Scholz is fuelled with illusions

How costly e-fuels are threatening the EU's climate targets

March 2023

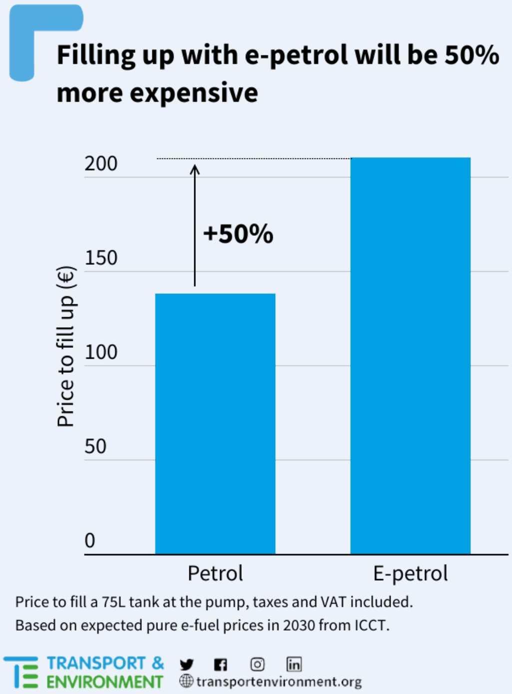
Summary

In October last year, EU negotiators on behalf of European governments and MEPs reached an agreement on new CO_2 standards for cars and vans. The deal made history as it stipulated that no new polluting combustion engine cars will be sold from 2035. This would put Europe on the path to becoming climate neutral by 2050 and make zero emission cars (mostly battery electric) affordable and accessible to all Europeans.

Just as the EU ministers were about to confirm the single most important law to tackle emissions from road transport, Chancellor Scholz - pressured by his junior coalition partner, the FDP - threatened to block the legislation and pull the rug from under the European Green Deal. U-turning on its previous position, the German government demanded that sales of new cars with internal combustion engines be allowed after 2035, if they run on e-fuels.

Unknown to many, e-fuels - or synthetic petrol and diesel - can in their be made from hydrogen and CO_2[1]. Even though the fuel is burned in engines - so releases similar CO_2 and pollution as conventional cars - provided Direct Air Capture technology is used to capture CO_2 from the air (not yet commercial), the CO_2 captured from the air can neutralise the CO_2 burnt (but not pollution!). These synthetic fuels have, since at least 2017, been pushed by the oil lobby in an attempt to derail the switch to clean electric motors.

[1] In this report, e-petrol is assumed to be a by-product coming from e-kerosene production driven by the RefuelEU regulation. E-diesel would be fully allocated to non-road sectors (shipping and industry), so only e-petrol is assumed to be allocated to cars.



German drivers will pay more than €200 to fill up at the pump

Producing e-fuels is a complex and energy intensive process (involving electrolysis to produce hydrogen and complex chemical reactions like Fischer-Tropsch to turn it into a liquid fuel), which means they are expensive to make. Using a cost at the pump in Germany in 2030 of at least €2.8/L[2], this means an average driver would pay €210 to fill up their tank with e-petrol. Based on current petrol prices in Germany (€1,84/L), filling up with e-petrol will be 50% more expensive than normal petrol. This would place an prohibitive cost on the average driver - a minimum of around €2,300 a year for an average mileage - meaning only the wealthiest drivers would be able to afford to do so. With conventional petrol still available for the existing fleet, it's likely some drivers would circumvent the rules and buy cheaper petrol for the cars bought after 2035 (the engine is the same), emitting as much carbon as cars do today but treated as "zero emission" cars under the EU car rules.

Wasting e-fuels in new cars is a gift to Big Oil and means fewer solutions to clean up the existing fleet

The deal on the table is about new car sales only, not the existing fleet where solutions like carbon neutral fuels are necessary to decarbonise. In the scenario where e-petrol would be used in new cars, as is being proposed by the German government, they would only displace other zero emission alternatives (electric and hydrogen fuel cell cars) sales without providing any additional CO_2 savings. By using e-petrol in new combustion engines instead of the existing car fleet, the existing cars would burn an additional 135 billion litres of fossil petrol and emit an extra 320 $MtCO_2e$ by 2050 than would otherwise be the case.

Rather than helping Europe meet its climate targets though, Scholz's plan would derail the decarbonisation of the new fleet while allowing more conventional oil to be used in the existing fleet post 2035 - a win-win for Big Oil. Furthermore, there is no regulatory framework in place to control or verify that these fuels are always carbon neutral, opening the door to fraud.

[2] Based on the ICCT's estimate of the retail e-fuel price in Germany in 2030

E-fuels risk repeating the mistakes of the past and creating a new fuel dependency for the EU

Even before the additional demand that would come from using e-fuels in cars is taken into account, Germany will need to import 72% of its green hydrogen demand. To meet this, Germany and Europe will have to import significant volumes of both e-fuels and hydrogen (needed to produce the e-fuel) from abroad. Middle-Eastern countries like Saudi Arabia are among the closest and most viable options and in 2021 a memorandum of understanding was signed between Germany and Saudi Arabia envisaging green hydrogen exports to Germany[3].

Switching from importing conventional to synthetic fuels only risks continuing Europe's dependency on autocratic regimes, as with today's oil. The German focus on Chile as a potential production hub also ignores the fact that e-fuels will only create new energy dependencies. Unlike oil, raw materials for batteries are dispersed around the world (e.g. Europe can supply over half of the lithium it needs by 2030 domestically), and the growing battery investments mean we can be self-sufficient this decade.

Cars powered by e-fuels still emit pollution at the tailpipe - unnecessarily damaging people's health

Burned in an internal combustion engine (ICE), e-petrol and e-diesel still emit CO_2 and air pollutants, notably toxic NO2 and carcinogenic particles. Based on optimistic assumptions about the availability of e-petrol, if 46 million new conventional and hybrid cars would be sold by 2050 and would be fuelled by pure e-petrol, these vehicles would still emit 160 thousand tonnes of NOx - more than Italy's entire fleet NOx emissions in 2019. Scholz's plan for e-fuels risks condemning Europeans to breathe toxic air for decades to come.

Scholz's plan for e-fuels undermines investment certainty in a multi-billion dollar industry

Ultimately e-fuels will be no more than a niche solution for the likes of Porsche drivers. But by delaying and undermining the clarity of the cars regulation, Scholz is risking up to €30 billion in battery plant investments in Germany just as the race to secure batteries and critical metals is gathering pace between China and the US.

