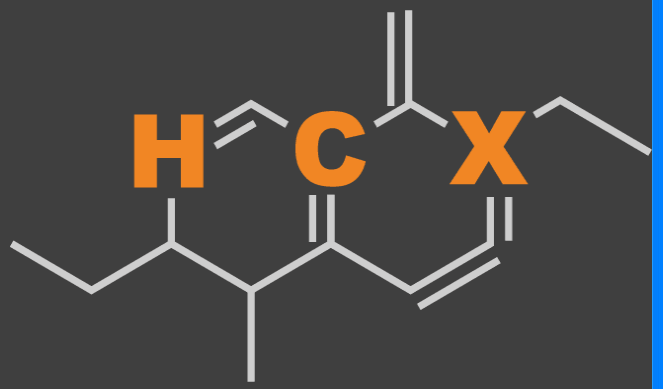


FARO90

Ethanol Blending in Gasoline - Argentina

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.

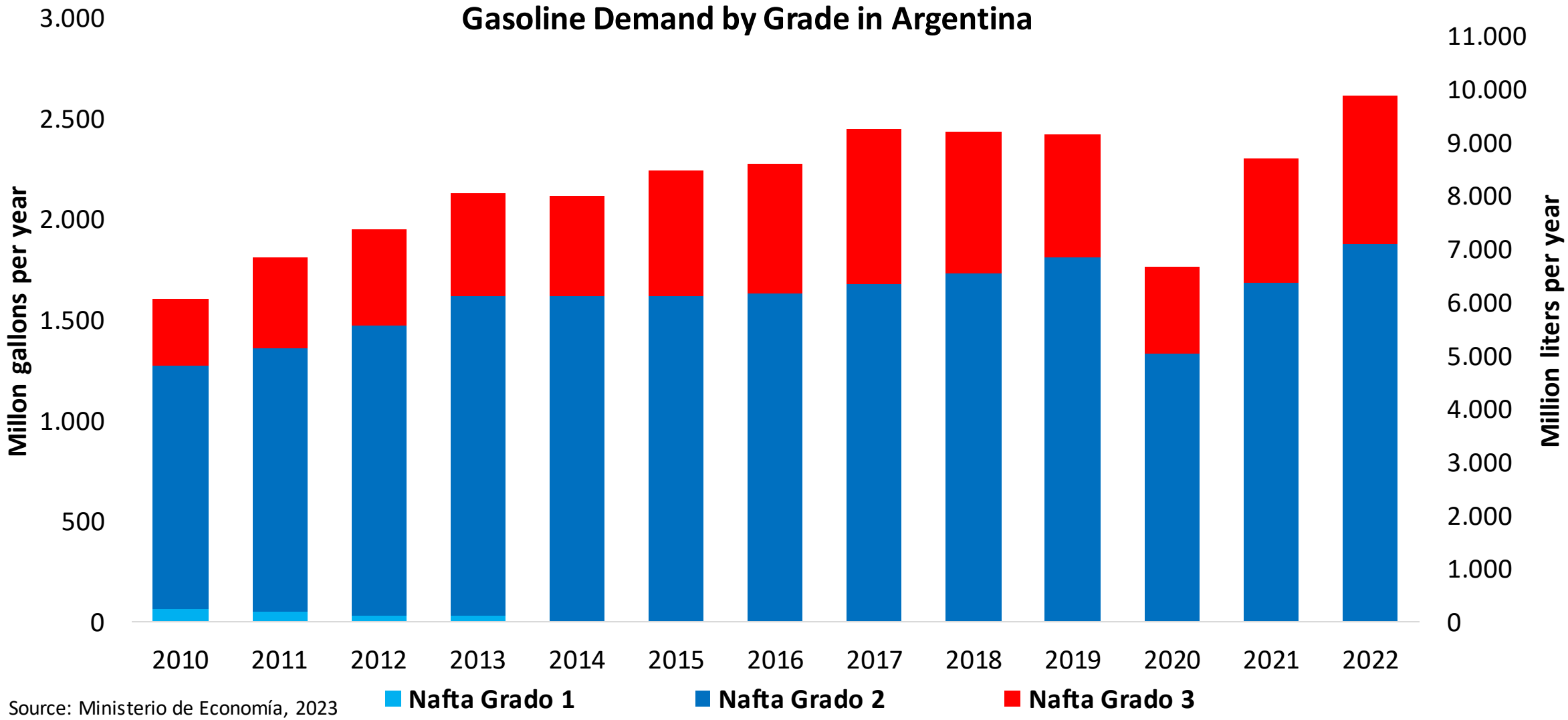
Ethanol Blending in Gasoline - Argentina

La demanda de gasolinas en Argentina fue poco más de 2,500 millones de galones en 2022 (9,000 millones de litros). Se cuenta con la siguiente participación por tipo de gasolina: 75% como Nafta Súper / Grado 2 (RON 93 – AKI 87) y 25% restante como Nafta Ultra / Grado 3 (RON 97 – AKI 92). Argentina produce casi la totalidad de la gasolina, las importaciones son menos de 250 millones de litros por año.

Argentina's policy is self-sufficiency and production and supply of ethanol for gasoline blend. Ethanol concentration varies according to local production. Currently, the concentration limit is 12% v/v. Ethanol production is almost equal to consumption.

