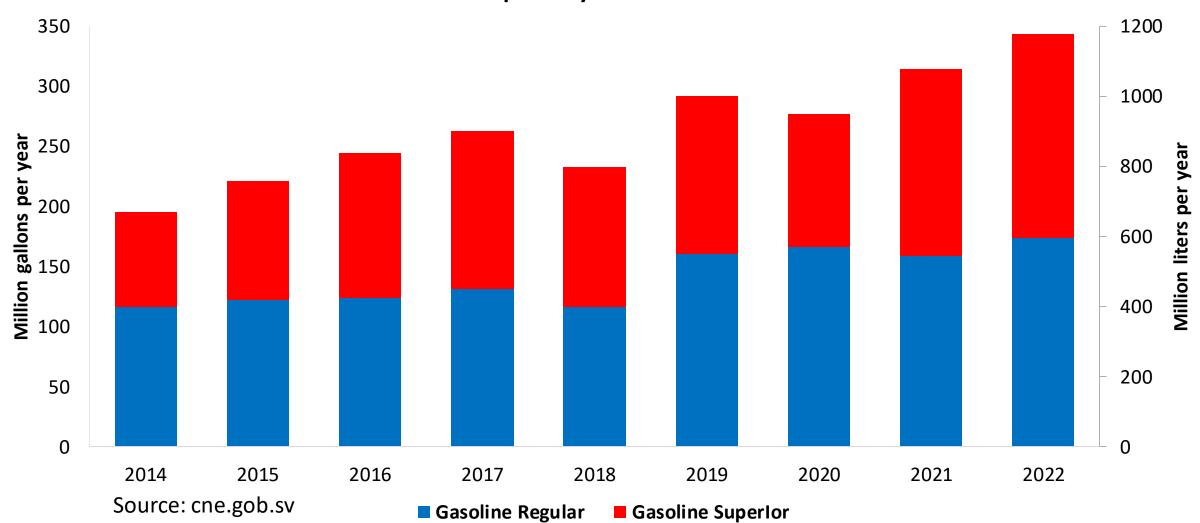
Gasoline Demand by Grade in El Salvador



Gasoline Imports in El Salvador



Gasoline Imports by Grande in El Salvador





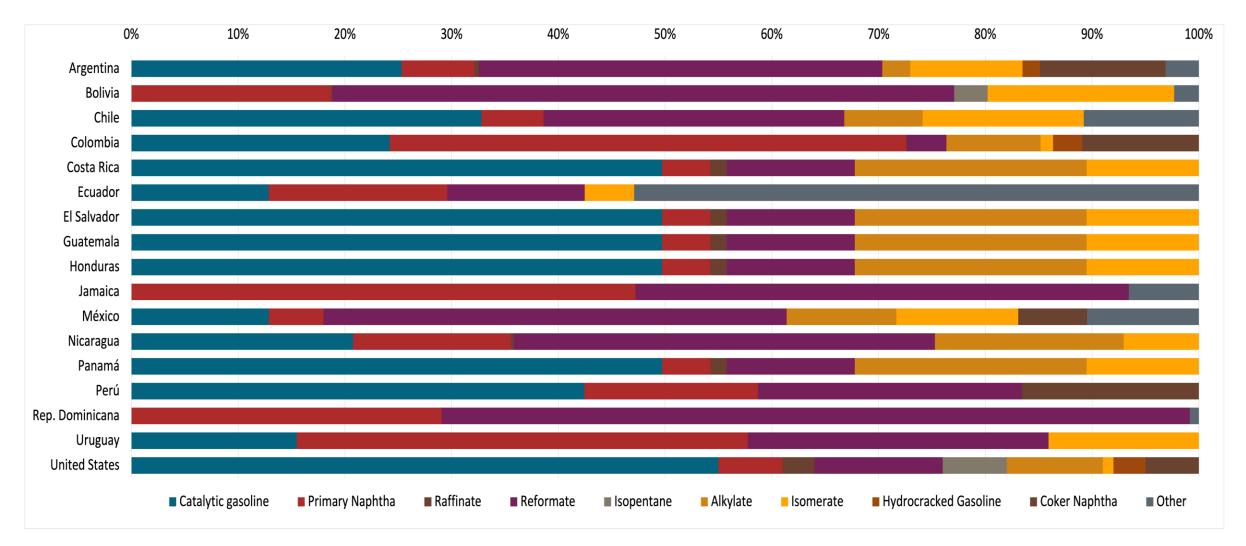
Gasoline Quality in El Salvador

Name	RTCA 75.01.19:19	RTCA 75.01.20:19	EN 228:2012 + A1:2017 (Euro 6 enabling)						
Implementation Date	2021	2021	2017						
Applicability	Whole country	Whole country	All countries						
Selected Grade	Gasoline Regular	Gasoline Premium	RON 95 E5	RON 95 E10	RON 98 E5	RON 98 E10			
Benzene Content	5% v/v	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	2,0% v/v	2,0% v/v	< 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	0,7% v/v	0,7% v/v	<2,7 % m/m	<3,7 % m/m	<2,7 % m/m	<3,7 % m/m			
