

Ethanol Blending in Gasoline – Dominican Republic

June, 2023

Ethanol Blending in Latin America

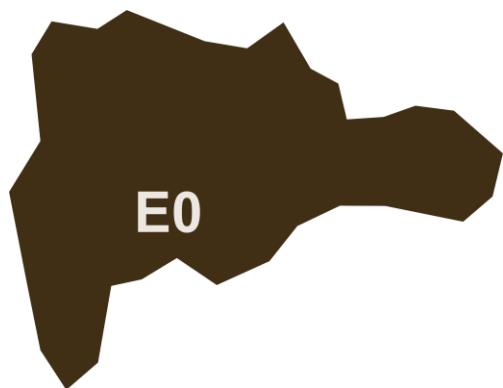
There are important fuel quality and environmental impact of vehicle emission challenges in the Region.

- 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 – Dominican Republic

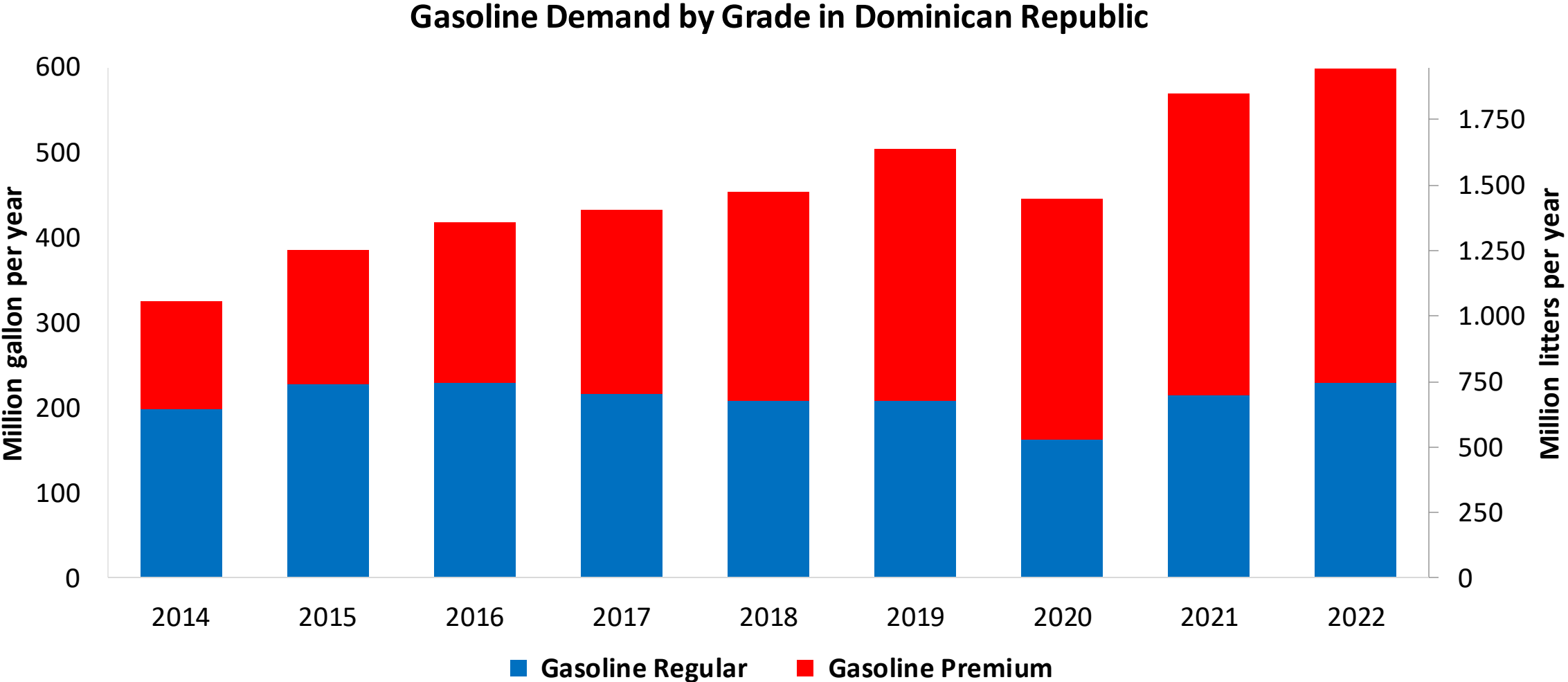


National demand is covered up by local production representing 20%, and imports from United States, Trinidad and Tobago, Caribbean, among other countries. In 2022, regular gasoline consumption was 38.3% of total demand and premium 61.7%.

Dominican Republic does not currently have an ethanol mandate.