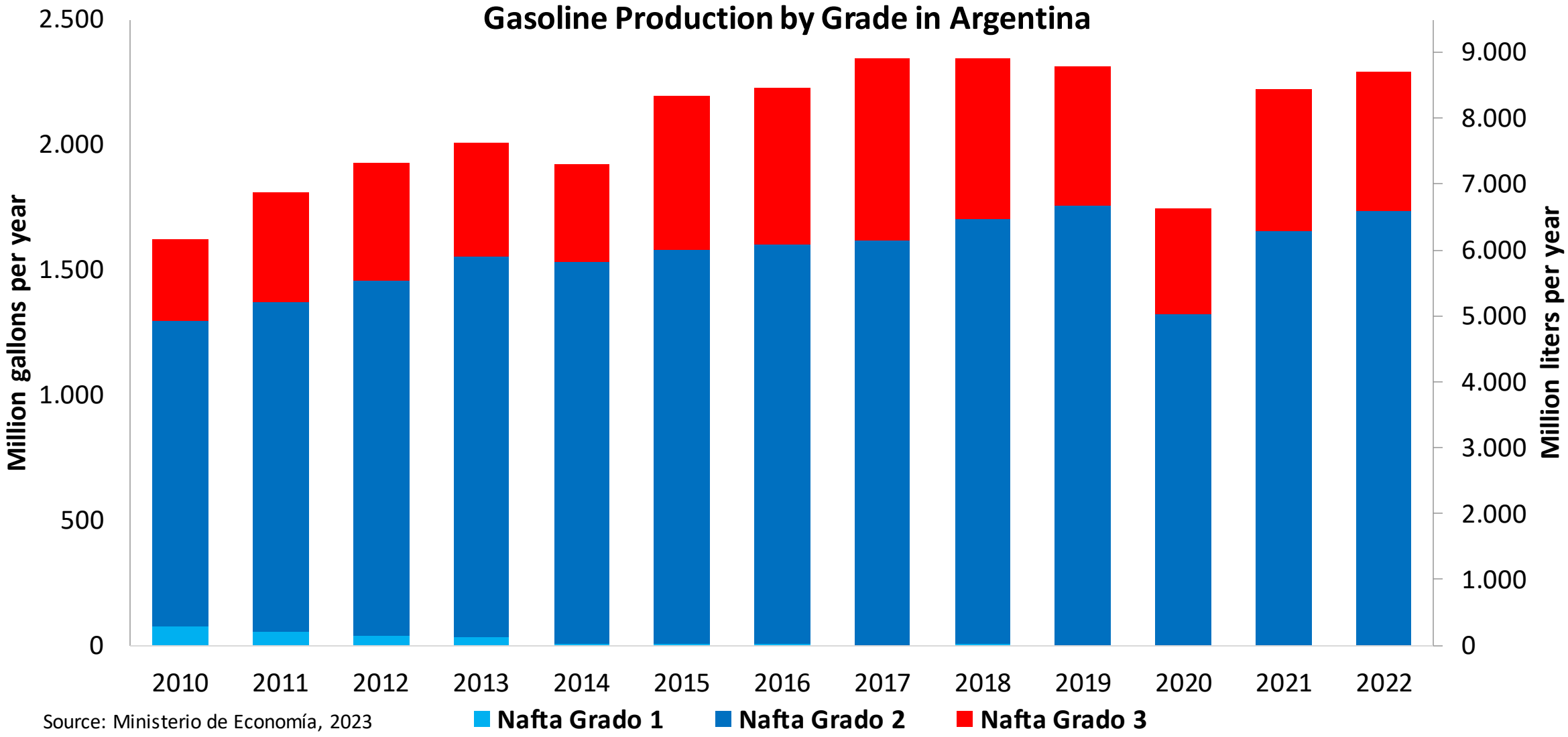
Source: Ministerio de Economía, 2023

Gasoline Demand in Argentina



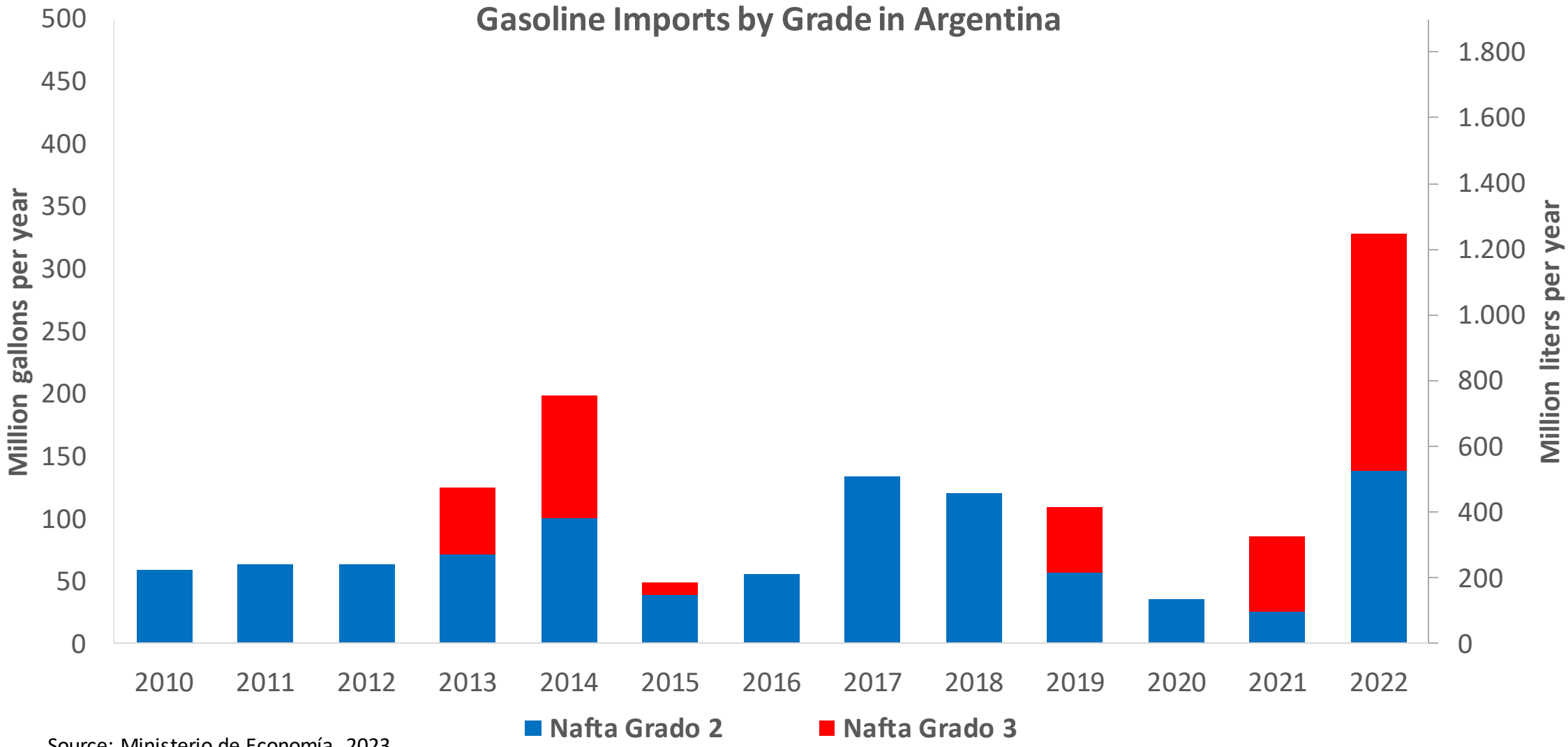
Source: Ministerio de Economía, 2023

Gasoline Production in Argentina



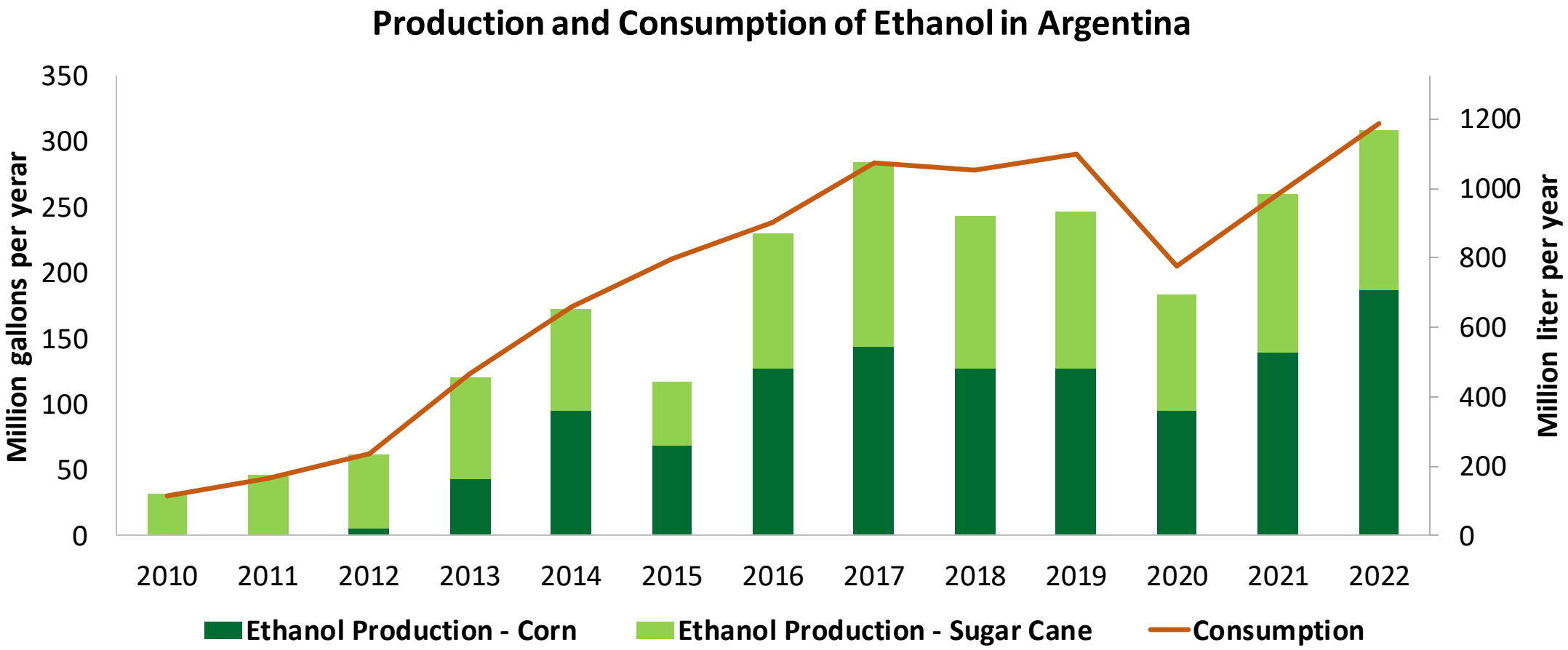
Source: Ministerio de Economía, 2023

Gasoline Imports in Argentina



Source: Ministerio de Economía, 2023

Ethanol Balance in Argentina



Source: Ministerio de Economía, 2023

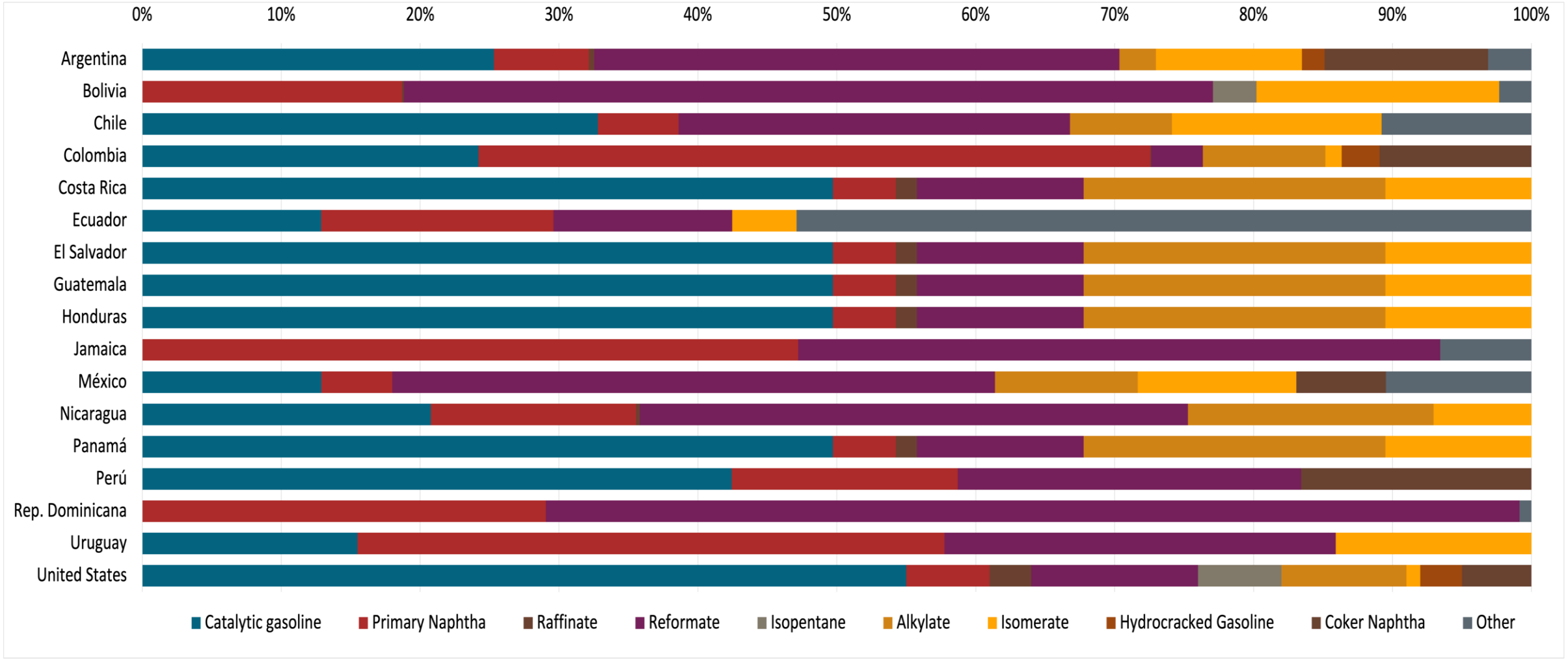
Gasoline Quality in Argentina

Name	Resolution 576/2019						EN 228:2012 + A1:2017 (Euro 6 enabling)			
Implementation Date	2019						2017			
Applicability	North Zone		Central Zone		South Zone		All countries			
Selected Grade	Gasoline Grade 2	Gasoline Grade 3	Gasoline Grade 2	Gasoline Grade 3	Gasoline Grade 2	Gasoline Grade 3	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	< 1 %v/v	< 1 %v/v	< 1 %v/v	< 1 %v/v	< 1 %v/v	< 1 %v/v
Aromatics	< 40 %v/v	< 40 %v/v	< 40 %v/v	< 40 %v/v	< 40 %v/v	< 40 %v/v	< 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	< 5 mg/l	< 5 mg/l	< 5 mg/l	< 5 mg/l	< 5 mg/l	< 5 mg/l	< 5 mg/l	< 5 mg/l	< 5 mg/l	< 5 mg/l
Manganese	< 2.5 mg/l	< 2.5 mg/l	< 2.5 mg/l	< 2.5 mg/l	< 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	> 93	> 97	> 93	> 97	> 93	> 97	> 95	> 95	> 98	> 98