[3] https://www.bmwk.de/Redaktion/EN/Downloads/J/joint-study-saudi-german-energy-dialogue.html

Infobox - what are e-fuels?

Petrol and diesel are hydrocarbons that, when ignited in an internal combustion engine, release energy, CO_2, and water (along with other pollutants). Synthetic fuels -or e-fuels- are produced by essentially reversing this process: combining hydrogen and carbon with energy in order to create a hydrocarbon. To be considered green, the hydrogen can be produced via electrolysis by splitting water and the carbon can be obtained via direct carbon capture using additional renewable electricity. Because of this energy intensive process, running a car on synthetic petrol is close to five times less efficient than powering a BEV through direct electrification. The overall efficiency of the direct electrification pathway is 77% whereas it is 16% for petrol cars powered with synthetic fuels[4].

As discussed in section 8, the quantity of e-fuels available for cars (e-petrol or e-diesel) is uncertain. In this report, it is assumed that only e-petrol would be available for cars as e-diesel has many applications outside of road transport (shipping and industry). We assume that e-petrol production is driven by the e-kerosene mandated under the ReFuelEU regulation[5] and that e-petrol would be a by-product of the e-kerosene production (assumptions detailed in Annex).

Burned in an internal combustion engine (ICE), e-petrol and e-diesel emit exactly the same CO_2 emissions as conventional fuels. For instance, in 2021 the average petrol car emitted 134 gCO_2/km[6] under the Worldwide Harmonized Light Vehicles Test Procedure (WLTP) and 14% more CO_2 under real-world driving conditions[7]. Moreover, running cars on e-fuels will not alleviate air pollution problems as our tests[8] showed that cars powered by e-fuel emit as much nitrogen oxides (NOx) as fossil fuel engines.

1. Introduction

On 27 October last year, EU negotiators on behalf of European governments and MEPs reached a deal on revised CO_2 standards for new cars and vans. The deal made history as an agreement was reached on ending sales of new polluting combustion engine cars by 2035 - putting Europe on the path to becoming climate neutral by 2050.

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4 https://www.transportenvironment.org/wp-content/uploads/2020/12/2020_12_Briefing_feasibility_study_renewables_decarbonisation.pdf

5 https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/698900/EPRS_BRI(2022)698900_EN.pdf

6 2021 average for a petrol car in the EEA according to: http://co2cars.apps.eea.europa.eu/

7 https://theicct.org/sites/default/files/publications/On-the-way-to-real-world-WLTP_May2020.pdf

8 https://www.transportenvironment.org/discover/in-tests-cars-powered-by-e-petrol-pollute-the-air-as-much-as-petrol/

The German government has declared last-minute opposition to the landmark deal, however, demanding that sales be allowed of new cars with internal combustion engines after that date if they run on e-fuels. This is despite all major carmakers publicly committing to a full transition to BEVs by 2035 or earlier[9].

Following intense lobbying by the oil and gas industry, lawmakers also agreed - on the insistence of the German government - on a non-binding recital[10] to ask the Commission to find a role for e-fuels in vehicles that are outside the scope of the regulation. The intention and interpretation of this recital has become a key point of political contention, with the German government now asking for assurances from the European Commission on how they will make good on this request and ensure there is a role for combustion engine cars fuelled by e-fuels after 2035.

Despite all major carmakers publicly committing to a full transition to electric cars by 2035 or earlier, the oil, gas and automotive supplier lobbies claim that cars are better decarbonised by so-called "carbon neutral" synthetic fuels, or 'e-fuels'. They claim theirs is an affordable and accessible solution, compatible with Europe's climate neutrality and energy security goals. This briefing looks at the viability of these claims.

While Germany blocks EU moves to phase out the combustion engine, emissions of their transport sector continue to rise[11]. By buying into the e-fuel lobby's illusions, Chancellor Scholz risks undermining Europe's (and Germany's) climate targets, slapping drivers with a financial penalty at the pump, condemning European's living in cities to toxic air pollution, and creating a new energy dependency for Europe.

2. E-fuels in new cars would place a cost burden on drivers

Drivers will have to pay over €200 to fill up a car with pure e-fuel at the pump compared to €140 today

With a more complex and energy intensive process of making e-fuels comes more prohibitive costs. Using a baseline with a retail e-petrol price in Germany in 2030 of €2.8/L[12]. This price means that in 2030 **drivers would need to pay at least €210 to fill up their tank[13]** and about €2,300 minimum per year to cover

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[9] https://www.transportenvironment.org/challenges/cars/electric-cars/race-to-electrify/

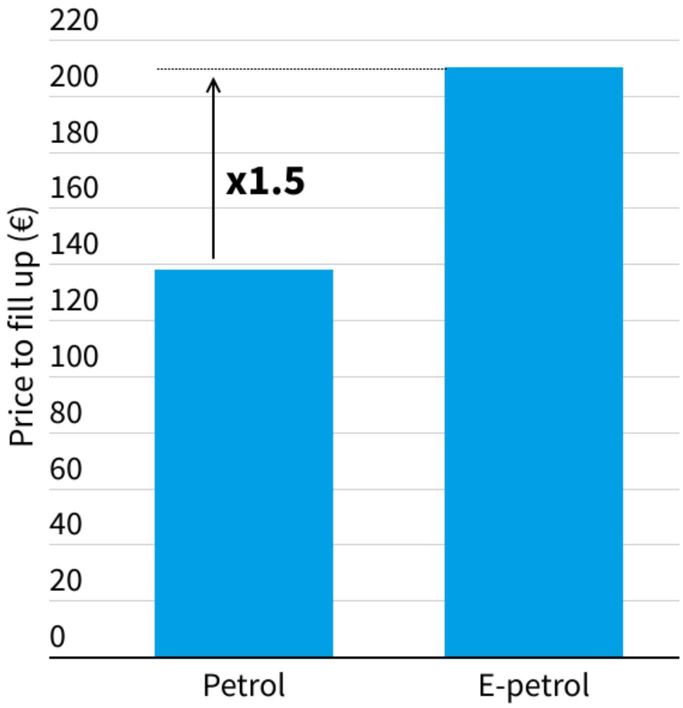
[10] Recital 11: "*Following consultation with stakeholders, the Commission will make a proposal for registering after 2035 vehicles running exclusively on CO_2 neutral fuels in conformity with Union law, outside the scope of the fleet standards, and in conformity with the Union's climate-neutrality objective.*"

[11] https://www.umweltbundesamt.de/en/press/pressinformation/final-2021-greenhouse-gas-emissions-balance

[12] Based on ICCT's estimate of the retail e-diesel price in Germany in 2030, assuming the tax rate for e-fuels is 0.15 euros per GJ as in the proposed revision to the ETD. We conservatively assumed that e-petrol price would be similar to e-diesel prices. In reality more processing is required to produce e-petrol from naphtha and would lead to higher prices than e-diesel. Production cost hypotheses detailed in ICCT. (2022). Current and future cost of e-kerosene in the United States and Europe.