Ethanol (EtOH)	-	-	<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	-	-	-	-	-	-			
Ehters 5 or more C Atoms	-	-	Based on oxygen content	<22 %v/v	Based on oxygen content	<22 %v/v			

Source: RTCA

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:



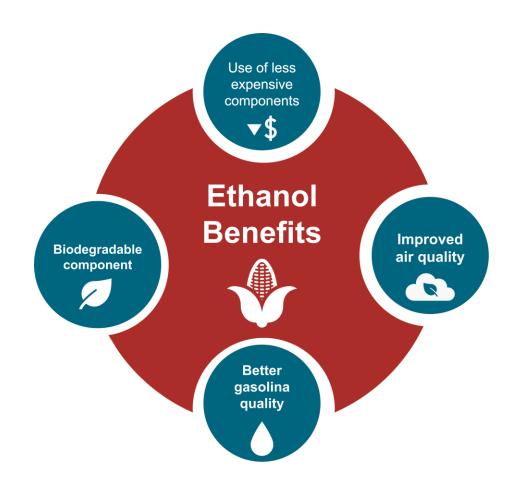
Gasoline Blending Optimization

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.

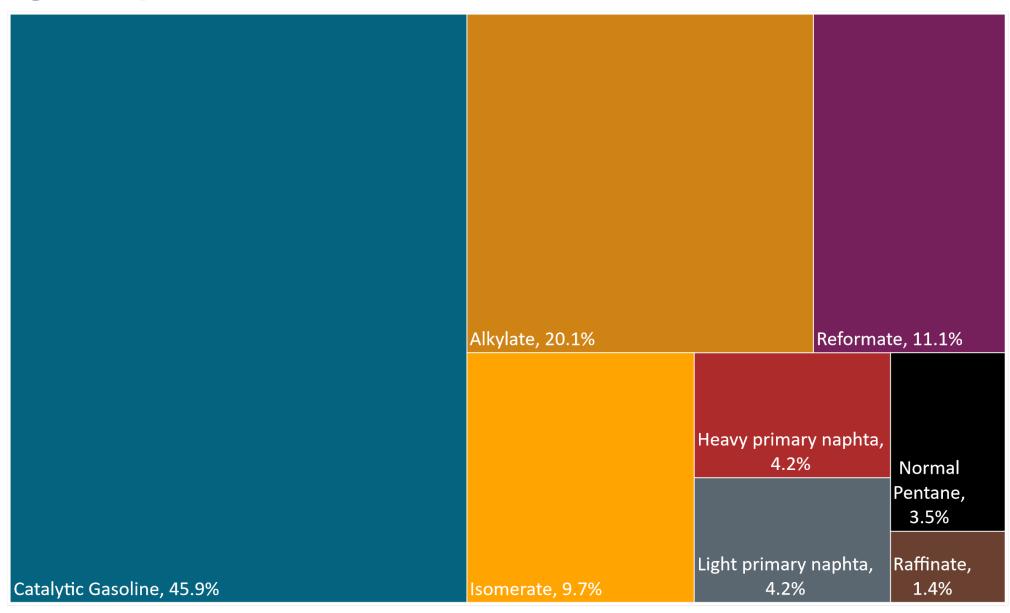
Through iterations, the model obtains the %v/v of the components to be blended with 10%, 15%, 20%, 25% and 30% of ethanol, in such a way that the final blend complies with the required properties of a finished gasoline by country.

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.