MON	> 83	> 85	> 83	> 85	> 83	> 85	> 85	> 88	> 85	> 88
AKI										
Sulfur Content	< 150 mg/kg	< 10 mg/kg	< 150 mg/kg	< 10 mg/kg	< 150 mg/kg	< 10 mg/kg	< 10 mg/kg	< 10 mg/kg	< 10 mg/kg	< 10 mg/kg
Oxygen Content	< 4.5 %m/m	< 4.5 %m/m	< 4.5 %m/m	< 4.5 %m/m	< 4.5 %m/m	< 4.5 %m/m	<2,7 % m/m	<3,7 % m/m	<2,7 % m/m	<3,7 % m/m
Ethanol (EtOH)	<> 12 - 14 %v/v	<> 12 - 14 %v/v	<> 12 - 14 %v/v	<> 12 - 14 %v/v	<> 12 - 14 %v/v	<> 12 - 14 %v/v	<5 %v/v	<10 %v/v	<5 %v/v	<10 %v/v
RVP 37.8°C (Summer)	<> 35 - 70 kPa	<> 35 - 70 kPa	<> 35 - 70 kPa	<> 35 - 70 kPa	<> 45 - 80 kPa	<> 45 - 80 kPa	<> 60 - 70 kPa *Depends on the country, RVP is regulated in the EU Fuel Quality Directive			
RVP 37.8 °C(Winter)	<> 45 - 80 kPa	<> 45 - 80 kPa	<> 55 - 90 kPa	<> 55 - 90 kPa	<> 55 - 90 kPa	<> 55 - 90 kPa				
RVP 37.8°C (Transition)			<> 45 - 80 kPa	<> 45 - 80 kPa						
MTBE	< 15 %v/v	< 15 %v/v	< 15 %v/v	< 15 %v/v	< 15 %v/v	< 15 %v/v	-	-	-	-
Ehters 5 or more C Atoms	< 22 %v/v	< 22 %v/v	< 22 %v/v	< 22 %v/v	< 22 %v/v	< 22 %v/v	Based on oxygen content	<22 %v/v	Based on oxygen content	<22 %v/v

Source: Ministerio de Hacienda, 2019

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:



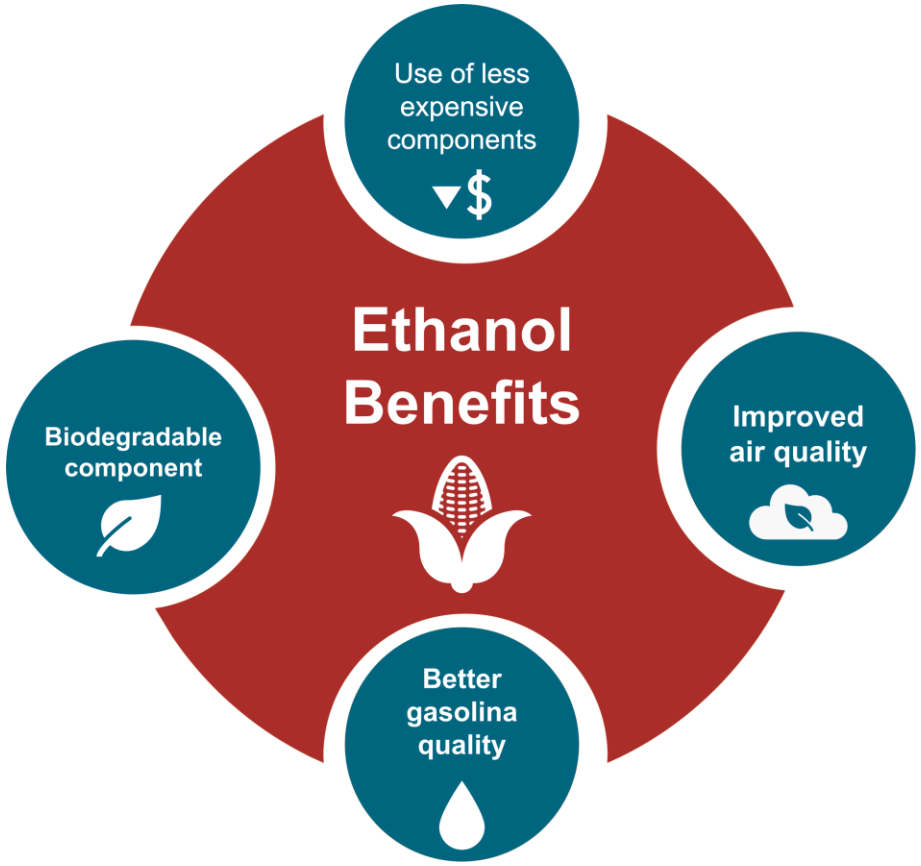
Gasoline Blending Optimization

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:

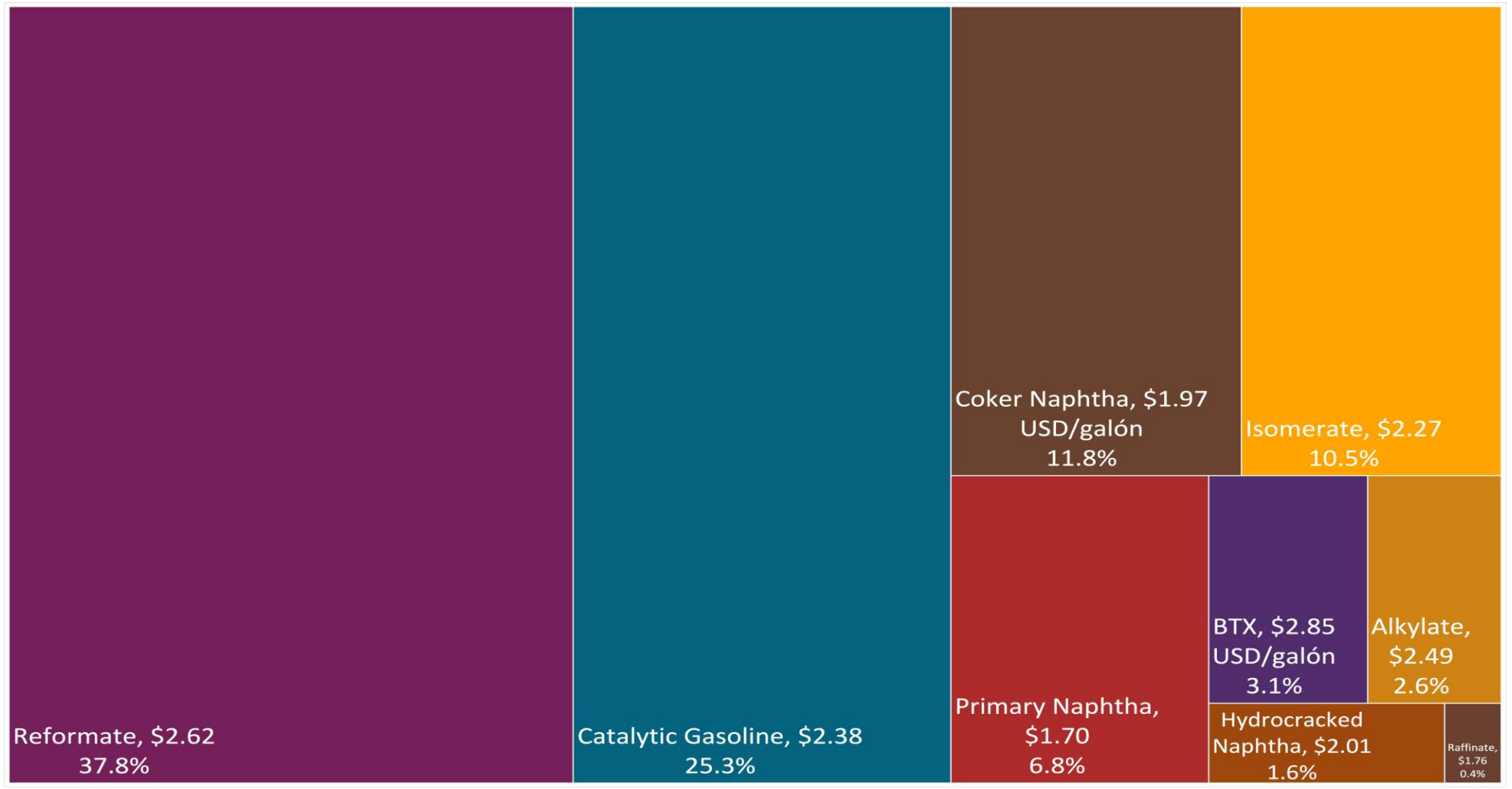
- Components prices,
- Properties each component affects,
- Quality parameters by country, and
- Component availability by country.

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.