[13] Based on a 75L tank. For instance, the fuel tank of a BMW X5 is 80L.

15,000km[14]. Based on current petrol prices in Germany (1,84/L[15]), filling up a tank costs around €140, meaning that, in 2030, e-petrol is expected to be 50% more expensive than fossil petrol today (Figure 1 below).



Price to fill a 75L tank at the pump, taxes and VAT included.
Based on expected pure e-fuel prices in 2030 from ICCT.

Figure 1 - Comparison of fossil and e-fuel price at the pump in 2030

Hydrogen and e-fuels market demand in all sectors will increase price further

All sectors of the economy need to adopt urgent decarbonisation pathways if Europe is to meet its binding target of becoming a net-zero carbon economy by 2050, and hydrogen and synthetic fuels will be a key lever for many sectors (steel, cement, industrial processes requiring heating, non-road transport with few alternatives such as aviation and shipping). In a context of high hydrogen demand, the price of green hydrogen required for e-fuel production is expected to remain fairly high. Despite potential economies of scale to reduce production costs, the increased demand and the urgency to implement solutions to face the climate crisis will likely keep prices high even in the long term.

German politicians supporting an exemption for e-fuels in engine cars claim to be standing up for ordinary drivers. Yet, filling a car up with e-fuels will place an exorbitant cost on the average driver, meaning only the wealthiest drivers would be able to afford to do so. The likely huge price difference between fossil and synthetic petrol will also create significant economic incentives for drivers to game the system and fill up with fossil fuel at the pump (*see section 7*).

[14] Based on a fuel consumption of 5.4L/100km.
[15] Euro-super 95(I) price on the 06/03/2023

3. E-fuels risk repeating the mistakes of the past and creating a new fuel dependency for the EU

Germany will require massive imports of e-fuels to meet expected demand

Producing a large quantity of carbon neutral e-fuel requires a large quantity of green hydrogen (H2) produced from renewables. Nevertheless, H2 demand will be very high all over Europe to cover the needs of many sectors seeking to decarbonise[16].

In Germany, the Federal Government[17] expects that around 90 to 110 TWh of hydrogen will be needed by 2030. In their last plan[18], the German government announced the target to build 10 GW of electrolysis capacity in Germany by 2030. Based on previous estimates from the National Hydrogen Strategy[19], this 10 GW electrolysis capacity would be equivalent to a 28 TWh hydrogen production. Assuming the mid-point of the expected hydrogen demand (100 TWh), Germany would therefore need to import 72% of its hydrogen demand if it were planning to only use green hydrogen. The government acknowledges that "the domestic generation of green hydrogen will not be sufficient to cover all new demand, which is why most of the hydrogen needed will have to be imported".

This means that if Germany also wants to run cars on e-fuels, it will need to import the fuels or the hydrogen needed to produce them from abroad. Germany plans to "intensify its cooperation with other European Member States, particularly those bordering the North and Baltic Sea, but also with the countries of southern Europe". However, in a tight domestic production market[20], any additional hydrogen demand would likely be imported from non-EU countries.

Europe will need to import e-fuels from outside the EU, likely including the Middle East

Looking at a map by the e-fuel alliance[21] of e-fuel production sites worldwide, the closest non-EU country with e-fuel production is Saudi Arabia. BloombergNEF's hydrogen project review confirms that Saudi Arabia's Neom project will be one of the first large scale hydrogen production projects of countries close

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[16] H2 is required in industrial sectors (chemicals, petrochemicals, steel), to produce fuels in hard-to-decarbonise transport sectors (e-kerosene for aviation and e-ammonia in shipping) or to support the decarbonisation of the heat sector (any process requiring heat generation as well as buildings).

[17] https://www.bmbf.de/bmbf/shareddocs/downloads/files/bmwi_nationale-wasserstoffstrategie_eng_s01.pdf

[18] https://www.bloomberg.com/news/articles/2023-03-07/germany-to-ramp-up-electrolyzers-needed-for-green-energy-shift

[19] The National Hydrogen Strategy reports that 5 GW of generation capacity corresponds to 14 TWh based on a 4,000 hours full-load hours of electrolyser operation and an efficiency ratio of 70%

[20] The REPowerEU plan targets 20Mt hydrogen consumption with 10 Mt from domestic production and 10 Mt from imports. This suggests that the EU is not self-sustaining on green H2 production.

[21] https://www.efuel-alliance.eu/efuels/efuels-production-map

to the EU from 2026[22], expected to produce 650 tonnes of green hydrogen per day. Furthermore, in 2021 a memorandum of understanding was signed between Germany and Saudi Arabia envisaging green hydrogen exports to Germany[23]. This also appears to be a possible pathway for hydrogen or e-fuel imports to Europe studied by the oil industry: a report[24] jointly commissioned by Concawe[25] and Aramco[26] assessed different options for e-fuel production from the Middle East and North Africa (MENA) using Saudi Arabia's renewable mix as a proxy in the base case assumptions. Diversifying its revenues away from crude oil exports, the oligarchy would be in a strong position to maintain and reinforce its position as a fuel supplier to the EU towards synthetic fuel.

Theoretically, e-fuel can also be produced in other countries benefiting from abundant wind and sun. For instance, Porsche is aiming to produce e-fuel in Chile, but its plant is only at pilot stage and cannot yet produce carbon neutral e-fuel[27]. Nevertheless, to save transport cost and energy losses, e-fuel produced in countries far away from Europe such as Chile could be prioritised in other large car markets such as South America where electrification is lagging. Many African countries could also be considered as potential locations for e-fuel production as the German government is directly financing H2 in old colonies such as Namibia[28]. We illustrated 2 possible e-fuel import pathways in Figure 2 below by adapting the Fraunhofer IEE[29] site assessment of power-to-X[30]. The location of these sites suggests that the closest potential exporters of e-fuels would be in non-democratic countries known for human rights issues[31] in the Middle-East[32] and North Africa.

