Tour d’Europe

Closing Event

Compact Report

TU Da, vkm | KIT, IFKM

2025

The road transport sector has to reduce its CO_2 emissions. The EU and its member states have set climate neutrality goals in accordance with the Paris Climate Agreement. Several solutions are proposed. One is the use of renewable fuels. Today, several types of renewable fuels with a CO_2 reduction potential compared to fossil fuels are available with varying degrees of CO_2 reduction potential - up to a high mark of over 90 %. These fuels can achieve a considerable CO_2 reduction in existing vehicle fleets powered by internal combustion engines, and could also contribute to new vehicles sold in the future.

Tour d’Europe is a technology demonstration which aims to show:

- the availability and feasibility of renewable fuels for vehicle fleets across Europe
- the potential of digital monitoring for verified CO_2 well-to-wheel emissions
- the potential for legislative action regarding CO_2 emission performance standards

European climate legislation related to road transport and its corresponding fuel distribution knows two different approaches. Renewable fuels are documented in national databases with emission factors which represent the climate impact of fuels in a well-to-tank approach. A fuel from a renewable base uses carbon or carbon dioxide from the atmosphere, residues or waste, also known as biogenic or captured CO_2, and has therefore the potential for much lower emission factors compared to the fossil reference of 94 g_{CO2}/MJ. With the Renewable Energy Directive a European regulation is in place for the calculation of the emission factors.

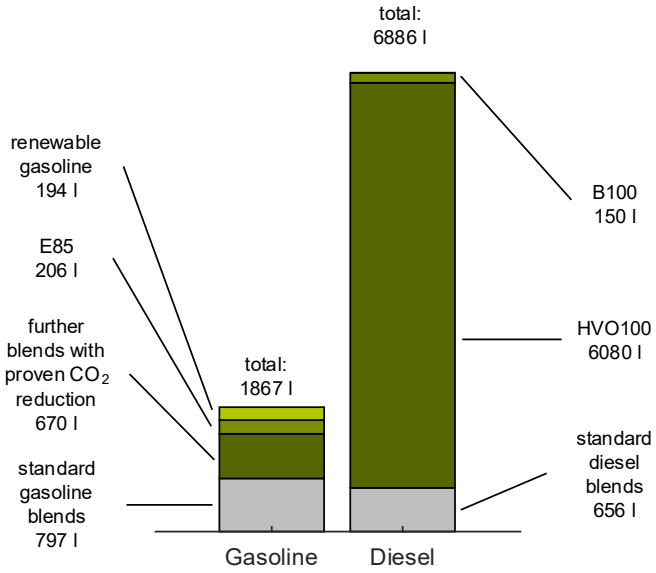
In contrast, CO_2 emission standards for vehicles follow a tailpipe measurement approach. Since the combustion of carbon-based renewable fuels lead to comparable CO_2 emissions in the test procedure, no advantage based on the use of these fuels is attributed. The use of digital monitoring aims to close this gap to provide certifiable information from the fuel distribution until final energy conversion in the vehicle. However, actions are required to close this gap to achieve maximum greenhouse gas reduction in the vehicle fleet.

What happened during Tour d’Europe

A total of 16 different vehicles of various types, fuel types and from different manufacturers powered by a combustion engine took part in the Tour d'Europe. The vehicle fleet consists of eleven passenger cars and five heavy duty vehicles. A total of eight of the participating vehicles were diesel-powered, while seven were gasoline-

powered. Finally, one heavy-duty vehicle was powered by BioLNG. As the data evaluation of this BioLNG vehicle is still ongoing, it is not included in this compact report. The vehicles made 289 refueling stops in 17 different European countries on five different routes across Europe. A wide variety of renewable fuels were used. The vehicles have covered a total of well over 77500 km across Europe.

What amount of renewable fuels were used?



Amounts of used fuels during the Tour d'Europe. Today, most of available renewable fuels are bio-based fuels.

The total amount of gasoline fuel used during the tour was 1867 l, which corresponds to 21.3 % of the total fuel during the tour. As part of the gasoline fuel, 797 l of standard gasoline blends were refueled: 206 l of E85; 194 l of renewable gasoline; and 670 l further blends with proven CO_2 reduction. A significant amount (877 l – 57 %) of the used gasoline fuel had a certified renewable component.

Diesel fuels were the most common type of fuel used during the tour (78.7 % in total). A total of 6886 l of diesel fuel was used: 150 l of B100; and 6080 l of HVO100. This resulted in 90.5 % of the fuel used were renewable. The amount of standard diesel blends was 656 l.