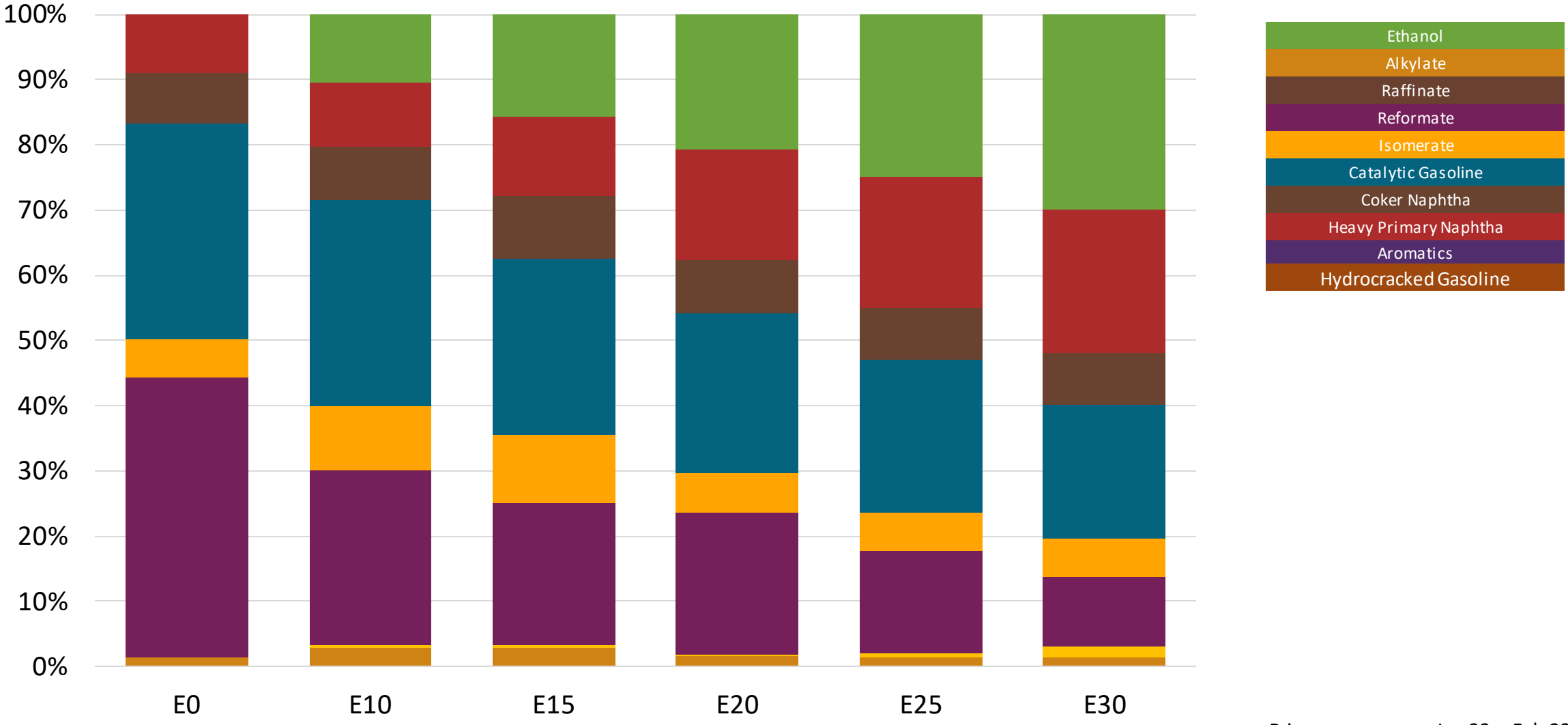


Available Blending Components



Source: Faro90

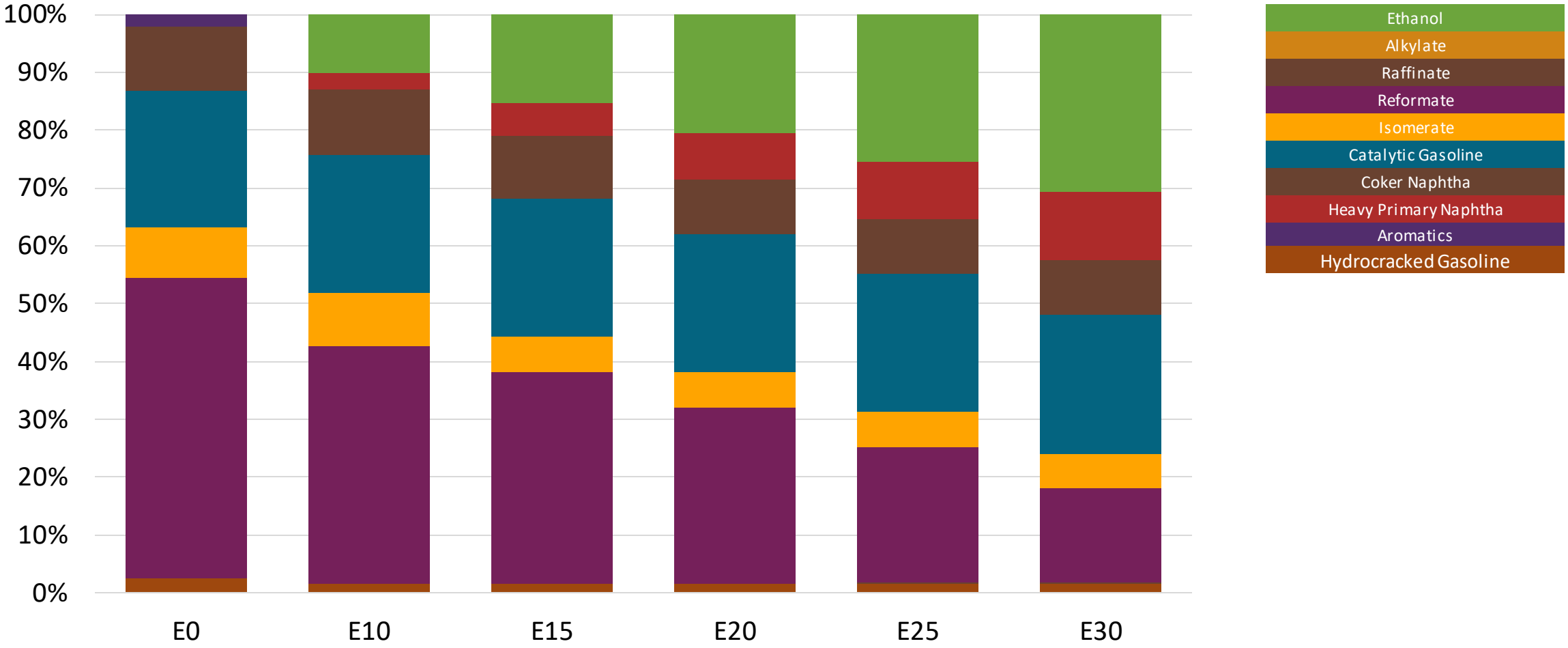
Argentina – Regular – Z. Norte y Centro – Constant Octane



	E0	E10	E15	E20	E25	E30
Octane (RON)	93.0	93.0	93.0	93.0	93.0	93.0
Price (USD/gal)	$ 2.380	$ 2.303	$ 2.261	$ 2.231	$ 2.195	$ 2.156

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

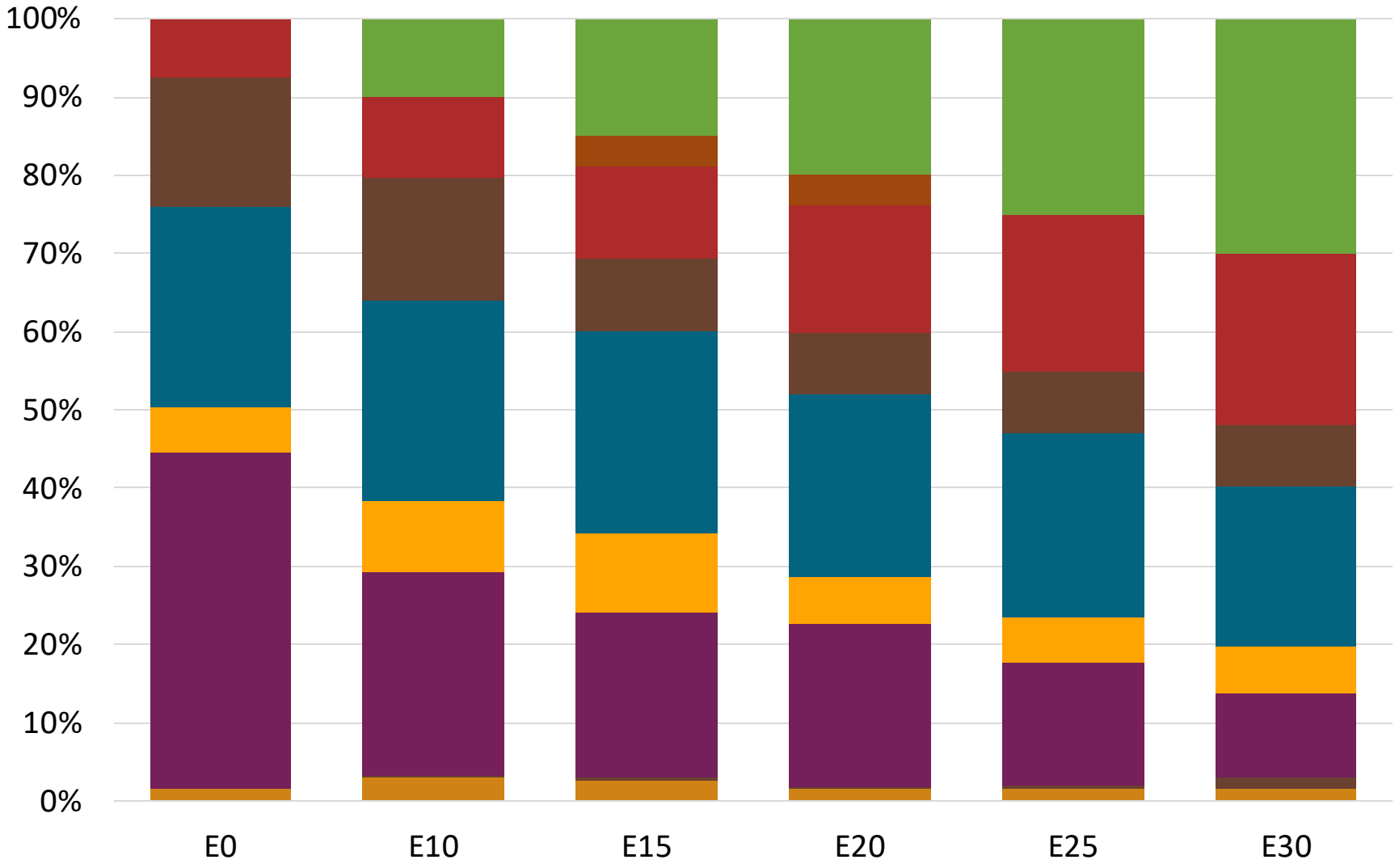
Argentina – Premium – Z. Norte y Centro – Constan Octane

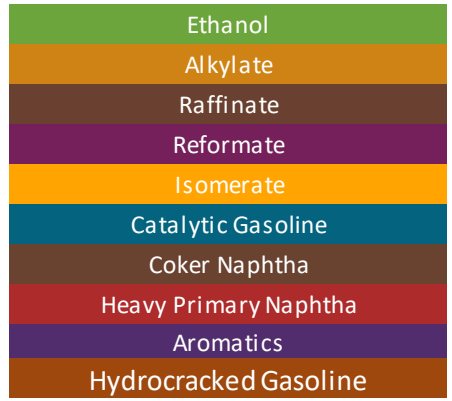


Octane (RON)	97.0	97.0	97.0	97.0	97.0	97.0
Price (USD/gal)	$ 2.465	$ 2.385	$ 2.352	$ 2.318	$ 2.281	$ 2.243