[22] BloombergNEF reporting on hydrogen capacity

[23] https://www.swp-berlin.org/publications/products/comments/2022C44_HydrogenAmbitiones_GulfStates_WEB.pdf

[24] https://www.concawe.eu/wp-content/uploads/Rpt_22-17.pdf

[25] A division of the European Petroleum Refiners Association

[26] Saudi Aramco, officially the Saudi Arabian Oil Group, is a Saudi Arabian public petroleum and natural gas company classified as one of the largest companies in the world by revenue.

[27] Porsche qualified its first production as "nearly CO_2-neutral" but did not claim to produce fully carbon-neutral fuel yet. https://newsroom.porsche.com/en/2022/company/porsche-highly-innovative-fuels-hif-opening-efuels-pilot-plant-haru-oni-chile-synthetic-fuels-30732.html

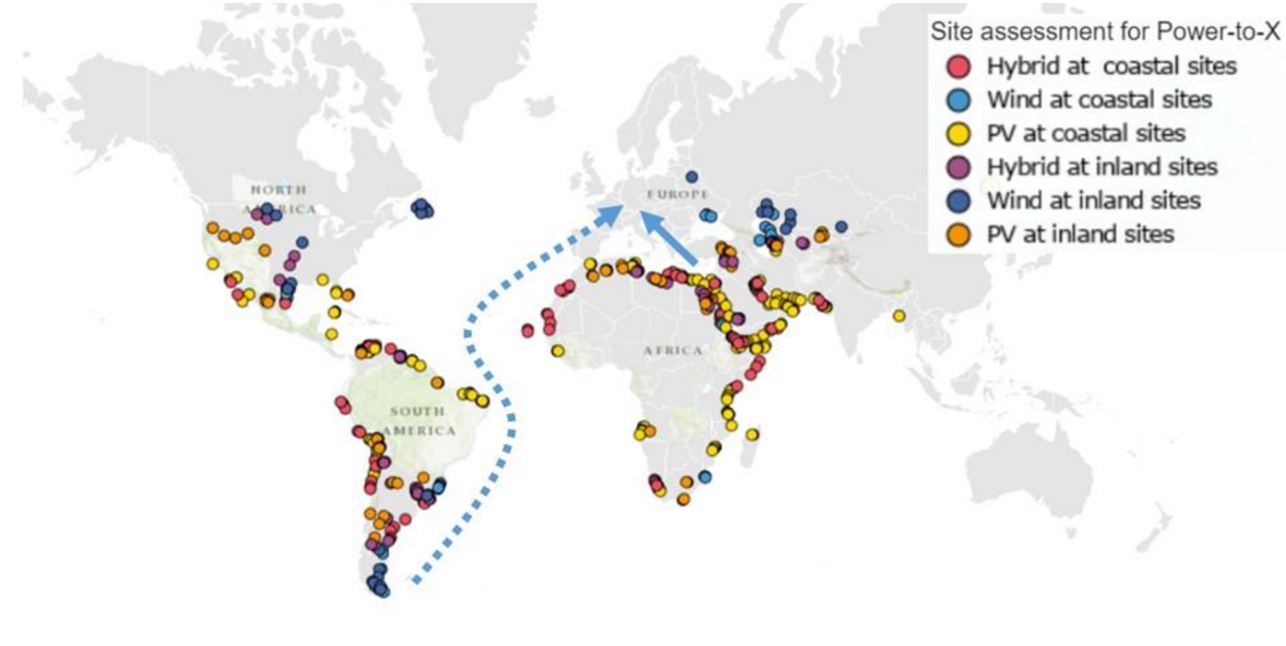
[28] https://www.bmbf.de/bmbf/shareddocs/kurzmeldungen/de/2022/10/gruener-wasserstoff-aus-namibia.html

[29] https://maps.iee.fraunhofer.de/ptx-atlas/

[30] Power-to-X refers to all technologies used to convert electricity into carbon-neutral synthetic fuels, such as hydrogen, synthetic natural gas, liquid fuels, or chemicals.

[31] For instance: https://www.amnesty.org/en/location/middle-east-and-north-africa/

[32] Projects in Oman could also become a large hydrogen source with more than 14GW capacity according to BloombergNEF but little information on timelines are published.



Source: Power-to-X sites from the global power-to-X atlas of potentials of Fraunhofer IEE

Figure 2 - Hydrogen and e-fuels potential imports

Switching from importing conventional to synthetic fuels will do nothing to solve Europe's current energy dependency on Russia and means the EU is likely to remain reliant on oligarchies and autocracies for its energy. The German focus on Chile as a potential production hub also ignores the fact that e-fuels will only create new energy dependencies for Europe.

4. E-fuels for new cars will be worse for the environment

To be used in new cars after 2035, e-fuels needs to provide a 100% emission reduction

Under the deal agreed by lawmakers, the target for 2035 for new cars is to reduce tailpipe emissions by 100%. In accordance with this target and the relevant recital (*mentioned in section 1*), e-fuel could only be used in new cars if they provide 100% emission reduction, meaning that new ICEs would need to be designed to run 100% on carbon neutral e-fuels. But, some industry actors[33] plan to progressively blend e-fuels with conventional fuels at the pump. While this could potentially decrease the cost at the pump for the use of e-fuels in the existing car fleet, this cannot be an option for new cars after 2035 under the car CO_2 regulation. If a new car is filled with a blend of carbon neutral e-fuel and fossil fuel, then it cannot achieve a 100% reduction in emissions and therefore be considered carbon neutral.

The proposal to include credits for e-fuels was rejected by the European Parliament. The idea was to cover emissions from new ICEs sold by carmakers by fuel credits related to e-fuel put on the market. But, in that case, there would be no mechanism (*see section 7*) to ensure that the e-fuel would be exclusively

[33] https://www.efuel-alliance.eu/efuels/costs-outlook

used by new cars, nor that new car emissions would be reduced by 100%. Hence, fuel credits would just risk artificially changing CO_2 accounting from new cars to existing ones, but not provide a 100% emission reduction in new cars as required under the car CO_2 regulation.