Blending Components- El Salvador

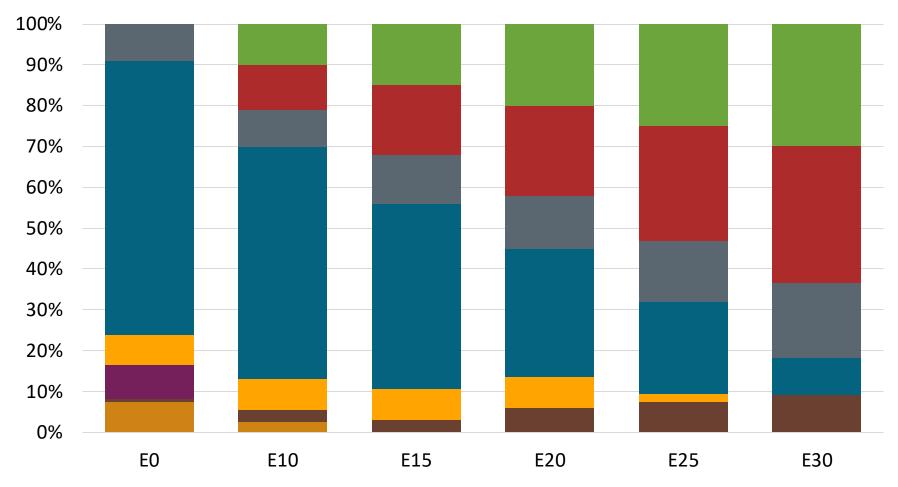




Source: Faro90

El Salvador – Regular – Constant Octane



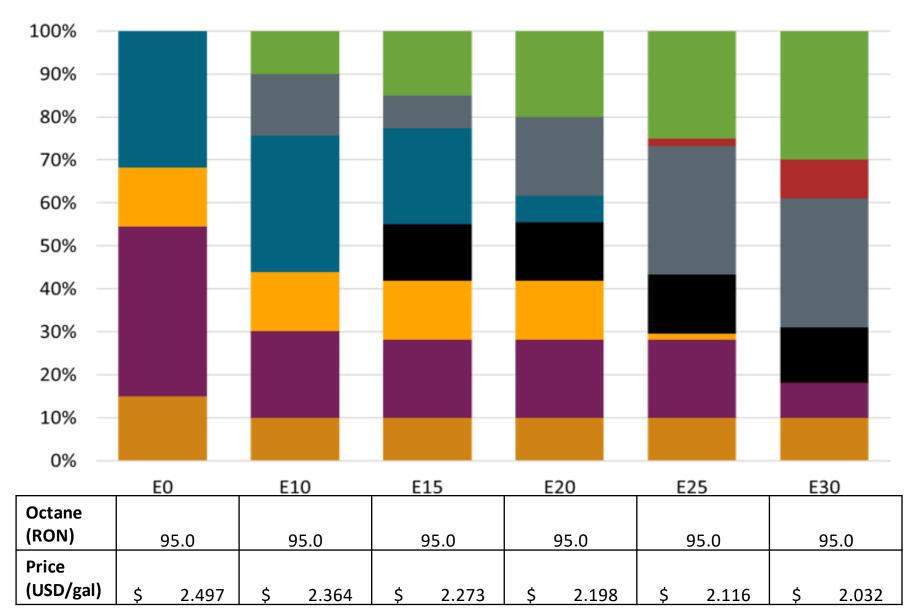


Ethanol
Alkylate
Raffinate
Reformate
Isomerate
Catalytic Gasoline
Light Primary Naphtha
Heavy Primary Naphtha

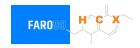
Octane (RON)	91.0		91.0		91.0		91.0		91.2		91.3	
Price (USD/gal)	\$ 2.331	\$	2.189	\$	2.127	\$	2.067	\$	2.009	\$	1.945	