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

Argentina – Regular – Z. Sur – Constant Octane

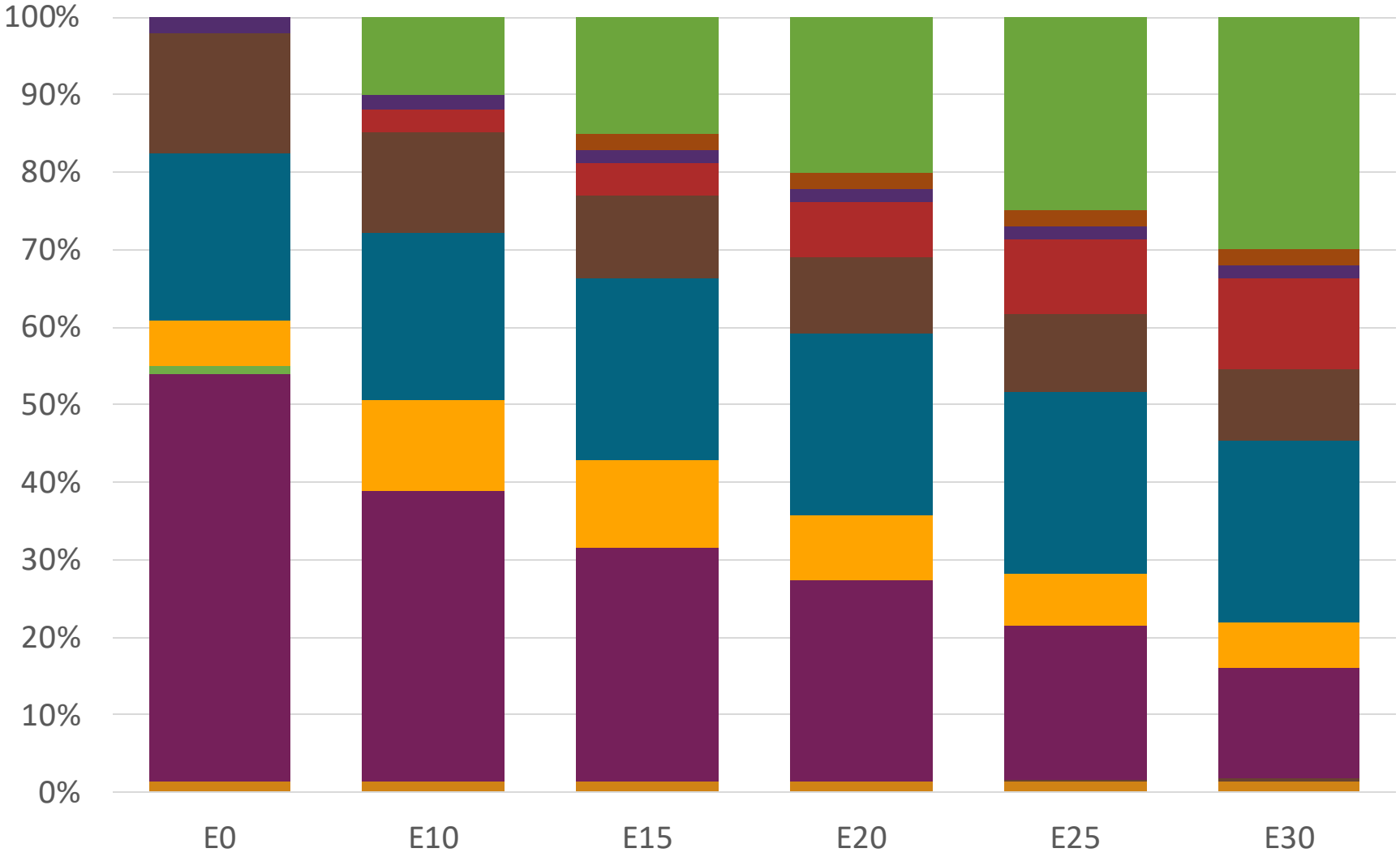


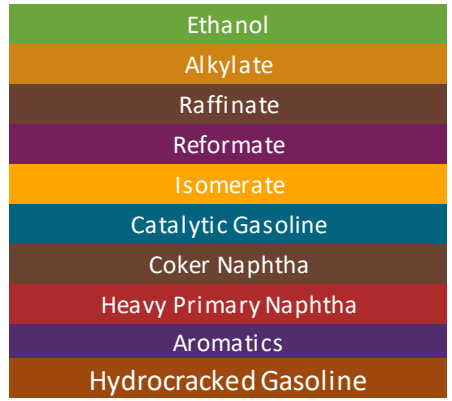


Octane (RON)	93.0	93.0	93.0	93.1	93.1	93.0
Price (USD/gal)	$ 2.355	$ 2.281	$ 2.261	$ 2.231	$ 2.195	$ 2.156

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

Argentina – Premium – Z. Sur – Constant Octane

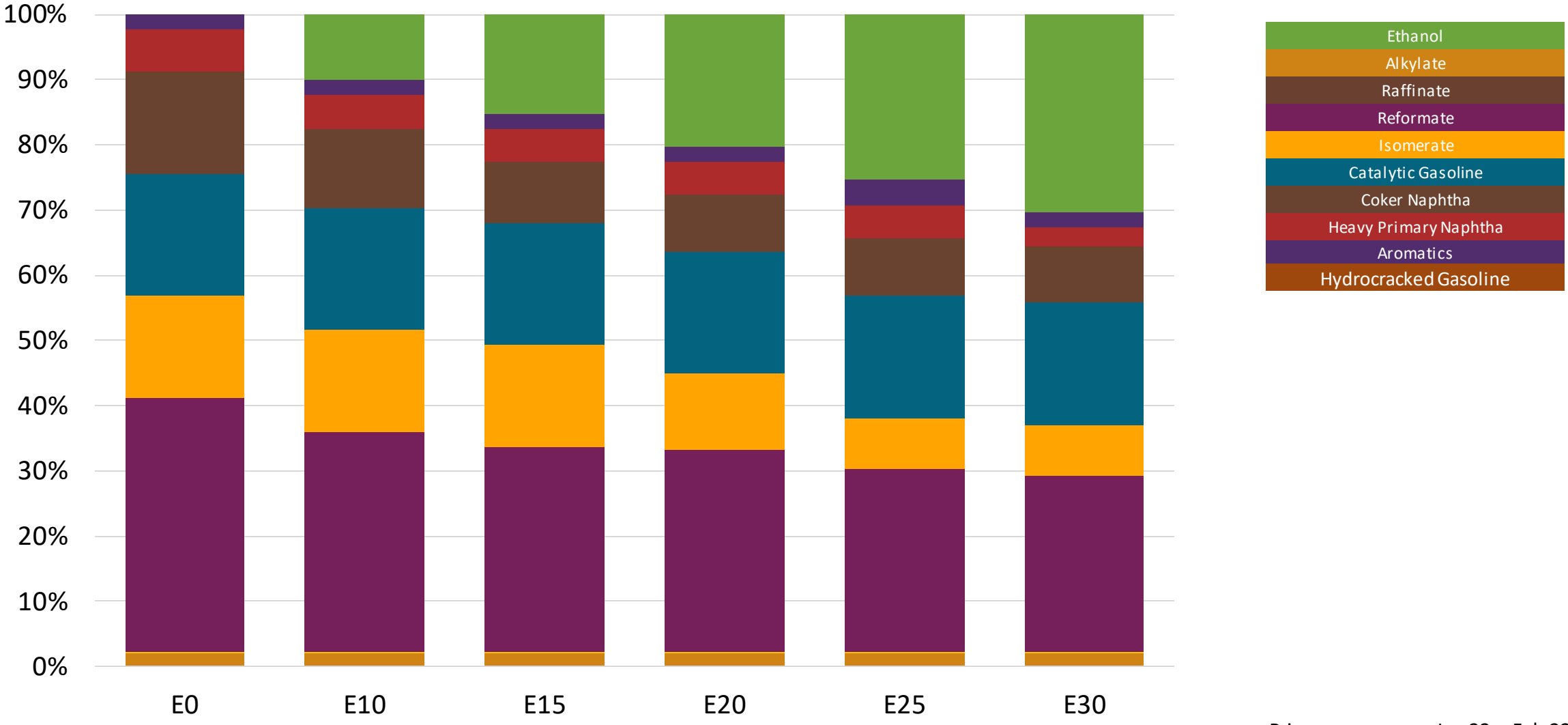




Octane (RON)	97.0	97.0	97.0	97.0	97.0	97.0
Price (USD/gal)	$ 2.437	$ 2.382	$ 2.350	$ 2.318	$ 2.279	$ 2.245