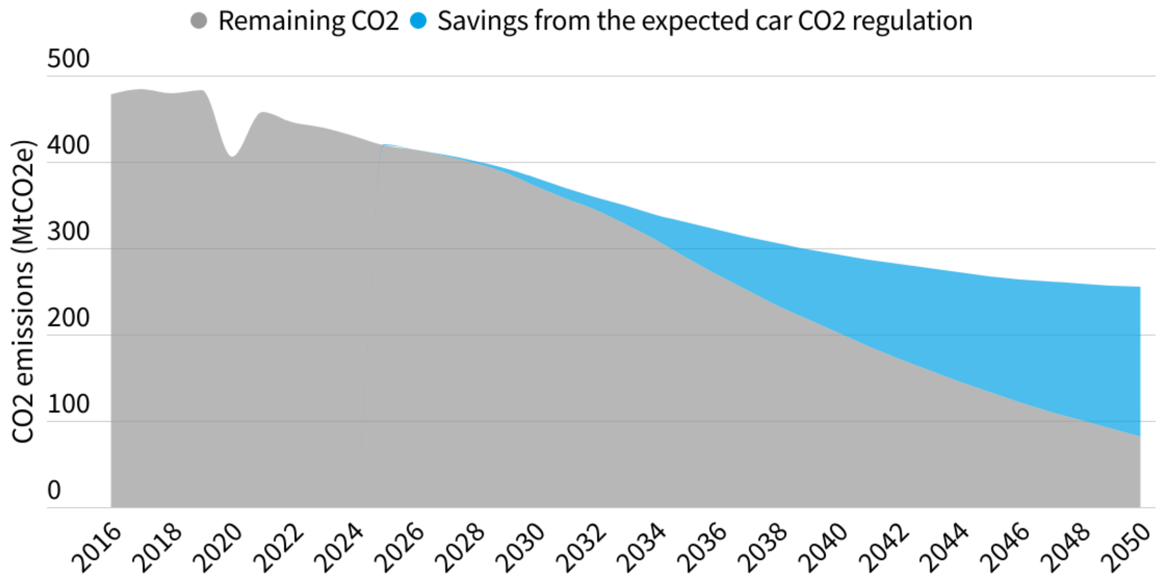
E-fuel use in new cars only displace BEVs without dealing with existing car CO_2 emissions

In the unlikely scenario where e-petrol would be available (*see discussion in section 8*) and used in new cars, they would only displace electric car sales without providing any additional CO_2 savings. As detailed in Annex, we modelled the number of cars that could run on e-petrol, assuming the first e-fuel specific car would be put on the road from 2030. With the expected e-fuel available in 2035, between 3.1% and 5.5%[34] of new car sales could be ICEs, but these would only replace BEV sales. In such a scenario, these fuels would displace between 26 and 46 million cumulative BEV sales by 2050, without providing any additional CO_2 savings compared to a scenario where BEVs only are used to meet the 2035 target. Assuming the e-petrol used in new cars would be carbon neutral (which is an extremely optimistic assumption, *see discussion in section 6*), this will still not do anything more to help the EU to meet its climate neutrality targets, as the remaining 70 million conventional ICEs in the existing fleet in 2050 will still be emitting 83 $MtCO_2$ (methodology described in Annex) and consume about 30 billion L of fossil fuels - emissions which could be better offset by using carbon neutral e-fuels in the existing fleet. Indeed, despite the car CO_2 regulation saving a cumulative 1.9 $GtCO_2$ over the decade, it would not fully decarbonise the car fleet as cars life span can exceed 15 years[35].

Instead, the use of these e-fuels in new cars appears as a good opportunity for the oil and gas majors, as it will ensure the continued use of fossil fuels in the existing fleet, maximising the revenues of the oil companies.

[34] Depending on the powertrain using e-fuel (ICE/HEVs or PHEVs)

[35] Modelling of fleet turnover found that the average lifespan in Eastern European countries could reach 28 years. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7829067/



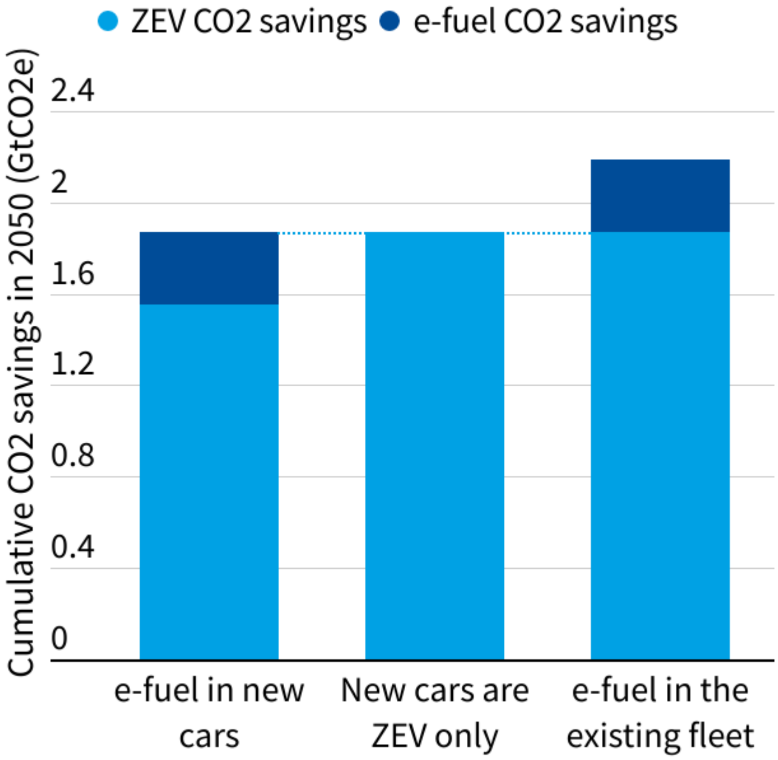
Scope: EU27
Source: T&E EUTRM modeling of the car fleet emissions.

Figure 3 - CO_2 savings from the Car CO_2 regulation

E-petrol in new cars does not save additional CO_2, but e-petrol use in the existing fleet does

While e-fuels used for compliance with the car CO_2 regulation (new cars) will have no climate benefit, they can provide CO_2 savings in the existing fleet. If e-petrol is used in the existing fleet, 0.3 $GtCO_2$ would be saved by 2050[36] (Figure 4 below), with e-petrol covering about 61% of the remaining fuel consumption in the existing fleet (covering about 42 million cars). Between 2030 and 2050, 135 billion L of fossil petrol could be saved if e-petrol is used exclusively in the existing fleet. The use of e-fuel in existing cars also appears as a better long term solution to avoid the cost burden that would be placed on new car drivers (*see section 2*) and this would still be compatible with an ICE phase-out in 2035. In that case, e-fuel would not fall into the scope of any regulation applied to new cars (car CO_2 regulation or Euro 7) and would be regulated outside of the vehicle fleet standards - in line with both the final draft text agreed by co-legislators and the German coalition treaty text.