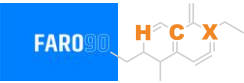
Source: DGII

Gasoline Demand in Dominican Republic

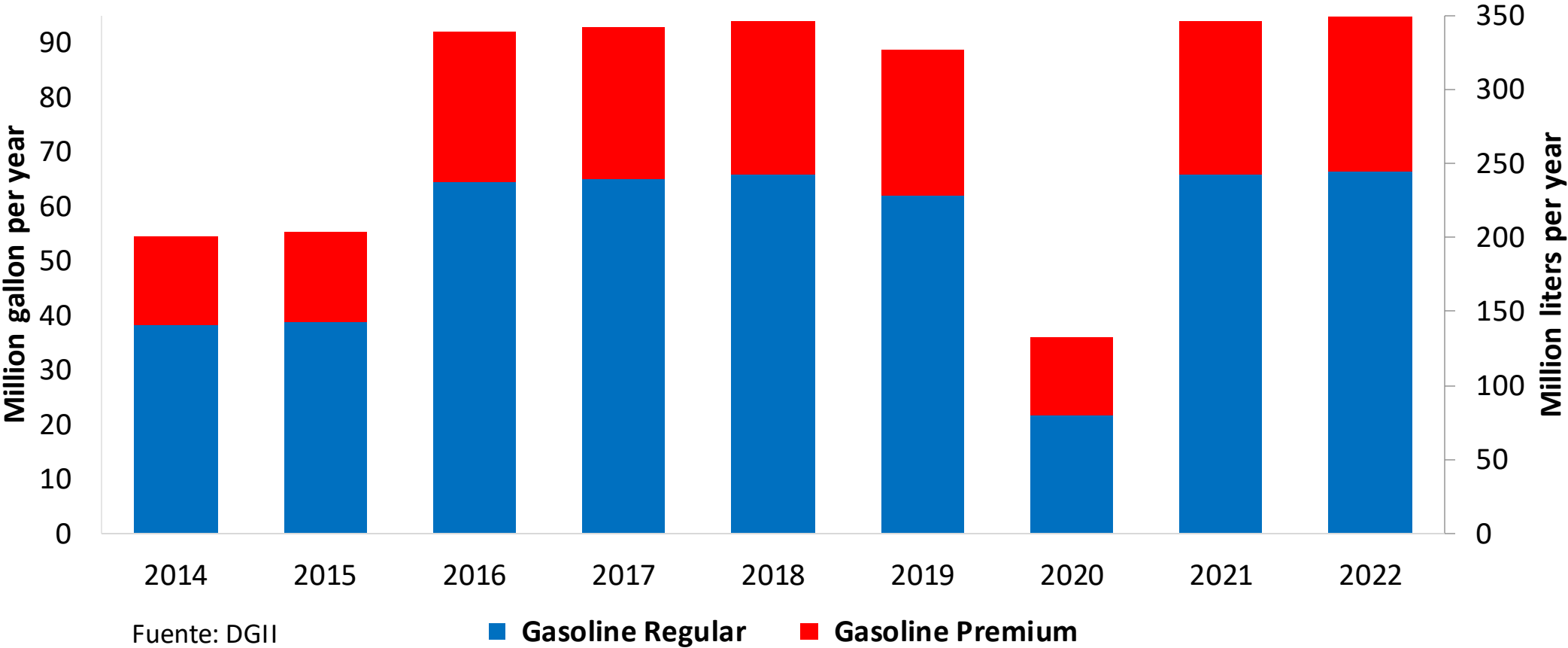


Fuente: DGII

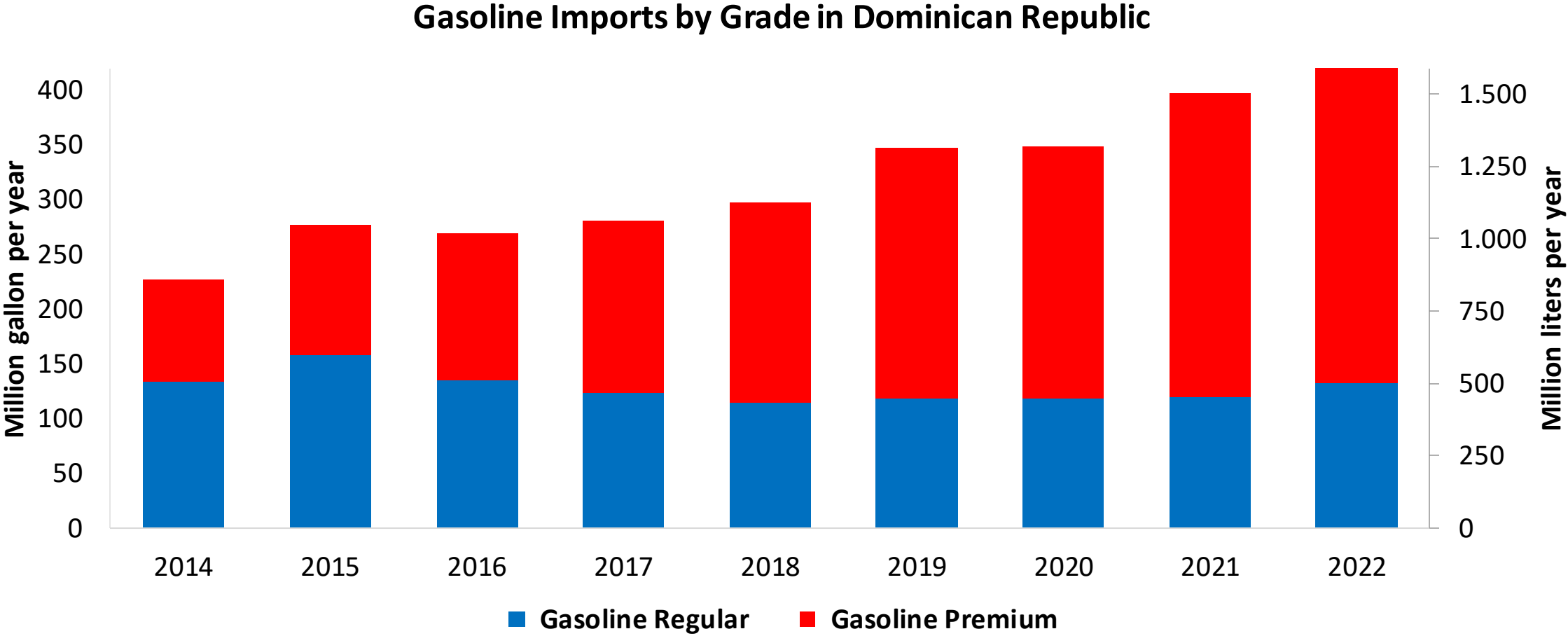
Gasoline Production in Dominican Republic