El Salvador – Premium – Constant Octane

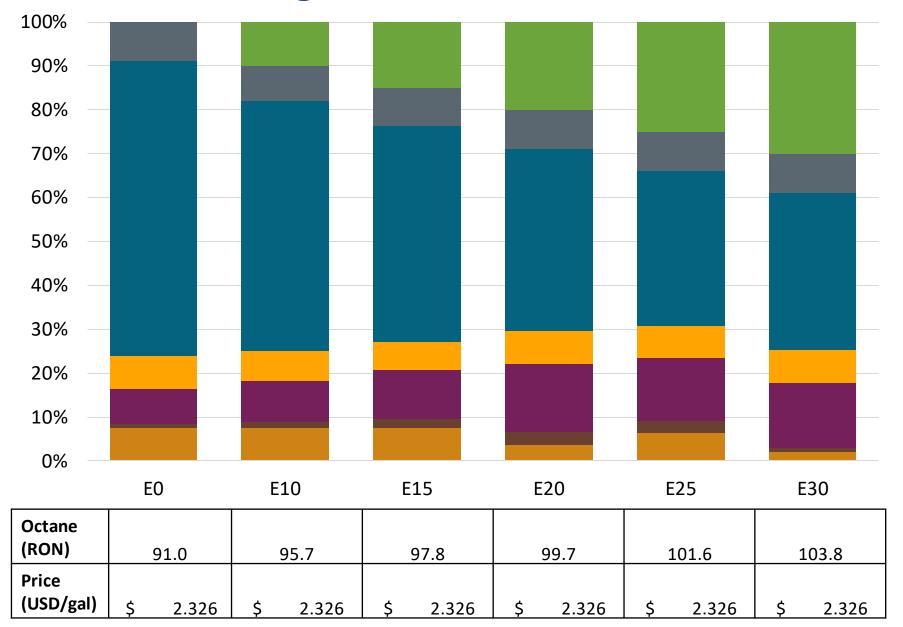




Ethanol
Alkylate
Raffinate
Reformate
Isomerate
Normal pentane
Catalytic Gasoline
Light Primary Naphtha
Heavy Primary Naphtha



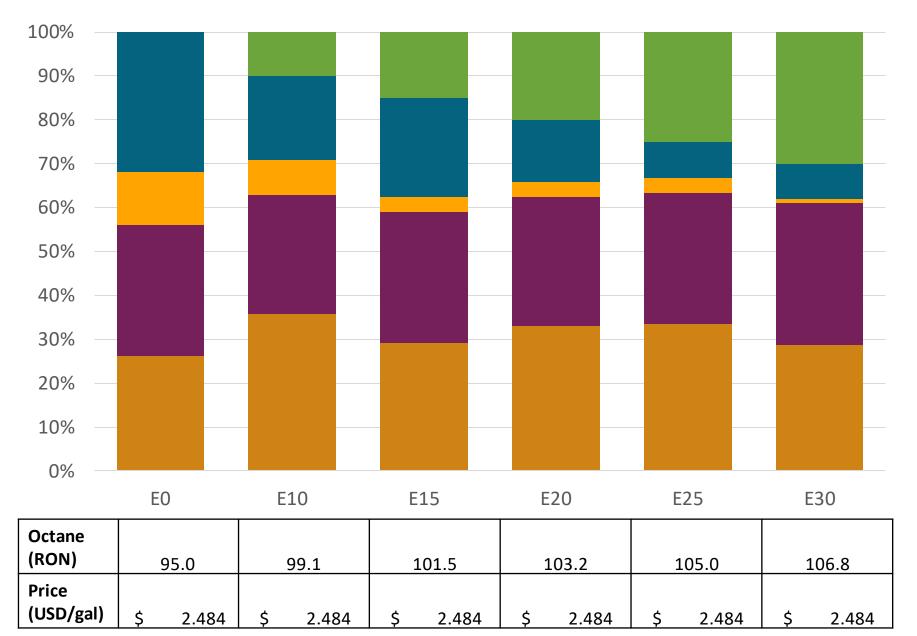
El Salvador – Regular – Octane Increment



Ethanol
Alkylate
Raffinate
Reformate
Isomerate
Catalytic Gasoline
Light Primary Naphtha

El Salvador – Premium – Octane Increment





Ethanol Alkylate Reformate Isomerate Catalytic Gasoline

Vehicle Emission Impact for Ethanol Gasoline Blending

The model used in this analysis takes as a reference the **International Vehicle Emissions Model (IVE).**

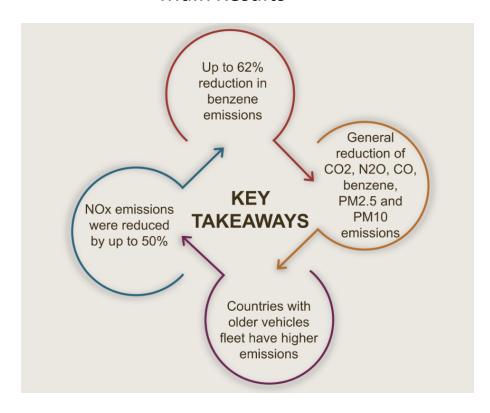
The model uses the Base Emission Rates from IVE model, as well as its Adjustment Factors based on:

- 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*.

