

Ethanol is a clean, high-performance renewable fuel that works in today's cars and certain trucks. Its use boosts engine efficiency, helps reduce harmful emissions of pollutants and fights climate change



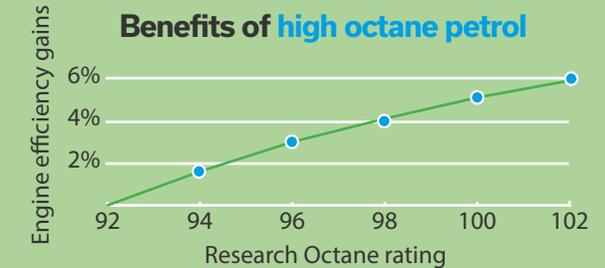
**Renewable ethanol:
Fuelling Europe's future**

1.

A fuel with a long history... and a future

- The history of ethanol as a fuel for petrol engines traces back to 1908, when the first mass-produced car, the Ford Model T, ran on petrol, kerosene and ethanol. **Ethanol was the most widely used fuel in cars before it was replaced by cheaper petrol after World War II.**
- Ethanol made a comeback in the 1970s as a way to reduce oil dependency and exposure to price volatility.
- **In Europe, renewable ethanol is used to reduce greenhouse gas (GHG) emissions in transport.** It is made from biomass feedstock such as crops, waste and residues in biorefineries, with high-protein animal feed and captured CO₂ as co-products.
- Ethanol is typically mixed with petrol then sold as a fuel blend. Fuels containing ethanol include: **E5** (up to 5%), **E10** (up to 10%), **E85** (from 65% to 85%) and **ED95** (95%).
- In Europe, most of the petrol fuel sold already contains up to 5% ethanol in volume. E10 has been progressively rolled out since 2009 and is available in 14 Member States. E85 is distributed in France, Sweden, Lithuania and Czechia.

E10 availability in Europe



2.

A fuel more energy-efficient than petrol

- In Europe, all petrol vehicles can run on up to 5% ethanol. Most post-2000 petrol vehicles have been declared E10-compatible and E10 became the standard European test fuel in 2016, meaning new cars are optimised to run on it. E85 can be used in flex-fuel vehicles and petrol cars equipped with a simple conversion system.
- Ethanol has benefits for engine performance thanks to its higher efficiency. Drivers may notice a slight increase in fuel consumption with the addition of ethanol to petrol: for example, a switch from E5 to E10 could lead to a maximum 1-2% increase in fuel consumption as ethanol contains less energy per unit of volume than petrol. **However, this increase is partially offset by ethanol's greater energy efficiency** and remains minor compared to other factors such as vehicle maintenance or driving style.
- Concerns are fading away progressively with regards to the introduction of petrol with an octane rating above 100, higher than that of regular petrol (95) and premium petrol (98). **New engines could be designed and optimised to run on this 'higher octane petrol' (HOP) thus improving engine efficiency and reducing tailpipe CO₂ emissions. Ethanol's octane boosting properties makes it a component of choice for HOP: several studies have elaborated on the perspective of a 102 octane E20 grade.**

Ethanol and your engine: What you need to know

3.

A fuel with benefits for air quality

- **Less particulate matter (PN):** Ethanol in fuel has a beneficial impact on the PN emissions. The more ethanol is blended, the less particles are emitted: compared to fossil petrol, E10 and E85 reduce PN emissions by nearly 80% and more than 90% respectively¹. Compared to E10, E20 can further reduce these emissions by 29% on average².
- **Less hydrocarbons (HC):** Addition of ethanol to the fuel blend can help reduce HC emissions depending on the engine application³, with even better results in older vehicles⁴. E85 reduces HC emissions by 36% on average compared to fossil petrol and by up to 78% in some models of FFVs⁵. Compared to E10, E20 can reduce HC emissions by more than 18%⁶.
- **Less nitrogen oxides (NO_x):** High fuel combustion temperatures in the engine produce NO_x. Higher blends of ethanol such as E85 reduce engine temperature thus allowing NO_x emissions savings up to 59% in some cases compared to E0¹⁰. E20 has also been shown to reduce NO_x emissions compared to E10.
- **Less carbon monoxide (CO):** In some cars, the addition of ethanol can cut CO emissions by more than 70% with E10 and more than 80% with E85 compared to fossil petrol¹. In other cases, E85 may instead increase CO emissions⁷.

Air pollutants	PN	HC	NO _x	CO
Reduction of emissions with ethanol				No clear evidence

Fossil petrol



Renewable ethanol



Well-To-Tank

Tank-To-Wheels

Well-To-Wheels emissions¹⁰

>150 gCO_{2eq}/km

≈40 gCO_{2eq}/km



Ethanol's CO₂ emissions per kilometre are >74% lower than fossil petrol

4.

A fuel that fights climate change

- **European renewable ethanol is produced from sustainably grown crops, waste and residues and saves more than 72% GHG emissions per unit of energy compared to fossil petrol⁸.** Its use reduces the European transport sector's total greenhouse gas emissions by more than 9 million tonnes each year, **the equivalent of about 4.4 million cars taken off the road⁹.**
- The use of fuels has a much greater impact on the environment than is accounted for in the current CO₂ standards for new vehicles, as they rely solely on tailpipe emissions. Emissions that occur during the extraction/cultivation of feedstock, processing and transport of fuels are equally important and should be taken into account by EU rules.
- Biofuels deliver significant emissions reduction on a full life cycle basis. According to the most recent data, GHG emissions per kilometer from renewable ethanol produced in the EU are more than 74% lower than fossil petrol¹⁰.

Average GHG emission savings per unit of energy from renewable ethanol produced by ePURE members compared to fossil petrol⁸



ePURE

european renewable ethanol

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¹ Bioethanol Blending Reduces Nanoparticle, PAH, and Alkyl- and Nitro-PAH Emissions and the Genotoxic Potential of Exhaust from a Gasoline Direct Injection Flex-Fuel Vehicle. EMPA, USAB (2016).

² E20/E25 Final report "Engine tests with new types of biofuels and development of biofuels standards" Netherlands Standardization Institute (2020)

³ Meta-analysis for an E20/25 technical development study - Task 2: Meta-analysis of E20/25 trial reports and associated data. TU Wien (2014).

⁴ A Complete Assessment of the Emissions Performance of Ethanol Blends and Iso-Butanol Blends from a Fleet of Nine PFI and GDI Vehicles. (2015)

⁵ Real-World fuel use and gaseous emission rates for flex fuel vehicles operated on E85 versus gasoline, Journal of the Air & Waste Management Association (2017)

⁶ E20/E25 Final report "Engine tests with new types of biofuels and development of biofuels standards" Netherlands Standardization Institute (2020)

⁷ Czerwinski et al. (2017): Research of Real Driving Emissions (RDE) with E85 and Two Flex Fuel Vehicles (FFVs). Project BAFU (ResRDE)

⁸ Aggregated and audited data of ePURE members, 2018. Compared to a fossil fuel comparator of 83.8 gCO_{2eq}/MJ

⁹ ePURE CO₂ calculator

¹⁰ With a petrol car consuming 5.0l/100km of purely fossil petrol, compared to a theoretical petrol car running solely on ethanol (increase of fuel consumption and efficiency included). Fossil petrol emitting 94.1gCO_{2eq}/MJ and renewable ethanol 23.1 gCO_{2eq}/MJ.