Gasoline Production by Grade in Dominican Republic



Gasoline Imports in Dominican Republic



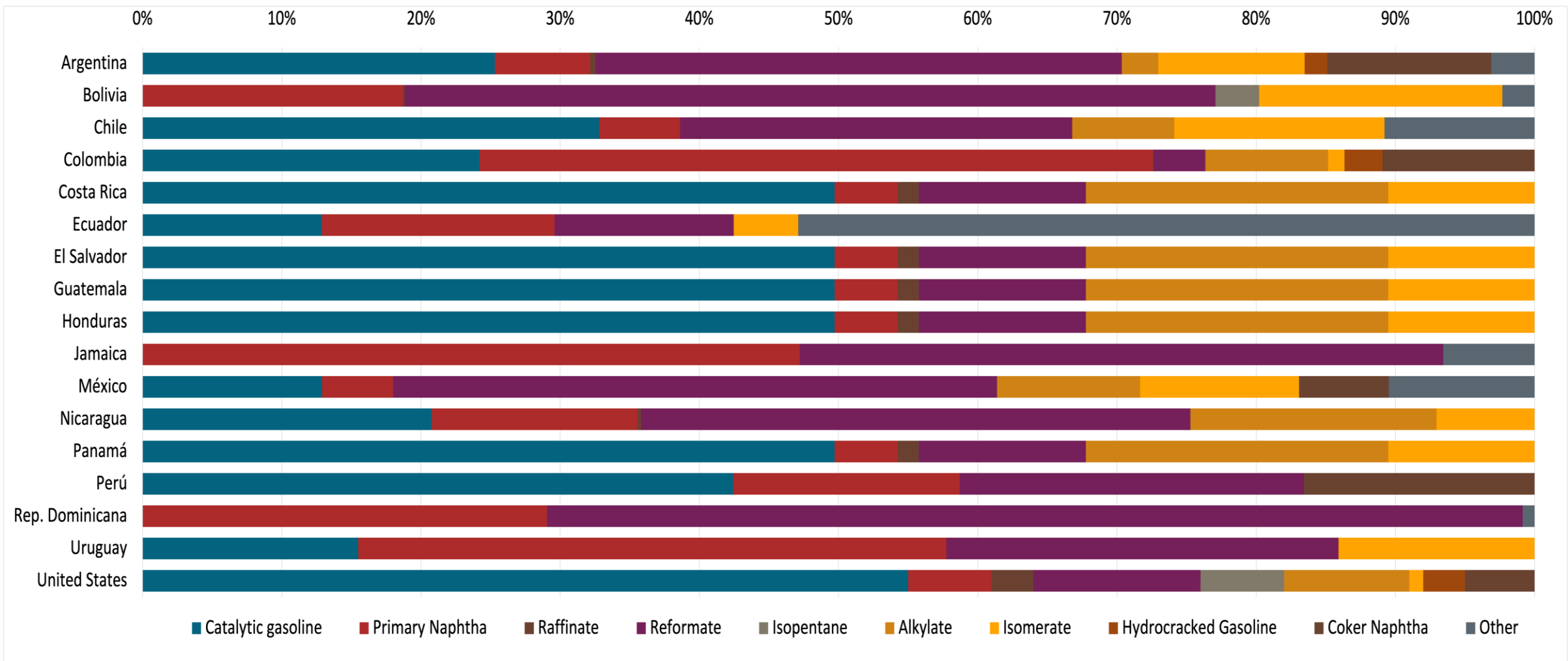
Fuente: DGII

Gasoline Quality in Dominican Republic

Name	NORDOM 476 3rd Revision				EN 228:2012 + A1:2017 (Euro 6 enabling)			
Implementation Date	2015				2017			
Applicability	Whole country	Whole country	Whole country	Whole country	All countries			
Selected Grade	Regular Gasoline	Premium Gasoline	Oxygenated Regular Gasoline	Oxygenated Premium Gasoline	RON 95 E5	RON 95 E10	RON 98 E5	RON 98 E10
Benzene Content	-	-	-	-	< 1 %v/v	< 1 %v/v	< 1 %v/v	< 1 %v/v
Aromatics	-	-	-	-	< 35 %v/v	< 35 %v/v	< 35 %v/v	< 35 %v/v
Olefins	-	-	-	-	< 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	< 8,3 mg/l	< 8,3 mg/l	< 8,3 mg/l	< 8,3 mg/l	< 2,0 mg/l	< 2,0 mg/l	< 2,0 mg/l	< 2,0 mg/l
RON	> 89	> 95	> 90	> 96	> 95	> 95	> 98	> 98
MON	> 76	> 82	> 77	> 83	> 85	> 88	> 85	> 88
AKI								
Sulfur Content	< 1.500 mg/kg	< 1.500 mg/kg	< 1.500 mg/kg	< 1.500 mg/kg	< 10 mg/kg	< 10 mg/kg	< 10 mg/kg	< 10 mg/kg
Oxygen Content			< 3.5 %m/m	< 3.5 %m/m	<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)	< 61 kPa	< 61 kPa	< 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

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:



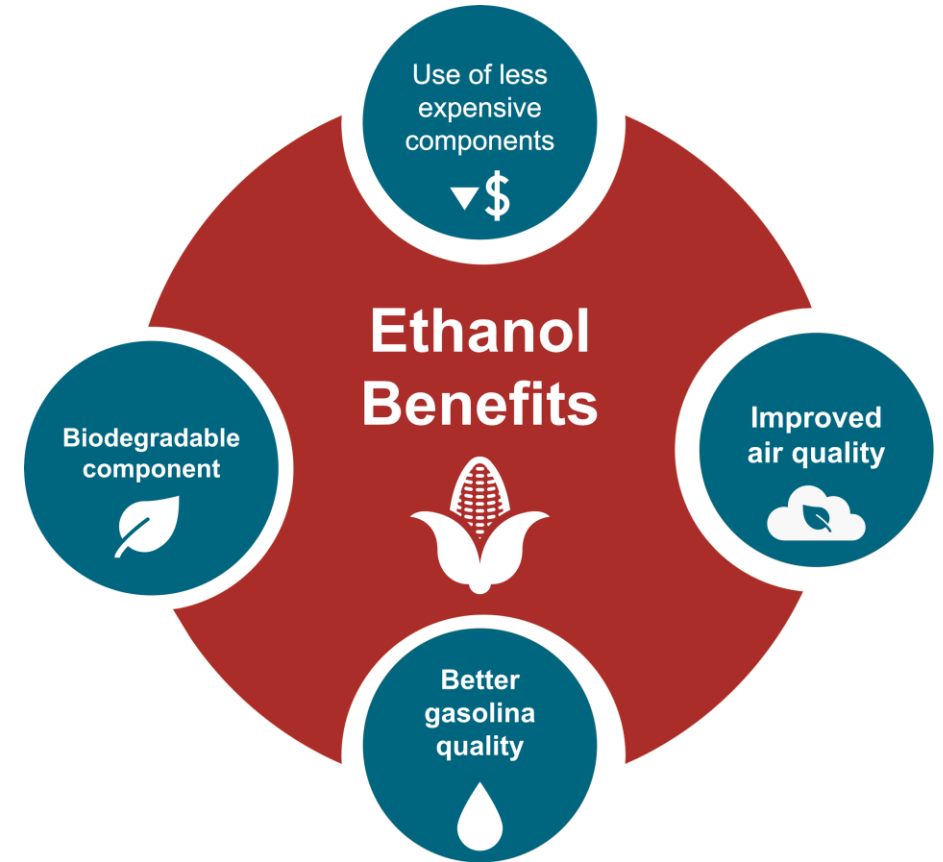
Gasoline Blending Optimization

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:

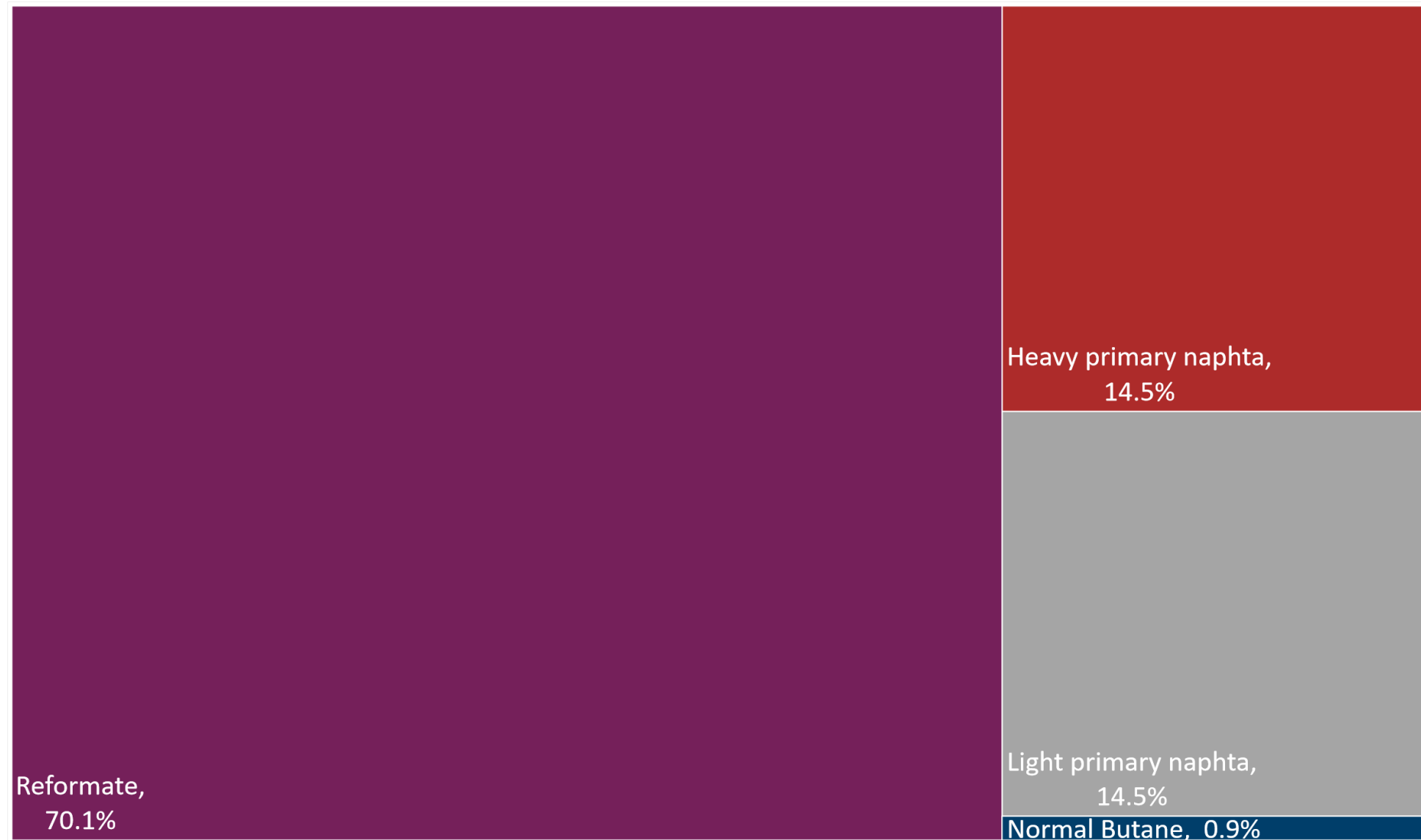
- Components prices,
- Properties each component affects,
- Quality parameters by country, and
- Component availability by country.

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.