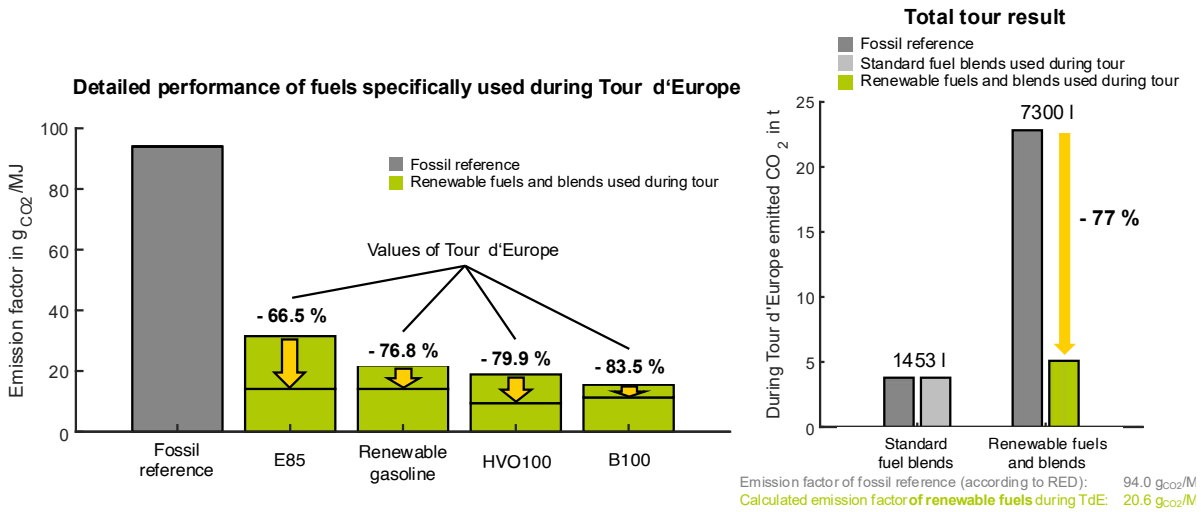
The CO_2 reduction achieved by renewable fuels is based on the analysis of the well-to-wheel CO_2 footprint of the respective fuel. This takes into account the acquisition of raw materials, processing into fuel, distribution and use in the vehicle. As of today, most of the available renewable fuels are bio-based fuels, such as HVO, B100, Bio-Ethanol and their blends with fossil fuels or other renewable fuels. For these fuels, biological materials such as vegetable oils, residues and waste materials or energy crops are used as feedstocks. This means that the CO_2 reductions achieved by using renewable fuels are based on the actual fuel that is filled into the vehicle's fuel tank and are therefore real,

verifiable and certified according to European regulations. All these fuels are reported and achieved a so-called proof of sustainability.

How was the CO_2 reduction of the renewable fuels tracked and verified?

A specially developed monitoring system is used for tracking the fuel and vehicles during the Tour d'Europe. This uses data from the respective vehicle such as tank level, GPS position, time, mileage and other information as well as information from the filling station about the fuel (based on the proof of sustainability). The refueling events can thus be monitored and verified via data synchronization in the cloud and the CO_2 emission factor of the tank filling can be determined. Of the total amount of fuel used during the Tour d'Europe, 84 % can be categorized as renewable fuels (or their blends). Of the total fuel amount, 54 % have been fully digitally monitored. For this share of fuel, the emission factors used can be tracked and the refueling events were digitally monitored. The remaining 30 % of the used renewable fuel volume were partially digitally monitored and complemented by a manual monitoring process. The latter was due to, either the emission factor of the fuel not provided on time, or the digital tracking itself being incomplete. However, as the type of fuel and quantity fueled were documented manually by using the receipts from the fuel station the full monitoring could be completed. Finally, only 16 % of the total fuels used in the tour are standard fuel blends, which have also been digitally monitored. This means that despite the challenging availability of necessary information for this monitoring procedure across Europe, a total of 84 % of the fuel used during the Tour d'Europe could be verified and certified as renewable fuels (and their blends).

Was Tour d'Europe able to reduce its vehicle CO_2 impact?



Significant CO_2 reductions were achieved for all renewable fuels (and their blends) and their total CO_2 emission reduction of these fuels on well-to-wheel basis during the Tour d'Europe is 77 %.

A wide variety of fuels with different CO_2 reduction potentials were used. The fuel-specific CO_2 reductions achieved, on a well-to-wheel basis, ranged from 66.5 % to 83.5 %.

However, all the renewable fuel options used have further reduction potential. This potential results from the use of other feedstocks (e.g. waste materials), and improved production processes.

The overall result of the Tour d'Europe is expressed as absolute emissions of CO_2. The data also represent the real-life experience of users travelling across Europe. Already today, only 16 % of standard fuel blends had to be used as the result of regional unavailability. For the overall fuel mix of the Tour d'Europe, including standard fuel blends used during the tour, the total CO_2 reduction reaches 67 %, showing a significant reduction in well-to-wheel CO_2 emissions with the given status of fuel availability. The renewable fuels (and their blends) by themselves achieved a 77 % CO_2 reduction of.

In this context, each improvement of fuel properties would be immediately visible as further CO_2 reduction. This could be achieved by higher blend rates with or a switch to other types of renewable fuels. This has been demonstrated with the renewable fuels used during the Tour d'Europe.

What has Tour d'Europe shown?

CO_2 Savings Potential

Simple and genuinely feasible as of today. Actual, **verifiable and certifiable CO_2 reduction** by renewable fuels.

Monitoring Available & Necessary

Monitoring based on information about the refueling process is necessary and already in development.
→ **Huge benefit for authorities and users**

Adaptation of Legislation Required

Instead of only measuring tailpipe emissions, the **well-to-wheel CO_2 footprint has to be considered** for renewable fuels.

The CO_2 reduction potential of future renewable fuels will further grow and reliable monitoring processes will be available.