[36] Cumulative savings over 2030-2050



Savings calculated compared to the past CO2 regulation
e-fuel in new cars: e-petrol cars displace ZEV to meet the proposed CO2 regulation
new cars are ZEV only: Only ZEVs are used to meet the proposed CO2 regulation
e-fuel in the existing fleet: 100 ZEV% sales from 2035 to meet the proposed CO2

Figure 4 - Comparison of CO_2 savings between e-fuel use in new cars and in the existing fleet

If Germany wants to meet its climate neutrality by 2045 target[37], then it needs to deal with CO_2 emissions from cars on the road. If e-fuels are used in new cars or if fuel credits prevent the sales of new BEVs, then CO_2 emissions would not be reduced further compared to a scenario with a proper ICE phase-out in 2035. In the unlikely scenario where e-petrol is actually available for cars in the future (*see section 8*), then the best option for Germany would be to use e-fuels in the existing fleet to provide additional CO_2 savings and accelerate the decarbonisation of its existing car stock.

Germany will not reach its target to get 15 million BEVs on the road by 2030[38]

Based on T&E's EU fleet modelling and the minimum BEV sales share required to meet the regulation by country (methodology in Annex), we estimated that the German BEV share of sales could reach 30% in 2025, 86% in 2030 before rising to 100% in 2035. New sales are expected to grow from 2.7 million in 2023 to 2.9 million in 2025 and 3.2 million in 2030. Based on the modelling sales trajectory and the 1,013,009

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[37] https://www.gesetze-im-internet.de/ksg/anlage_3.html

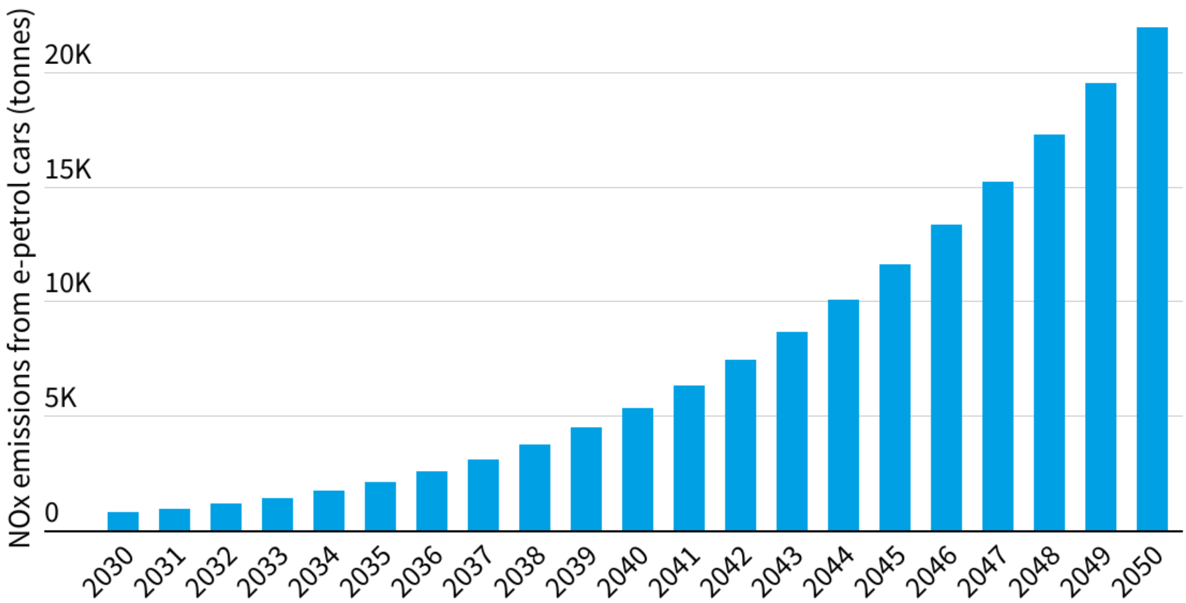
[38] The German federal government aims to have at least 15 million electric cars on the roads by 2030 as part of its shift towards climate neutrality: Mehr Fortschritt wagen – Bündnis für Freiheit, Gerechtigkeit und Nachhaltigkeit (spd.de)

BEV already on the road in Germany in 2022[39], we expect the cumulative number of BEV on German roads to reach 10.8 million by 2030, only 72% of the target. Germany will only reach its target if carmakers sell more BEVs than what is required by EU regulation (car CO_2 standards). However, if new dedicated e-fuels cars are planned in parallel, carmakers are unlikely to ramp-up their BEV production to the maximum potential, which will leave Germany falling even further behind its BEV target.

5. ICEs running on e-fuels will continue to emit health damaging pollution...and will likely be banned from low emission zones

New ICE fueled with e-petrol will still emit NOx that would have been eliminated by BEVs

Any fuel burned in a combustion engine still emits CO_2 and air pollutants. Based on Euro 6 RDE emission limit[40], in a scenario where 46 million new ICEs and HEVs would be sold by 2050 and would be fuelled by pure e-petrol, these vehicles would still emit 160 thousand tonnes of NOx which is more than Italy's whole fleet emissions in 2019[41]. These are emissions that would have otherwise been completely eliminated by BEVs.



Scope: EU27

Source: T&E modelling of new e-petrol cars NOx emissions

Figure 5 - NOx emissions from new e-petrol cars

39 https://www.electrive.com/2023/03/03/ev-registrations-in-germany-surpass-one-million-mark/

40 0.064 gNOx/km

41 https://www.eea.europa.eu/data-and-maps/dashboards/air-pollutant-emissions-data-viewer-4&sa=D&source=docs&ust=1678866919912657&usg=AOvVaw04wn0zM_n0bW3rFBEk7cn9

At a time when 70,000 Europeans are dying prematurely every year from air pollution from road transport[42] and 2 out of 3 citizens of the EU's biggest cities demand cleaner air[43], Europe needs a credible plan to slash toxic pollution from cars, one of the biggest sources of air pollution. T&E's tests[44] have already shown that e-petrol is not a clean fuel and, beyond particles, will do little to reduce toxic pollutant emissions of both regulated and unregulated pollutants compared to petrol fuel used today.