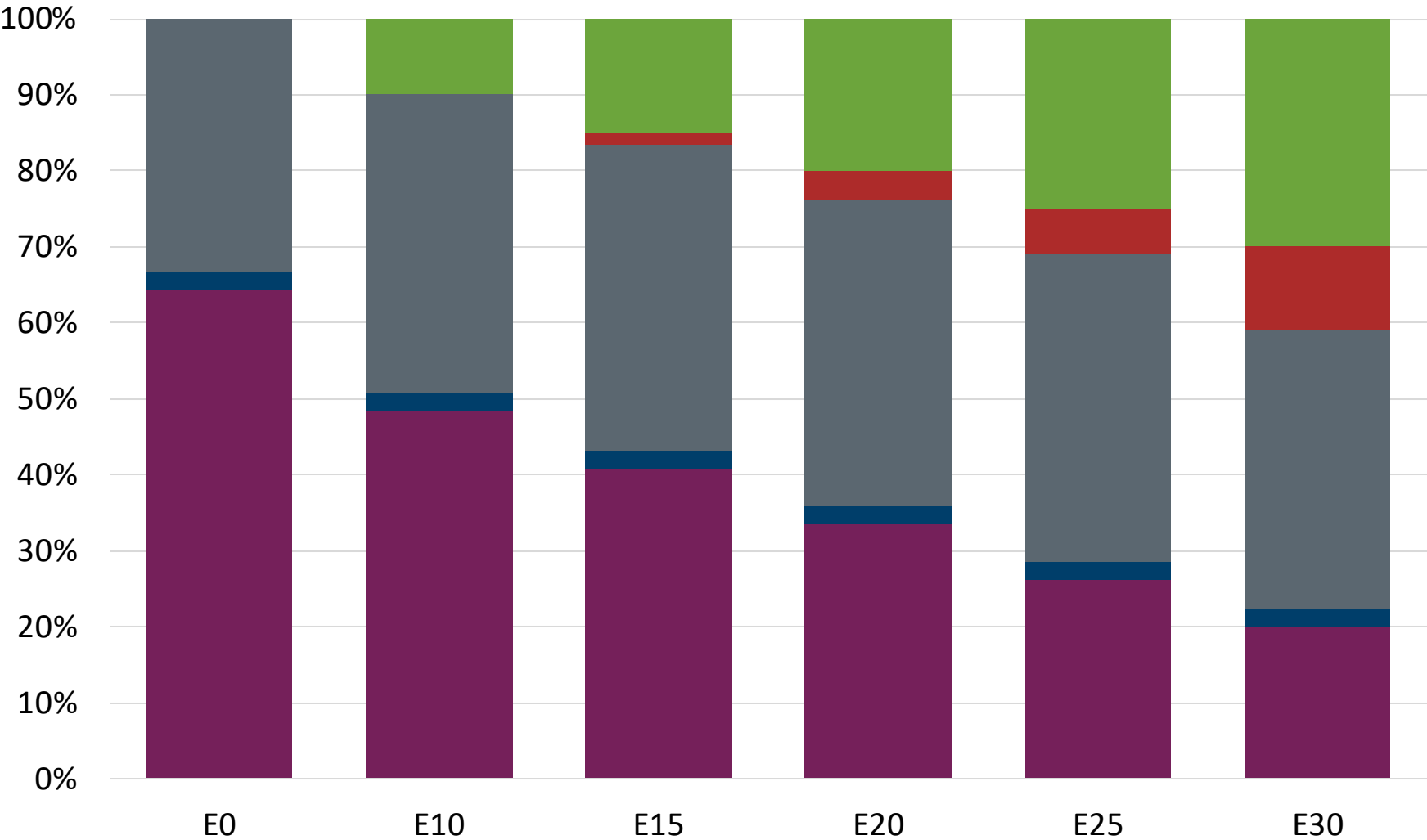
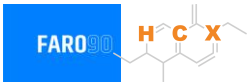
The blending model uses gasoline component spot average prices January 2022 – February 2023 and provides fuel prices that do not include country distribution costs, local taxes and subsidies and import or gas station margins.



Available Blending Components



Rep. Dominicana – Regular – Constant Octane

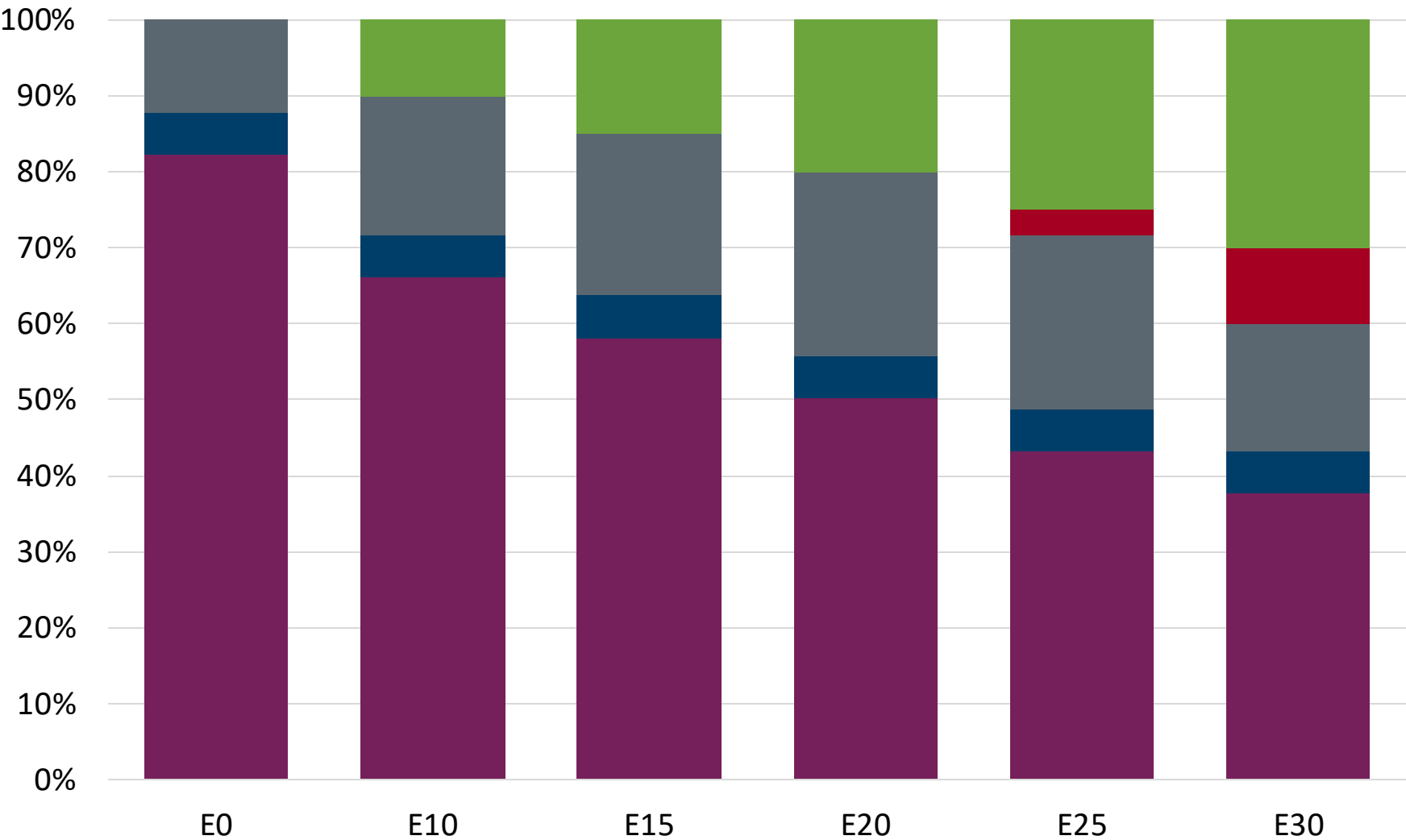
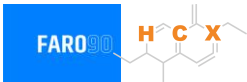