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

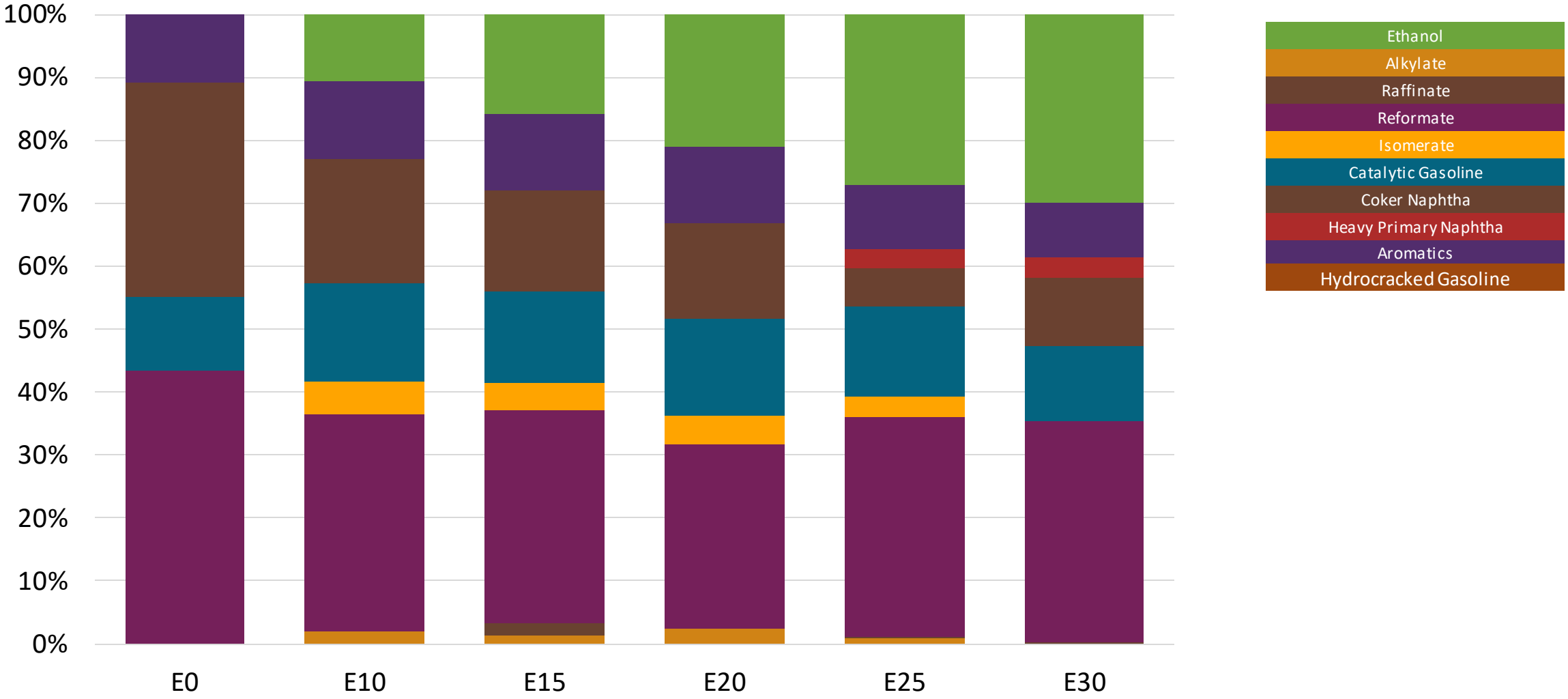
Argentina – Regular – Z. Norte y Centro – Octane Increment



Octane (RON)	93.0	95.6	96.8	98.2	99.7	101.3
Price (USD/gal)	$ 2.352	$ 2.352	$ 2.352	$ 2.352	$ 2.352	$ 2.352

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

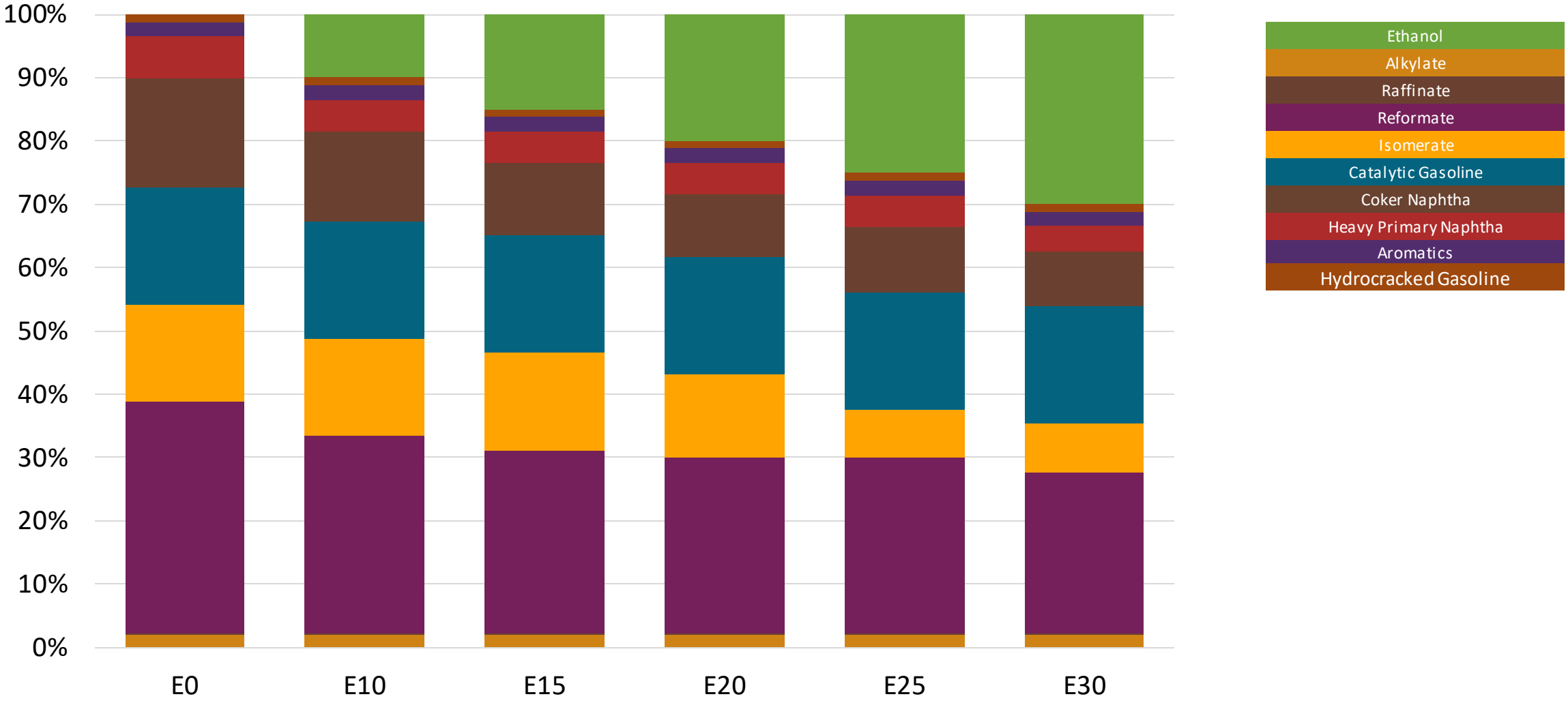
Argentina – Premium – Z. Norte y Centro – Octane Increment



Octane (RON)	97.0	98.2	99.2	100.7	101.2	103.4
Price (USD/gal)	$ 2.402	$ 2.402	$ 2.402	$ 2.402	$ 2.402	$ 2.402