E-fuel vehicles will be banned from low and zero emissions zones

According to the Clean City Campaign[45], 507 low-emission zones (LEZs) will be in place in Europe by 2025 and there are plans for a total of 35 zero-emission zones (ZEZs) to be implemented by 2030. By limiting or banning the use of combustion engine vehicles in cities, these zones aim to reduce harmful levels of air pollution in urban areas. For instance, LEZs have been shown to reduce nitrogen dioxide (NO2) concentrations by around 20% in a wide range of conditions[46]. With their continued health threat, new ICEs fuelled with e-petrol will need to be banned from these low and zero emissions zones. This will cause serious issues to carmakers aiming at selling these new cars as they will be far less attractive to consumers. Drivers are likely to prioritise vehicles with no tailpipe pollutant allowed in these urban areas.

6. E-fuels' carbon neutrality cannot be guaranteed under the current legislative framework

As explained in section 4, ICEs sold after 2035 will need to run exclusively on carbon neutral e-fuels to be compliant with the cars CO_2 regulation and achieve a 100% emission reduction. In theory, as claimed by the e-fuel industry[47], e-fuels could be considered as carbon neutral if the electricity used to generate the hydrogen used in e-fuel production and to produce the fuel itself comes from additional 100% renewable energy sources, and if the CO_2 is captured directly from the air (direct air capture, DAC). In practice, however, there is no legal framework to certify that e-fuels produced in Europe or imported meet these requirements.

[42] European Commission. (2022) Euro 7 proposal: Impact Assessment Part 1.

[43] A pan European by YouGov of 21 of Europe's largest cities shows that 2 out of 3 do not want to go back to the levels of pollution experienced before the lockdown. https://www.transportenvironment.org/wp-content/uploads/2021/07/Briefing%20-%20polling%20Covid-19%20&%20mobility.pdf

[44] https://www.transportenvironment.org/discover/magic-green-fuels-why-synthetic-fuels-in-cars-will-not-solve-europes-pollution-problems/

[45] https://cleancitiescampaign.org/research-list/the-development-trends-of-low-and-zero-emission-zones-in-europe/

[46] https://cleancitiescampaign.org/research-list/quantifying-the-impact-of-low-and-zero-emission-zones/

[47] https://www.efuel-alliance.eu/efuels/what-are-efuels

The renewable energy directive (RED) does not guarantee carbon neutral fuels

Under the RED, the renewable liquid and gaseous fuels of non-biological origin (RFNBO) methodology[48] ensures that synthetic fuels produced in Europe would meet a 70% GHG emissions reduction threshold over their full lifecycle. Therefore, e-fuels produced and certified in Europe cannot be guaranteed to provide a 100% emission reduction as some grid electricity (potentially coming from fossil sources) could still be used to cover part of the e-fuel production.

Moreover, the RED allows the use of existing renewable energy capacity by e-fuels companies starting production before 2028. Under this "grandfathering" clause, fuel producers can continue using existing renewables for 10 years and still be certified as additional. This means that any renewables used for e-fuel production in Europe will only be guaranteed to be additional by 2038. Before this date, the use of existing renewable energy capacity would only reduce the renewable energy available to the grid and therefore imply the need for additional electricity generation from dispatchable energy sources, which often comes from fossil sources such as gas power plants.

The RED also allows the use of carbon capture from industrial sources covered under the ETS as a source of carbon to make synthetic fuels. This remains the case until 2036 for fossil power generation and until 2041 for other point sources in scope of ETS. This is a very long transition period because carbon capture from fossil sources will potentially lock-in investment in fossil sources, slow down their decarbonisation and will result in a delay in DAC investments.

Additional conditions are required to legally certify carbon neutral fuels

The current regulatory framework does not contain sufficient conditions to ensure e-fuels put on the market would enable a 100% emissions saving. To do so, a new regulatory framework would be needed to define the strict conditions for synthetic fuels to qualify as carbon neutral.

T&E supports at least the following conditions for defining a fuel as carbon neutral:

- The electricity used in all fuel and hydrogen generation processes needs to be both 100% generated from renewable energy sources and additional.
- A pathway with progressive uptake of direct air capture (DAC) is required to ensure the development of this new technology. T&E's proposal is to ensure 10% of the carbon feedstock in 2030 comes from DAC, 20% in 2035, 40% in 2040, 80% in 2045 and 100% by 2050. This will send a strong signal to the market that DAC is the only sustainable source of carbon feedstock for e-fuels.
- An hourly temporal correlation between electricity generation and use is required.

7. Nothing will prevent e-fuel cars from using fossil fuels

E-fuels and fossil fuels are interchangeable and there would be strong incentive for drivers to tamper due to the high potential cost savings as e-fuels will be much more expensive (*see section 2*). Mixing fuels into

48 https://energy.ec.europa.eu/system/files/2023-02/C_2023_1086_1_EN_annexe_acte_autonome_part1_v4.pdf

legislation regulating engines (car CO_2 standards) would likely lead to a law that is full of loopholes and unenforceable. To prevent this, it will be required to monitor what drivers put in their cars over the lifetime of an e-fuel car - hypothetically credited as zero-emission or carbon neutral - to prove that emissions have been reduced in the real world. This would need to include monitoring the fuel use of a car even when it is exported, within but also outside the EU.

As e-fuels are chemically similar to conventional fossil fuels, they could be blended into the regular fuel available at the pump. A vehicle hypothetically labelled as '100% e-fuel certified' that would be fueled with a blend of e-petrol and fossil petrol would not achieve a 100% GHG emissions reduction. Assuming a credit system is implemented and a carmaker purchases e-fuel credits to cover the car's projected lifetime fuel use, this cannot prevent divergences in the real world. Nobody can predict the exact fuel consumption of a car during its lifespan as the EU is currently not even able to track the fate of end-of-life vehicles[49]. The mileage that would be certified when these e-fuel cars are purchased would also need to be based on estimation and no crediting system can realistically cover the real world use and potential export of an e-fuel certified ICE.

It is highly unlikely that any robust and tamper proof car based solution can be developed for ensuring that a car only runs on e-fuels. A unique fuel nozzle design could be overcome very quickly through an adapter or even a permanent change to the fuel port. A fuel based sensor would be costly, time consuming and difficult to develop and still not tamper proof. Dye markers in fuel are also ineffective as they can be removed.