Prices are average Jan 22 – Feb 23.
They do not include local distribution costs, import or gas station margins, taxes and subsidies.

Source: Faro90

Octane (RON)	90.0	90.0	90.0	90.0	90.0	90.0
Price (USD/gal)	\$ 2.311	\$ 2.224	\$ 2.182	\$ 2.141	\$ 2.100	\$ 2.062

Rep. Dominicana – Premium – Constant Octane

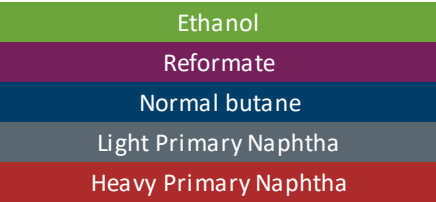
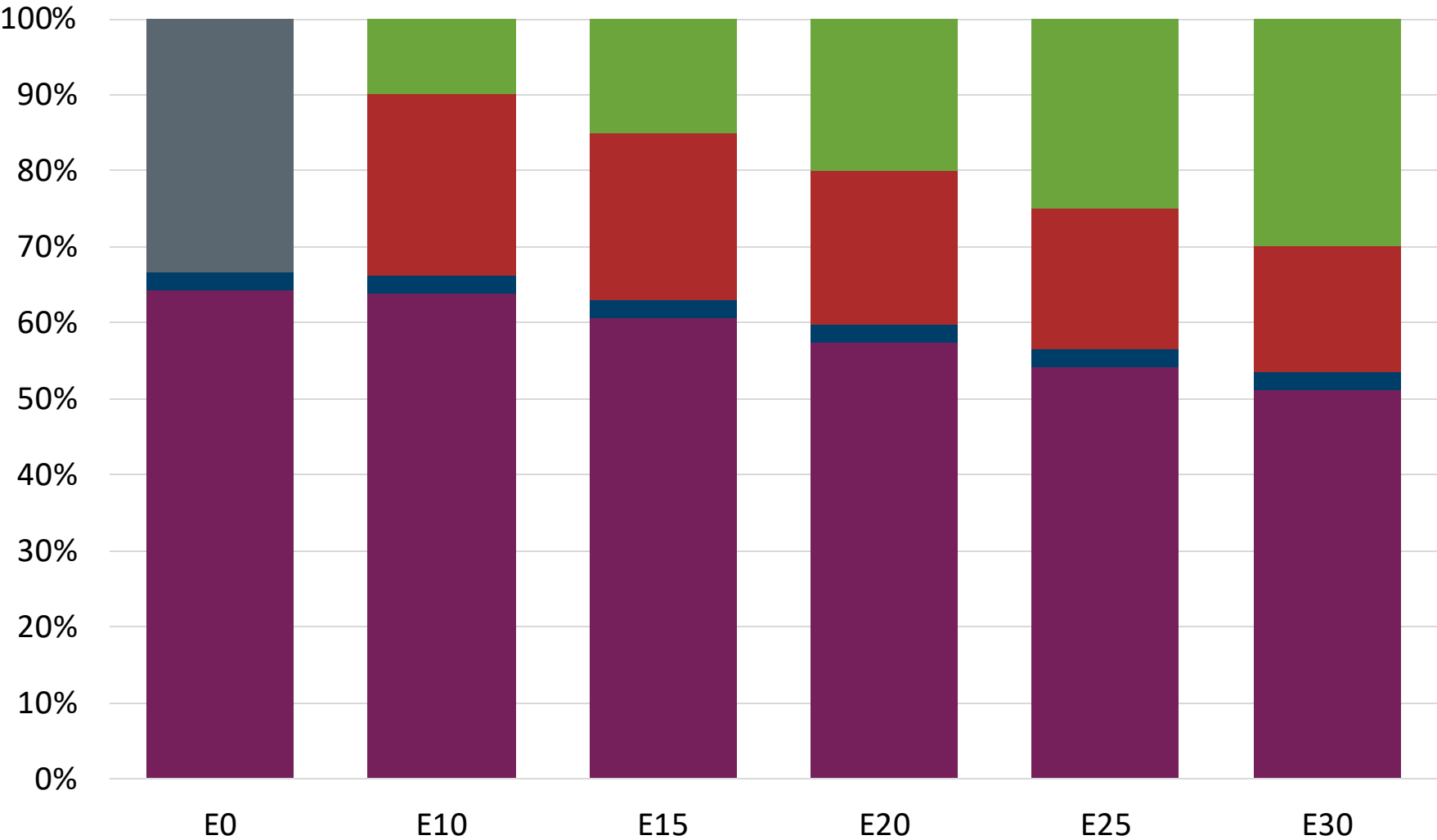
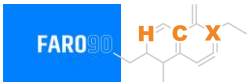