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

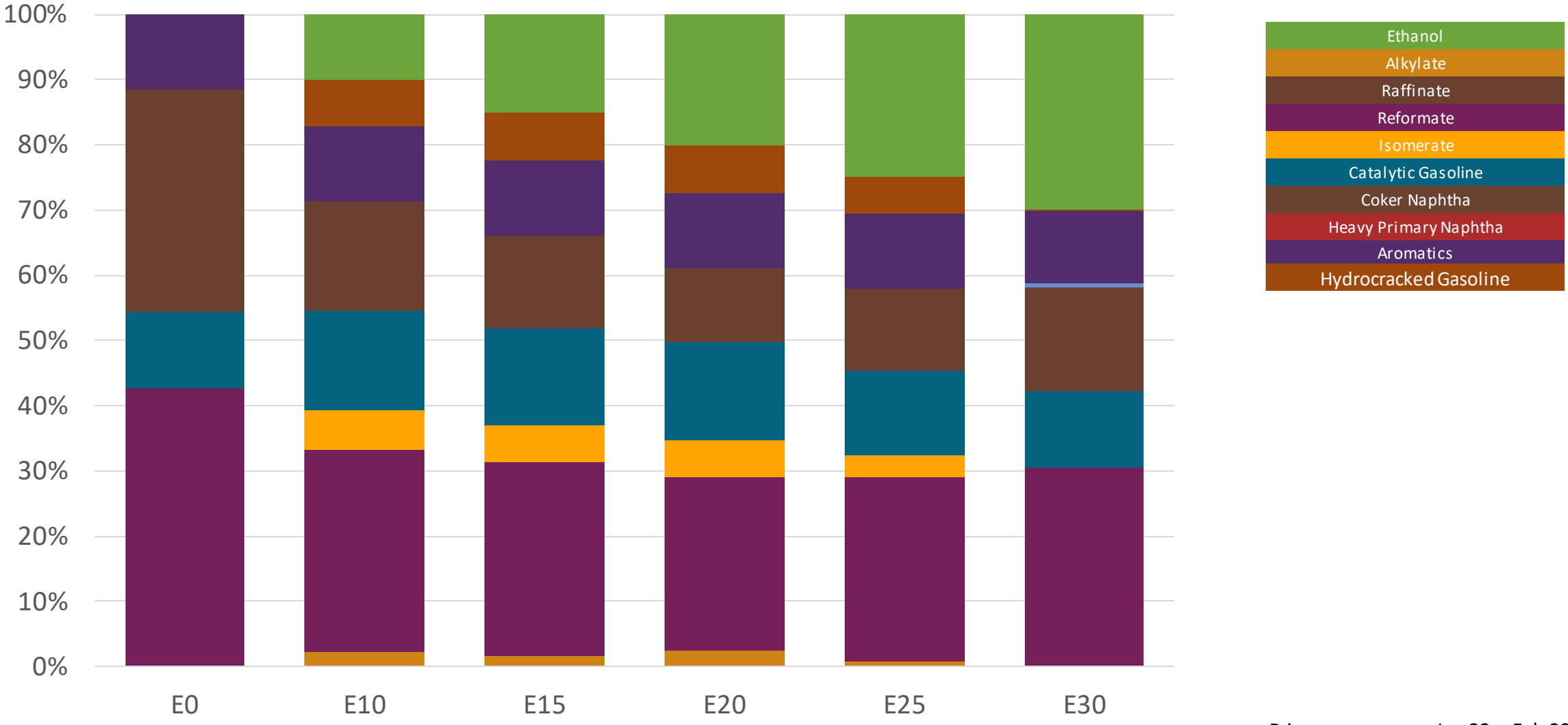
Argentina – Regular – Z. Sur – Octane Increment



Octane (RON)	93.0	95.3	96.5	97.8	99.3	100.7
Price (USD/gal)	$ 2.338	$ 2.338	$ 2.338	$ 2.338	$ 2.338	$ 2.338

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

Argentina – Premium – Z. Sur – Octane Increment



Octane (RON)	97.0	97.9	99.2	100.3	102.0	104.0
Price (USD/gal)	$ 2.402	$ 2.402	$ 2.402	$ 2.402	$ 2.402	$ 2.402

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

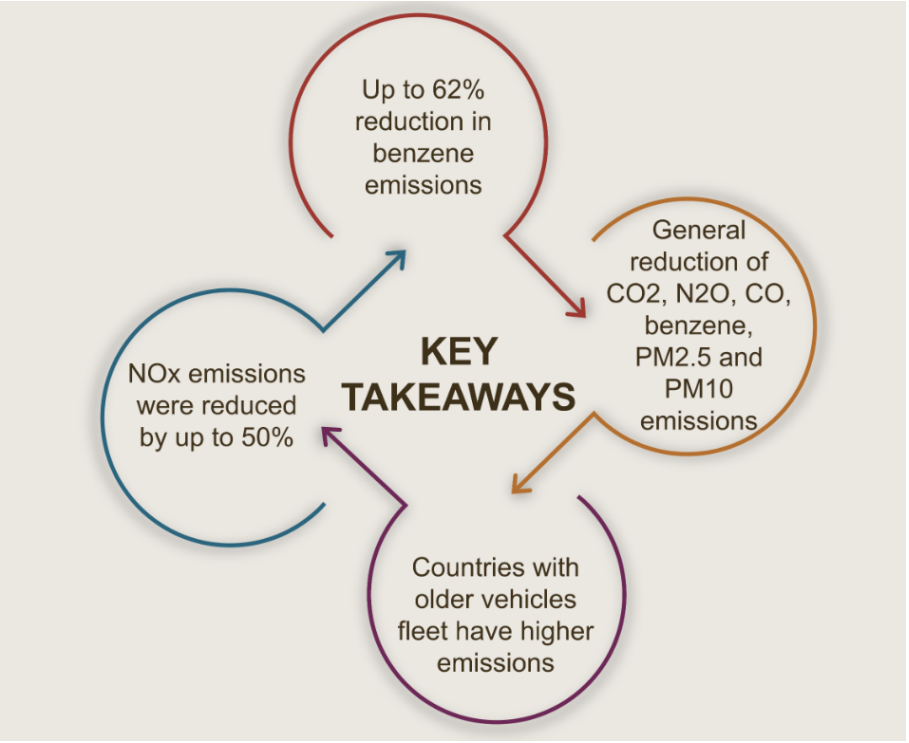
The model used in this analysis takes as a reference the **International Vehicle Emissions Model (IVE).**
The model uses the Base Emission Rates from IVE model, as well as its Adjustment Factors based on:

- 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



Source: Bureau of transportation statistics.

Gasoline Vehicle Fleet - Argentina

Type	Motor	Tailpipe	Recuperator	Age	Number of vehicles
Auto/Sml Truck	Multi FI-Pt	Euro V	PCV Tank	>4years, >80 mkm	4.097.578
				4-8 years, 80-160 mkm	5.469.234
				<8 years, < 160 mkm	4.569.289
		Euro IV		<8 years, < 160 mkm	536.055
		Euro III		<8 years, < 160 mkm	1.250.794
		3-Ways		<8 years, < 160 mkm	5.814.866
Sml Engine	FI 4-ciclos	Euro III	PCV	>4 years, >80 mkm	2.153.611
				4-8 years, 80-160 mkm	2.012.169
		Euro II		4-8 years, 80-160 mkm	862.358
				<8 years, < 160 mkm	6.396.853
Truck	FI	Euro V	PCV	>4 years, >80 mkm	101.645
				4-8 years, 80-160 mkm	135.671
				<8 years, < 160 mkm	113.347
		Euro IV		<8 years, < 160 mkm	31.027
		Euro III		<8 years, < 160 mkm	13.297
		3-Ways		<8 years, < 160 mkm	144.245

Vehicular Fleet: **33,702,039**
Average age: **12 year**

Source: Ministerio de Transporte, CAFAM, AFAC, 2023

Argentina – 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	5.82	4.88	4.49	4.10	3.80	3.47	-16%	-30%	-40%	1	3.5
VOC	0.81	0.69	0.65	0.61	0.57	0.53	-14%	-25%	-35%	95	255
VOCevap	0.39	0.39	0.40	0.41	0.42	0.42	0%	4%	7%	0.1	0.273
NOx	0.34	0.24	0.22	0.21	0.20	0.18	-30%	-38%	-46%	0.06	0.203
SOx	0.00	0.00	0.00	0.00	0.00	0.00	-15%	-28%	-41%		
NH3	0.07	0.07	0.07	0.07	0.07	0.08	-2%	0%	1%		
Butadiene	0.01	0.01	0.01	0.01	0.01	0.00	-11%	-19%	-26%		
Acetaldehyde	0.02	0.03	0.05	0.06	0.07	0.08	68%	249%	372%		
Formaldehyde	0.07	0.08	0.09	0.09	0.11	0.11	13%	39%	68%		
Benzene	0.03	0.03	0.03	0.03	0.03	0.03	-9%	-11%	-18%		
CO2	191.99	182.39	178.72	176.91	175.12	171.89	-5%	-8%	-10%		
N2O	0.00	0.00	0.00	0.00	0.00	0.00	-1%	2%	4%		
CH4	0.18	0.18	0.18	0.19	0.19	0.20	0%	4%	7%		
PM 2.5	0.01	0.01	0.01	0.01	0.01	0.00	-22%	-43%	-65%		
PM10	0.04	0.03	0.02	0.02	0.02	0.01	-22%	-43%	-65%	0.005	0.007
THC	0.31	0.32	0.35	0.38	0.40	0.42	-4%	-5%	-6%		