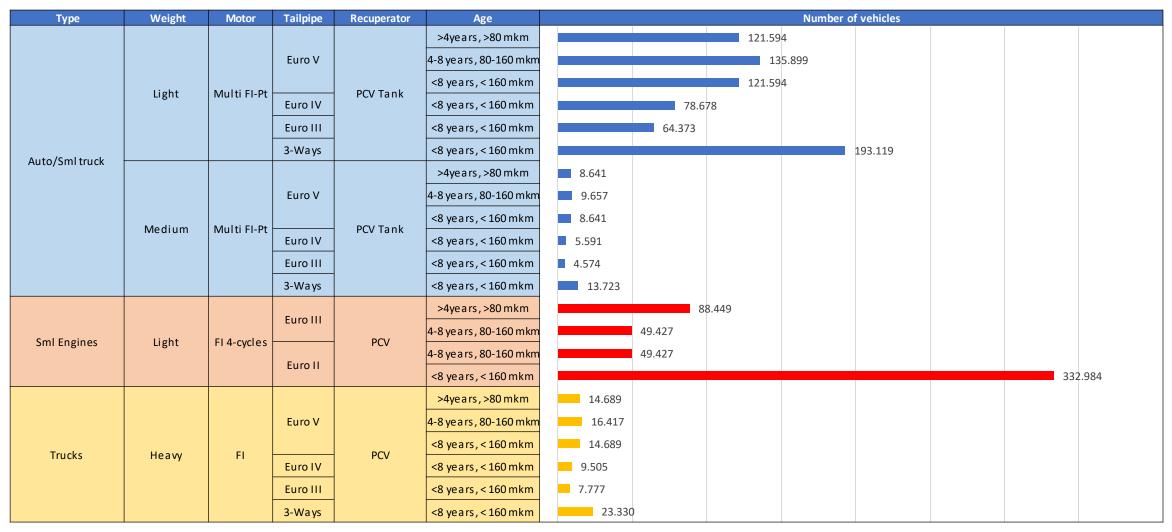
Main Results



^{*}Source: Bureau of transportation statistics.

Gasoline Vehicle Fleet - El Salvador

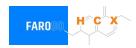




Vehicle Fleet: **1,372,776** Average Age: **11 years** Motorcycles: 31.1%

Fuente: INE 15

El Salvador – 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
со	10.12	8.77	8.24	7.71	7.31	6.86	-13%	-24%	-32%	1	3.5
VOC	1.23	1.08	1.02	0.97	0.92	0.86	-12%	-22%	-30%	95	255
VOCevap	0.47	0.47	0.48	0.49	0.50	0.51	0%	4%	7%	0.1	0.273
NOx	0.51	0.36	0.34	0.32	0.30	0.27	-30%	-38%	-46%	0.06	0.203
SOx	0.01	0.00	0.00	0.00	0.00	0.00	-15%	-28%	-41%		
NH3	0.07	0.07	0.07	0.07	0.07	0.07	-2%	0%	1%		
Butadiene	0.01	0.01	0.01	0.01	0.01	0.01	-11%	-19%	-25%		
Acetaldehyde	0.02	0.04	0.06	0.08	0.09	0.10	68%	249%	372%		
Formaldehyde	0.09	0.10	0.11	0.12	0.13	0.14	13%	39%	68%		
Benzene	0.05	0.05	0.05	0.04	0.04	0.04	-9%	-11%	-18%		
CO2	223.98	212.78	208.50	206.39	204.35	200.59	-5%	-8%	-10%		
N2O	0.01	0.01	0.01	0.01	0.01	0.01	-1%	2%	4%		
CH4	0.27	0.27	0.28	0.28	0.29	0.29	0%	4%	7%		
PM 2.5	0.02	0.01	0.01	0.01	0.01	0.01	-22%	-43%	-65%		
PM10	0.05	0.04	0.03	0.03	0.02	0.02	-22%	-43%	-65%	0.005	0.007
тнс	0.44	0.46	0.50	0.53	0.56	0.59	5%	21%	34%		

Source: Faro90