Octane (RON)	96.0	96.0	96.0	96.0	96.0	96.0
Price (USD/gal)	\$ 2.438	\$ 2.351	\$ 2.308	\$ 2.264	\$ 2.224	\$ 2.189

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

Source: Faro90

Rep. Dominicana – Regular – Octane Increment

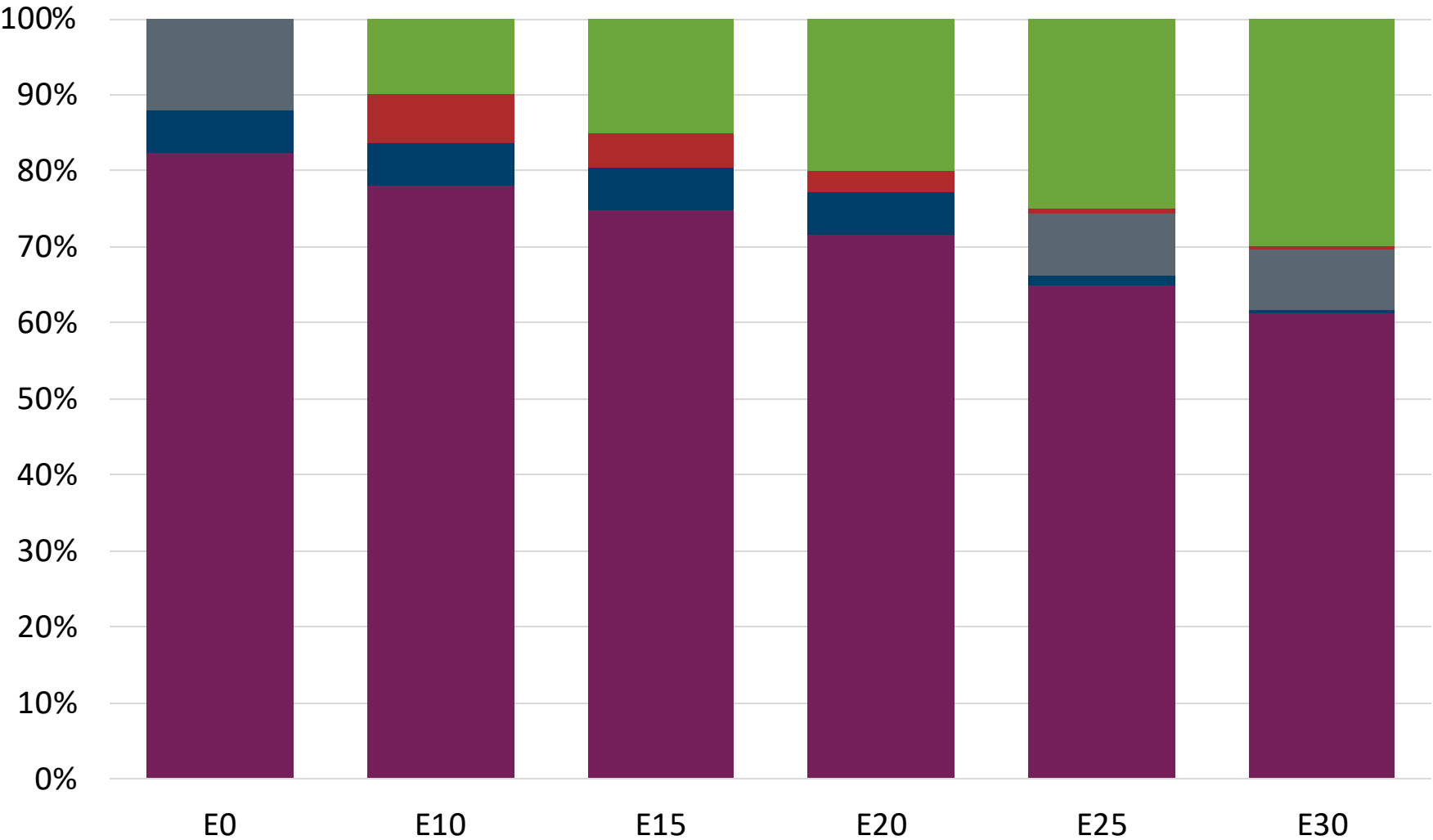
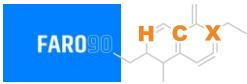


Prices are average Jan 22 – Feb 23.
They do not include local distribution costs,
import or gas station margins, taxes and
subsidies.

Source: Faro90

Octane (RON)	90.0	92.1	93.7	95.4	97.0	98.6
Price (USD/gal)	\$ 2.311	\$ 2.311	\$ 2.311	\$ 2.311	\$ 2.311	\$ 2.311

Rep. Dominicana – Premium – 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

Octane (RON)	96.0	98.8	100.4	102.1	101.7	102.9
Price (USD/gal)	\$ 2.438	\$ 2.438	\$ 2.438	\$ 2.438	\$ 2.438	\$ 2.438

Vehicle Emission Impact for Ethanol Gasoline Blending

The model used in this analysis takes as a reference the [International Vehicle Emissions Model \(IVE\)](#).

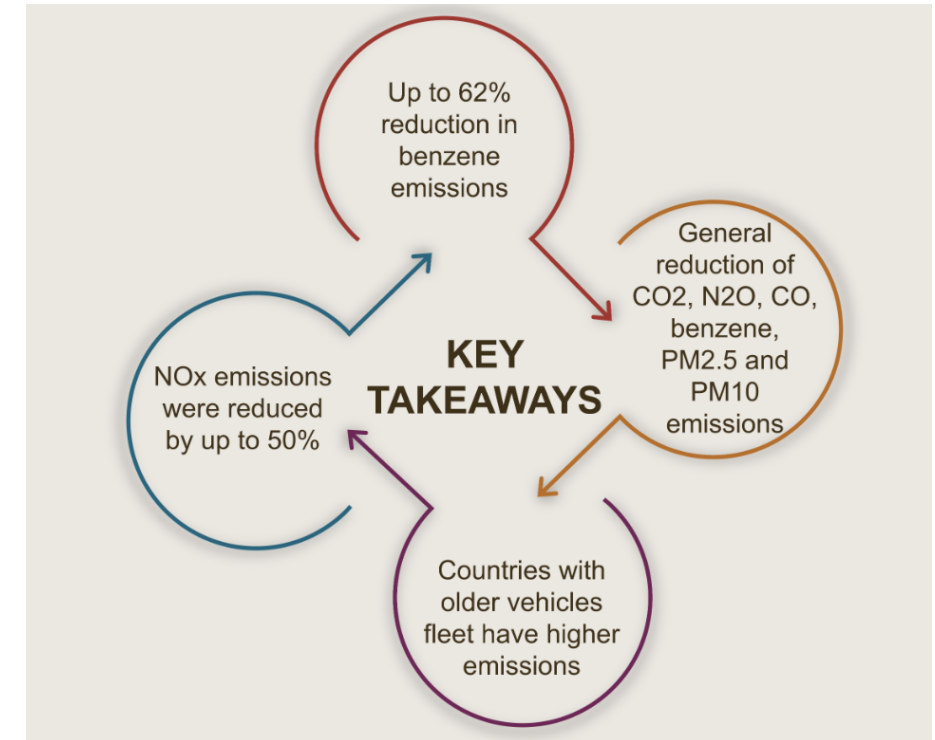
The model uses the Base Emission Rates from IVE model, as well as its Adjustment Factors based on:

- 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 – Dominican Republic

Type	Motor	Tailpipe	Recuperator	Age	Number of vehicles						
Auto/Sml Truck	Multi FI-Pt	Euro V	PCV Tank	>4years, >80 mkm	<div><div></div></div> 33.537						
				4-8 years, 80-160 mkm	<div><div></div></div> 121.672						
				<8 years, < 160 mkm	<div><div></div></div> 258.725						
		Euro IV		<8 years, < 160 mkm	<div><div></div></div> 275.584						
		Euro III		<8 years, < 160 mkm	<div><div></div></div> 210.321						
		3-Ways		<8 years, < 160 mkm	<div><div></div></div> 807.127						
Sml Engine	FI 4-cycle	Euro III	PCV	>4 years, >80 mkm	<div><div></div></div> 203.962						
				4-8 years, 80-160 mkm	<div><div></div></div> 260.076						
		Euro II		4-8 years, 80-160 mkm	<div><div></div></div> 224.705						
				<8 years, < 160 mkm	<div><div></div></div> 2.374.961						
Truck	FI	Euro V	PCV	>4 years, >80 mkm	<div><div></div></div> 11.166						
				4-8 years, 80-160 mkm	<div><div></div></div> 20.697						
				<8 years, < 160 mkm	<div><div></div></div> 16.744						
		Euro IV		<8 years, < 160 mkm	<div><div></div></div> 19.818						
		Euro III		<8 years, < 160 mkm	<div><div></div></div> 34.793						
		3-Ways		<8 years, < 160 mkm	<div><div></div></div> 163.311						

Vehicular Fleet: **5,037,199**
Average age : **13 years**
Motorcycle: **61%**

Gasoline Vehicle Emissions – Dominican Republic

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	12.81	10.29	9.20	8.09	7.22	6.31	-20%	-37%	-51%	1	3.5
VOC	1.98	1.66	1.52	1.39	1.28	1.14	-16%	-30%	-42%	95	255
VOCevap	0.69	0.69	0.70	0.72	0.73	0.74	0%	4%	7%	0.1	0.273
NOx	0.64	0.45	0.42	0.40	0.37	0.34	-30%	-38%	-46%	0.06	0.203
SOx	0.00	0.00	0.00	0.00	0.00	0.00	-15%	-28%	-41%		
NH3	0.08	0.08	0.08	0.08	0.08	0.08	-2%	0%	1%		
Butadiene	0.02	0.01	0.01	0.01	0.01	0.01	-13%	-24%	-33%		
Acetaldehyde	0.04	0.07	0.11	0.15	0.17	0.20	68%	249%	372%		
Formaldehyde	0.17	0.20	0.23	0.24	0.27	0.29	13%	39%	68%		
Benzene	0.07	0.06	0.06	0.06	0.06	0.06	-9%	-11%	-18%		
CO2	201.92	191.82	187.96	186.06	184.31	180.91	-5%	-8%	-10%		
N2O	0.01	0.01	0.01	0.01	0.01	0.01	-1%	2%	4%		
CH4	0.44	0.44	0.44	0.45	0.46	0.47	0%	4%	7%		
PM 2.5	0.02	0.01	0.01	0.01	0.01	0.01	-22%	-43%	-65%		
PM10	0.10	0.08	0.07	0.06	0.05	0.03	-22%	-43%	-65%	0.005	0.007
THC	0.74	0.78	0.86	0.91	0.96	1.02	6%	24%	39%		