Today, in a context of high energy costs and difficult conditions for many households, the continued use of red diesel in cars[50] prove that drivers will be ready to hack and fraud to save money. Future measures to prevent fossil fuel use in e-fuel designed cars will very likely face the same difficulties.

8. There is no certainty that e-fuel will be available for cars

The generation of e-kerosene for aviation will be driven by the RefuelEU regulation[51]. The process of making e-kerosene results in by-products, such as hydrocarbons of different chain lengths, like diesel and petrol, and naphtha. A common misunderstanding is that these by-products would necessarily have to be used or be available for cars. For instance, a study[52] defined a "kerosene-mode" with an output of 50% jet fuel, 25% naphtha and 25% diesel but the e-diesel leftover could still be used in shipping and industry

[49]According to the German Environment Agency, 6 million end-of-life vehicles are disposed of in the EU each year but the fate of an additional 3.4 to 4.7 million deregistered vehicles is unaccounted for. https://www.umweltbundesamt.de/en/publikationen/effectively-tackling-the-issue-of-millions-of

[50] https://www.dhnet.be/actu/societe/2022/08/09/les-cas-de-fraude-au-diesel-rouge-explosent-les-amendes-pleuvent-NKBT63CNH5GZJHXHZUXKZ5JQ2Y/

[51] https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/698900/EPRS_BRI(2022)698900_EN.pdf

[52] https://www.sciencedirect.com/science/article/pii/S1876610216310761

applications. In 2021, Eurostat[53] reports that 68 Mtoe of diesel was used in non-road sectors including industry, shipping and energy use in other sectors, much more than the 14 Mtoe e-diesel left from the e-kerosene production in 2050, following the “kerosene-mode” scenario.

As different processes and pathways for by-products are possible, the final choice will likely depend on prices, profit margin, and the market demand from specific sectors. For instance, the petrochemical industry will need to turn away from fossil fuels, and synthetic fuels might soon become a priority for this sector with few alternatives. As such, a likely pathway would be to optimise both e-kerosene and by-products required for industry applications with few alternatives available for hard-to-decarbonise non-road transport applications. Even though the oil industry might produce some by-products such as e-petrol in the early production (e.g. if they use current refinery processes), future processes could be progressively optimised to maximise the e-kerosene or petrochemical by-products in output of refineries. Ongoing discussions on e-fuels at EU level will likely result in strong incentives to deliver fuels to the aviation and shipping sector by means of mandates in the RefuelEU and FuelEU regulations or a multiplier in the Renewable Energy Directive for e-fuels delivered to planes and ships.

Despite their initial high production costs, e-fuels are said to have the potential to become cheaper at industrial scale and with cheap renewable energy inputs. The argument follows that this would benefit more drivers when used in cars. The reality is that the cheaper the production costs would be, the more competition there will be for co-products from sectors that need it the most. Expensive e-petrol could be a potential output of synthetic fuel refinery but it will soon be phased-out as other co-products would be prioritised when production costs decrease due to economy of scale.

9. EU needs clear industrial roadmap for BEVs to compete with the U.S IRA

With electric car sales and e-mobility value chains gathering pace in China, the US and elsewhere in the world, Europe should accelerate its efforts to continue to lead this transition. Investment certainty on the future of the automotive industry in Europe is key. The 2035 target gives a clear direction and would allow the market to focus on ramping up the industrial infrastructure required. Audi CEO Markus Duesmann warned against a departure from the planned ICE phase out and demanded planning security for his billion-dollar investments in e-mobility[54]. Volvo Car CEO Jim Rowan[55] said setting a zero-emission target for all new passenger cars showed the EU's "global climate leadership at a critical time for our planet and humanity” and called for EU governments to choose “strong, decisive and progressive policy and

[53] https://ec.europa.eu/eurostat/databrowser/explore/all/envir?lang=en&subtheme=nrg.nrg_quant.nrg_quanta&display=list&sort=category&extractionId=NRG_BAL_C

[54] https://www.spiegel.de/wirtschaft/verbrenner-aus-audi-chef-markus-duesmann-warnt-vor-haengepartie-fuer-autoindustrie-fatal-a-90711e6e-60f1-429f-81f8-fb59696bfe16

[55] https://www.linkedin.com/feed/update/urn:li:activity:7041402040991776768/

leadership". If the phase-out is questioned, some battery makers are likely to prioritise the US market, attracted by subsidies under the IRA, this means the EU would lose major industrial opportunities and future jobs.

Proponents of e-fuels claim that the shift to EVs will put at risk hundreds of thousands of jobs in the automotive sector. However, a study by the Boston Consulting Group[56] concluded that the transition to BEVs will create almost as many jobs as are likely to be lost in traditional manufacturing, but it will be in new sectors such as the battery supply chain or the power sector. The real threat to European jobs and manufacturing is to delay the transition and hand leadership to China and the US. European battery makers are already announcing plans to move to the US, and this should be a wake-up call to European lawmakers to avoid further investment and jobs leaving the bloc. In Germany, we estimated that 87 GWh of planned battery cell manufacturing are at high risk of being delayed, scaled down or not realised and 301 GWh at medium risk in 2030[57]. Based on an average €80m/GWh investment[58], this means Germany is risking €31.1 billion domestic investment if the ICE phase-out is not fully confirmed.

Carmakers will face major uncertainties to plan their new ICE sales targets

The ramp-up of e-fuel ICE sales might also prove uncertain for carmakers when planning production volumes. They would need a very precise forecast of the e-petrol availability for the coming year and they would need to anticipate the exact consumption of both new cars and cars sold in previous years. OEMs will not be able to sell the maximum number of e-petrol cars each year as any excess could lead to a shortage of e-petrol for drivers of these cars. OEMs cannot set detailed production plans in advance if e-fuel forecasts are uncertain and if they cannot know the exact consumption of drivers every year (e.g. there would be major mileage difference between new e-fuel ICE in corporate fleets or if those cars are bought by luxury car drivers with low mileage).

10. Conclusions

In October last year, EU negotiators on behalf of European governments and MEPs reached a deal on new CO_2 standards for cars and vans. The deal made history as an agreement was reached on ending sales of new polluting combustion engine cars by 2035 - putting Europe on the path to becoming climate neutral by 2050. Just as the EU was about to confirm the single most important law to tackle emissions from road transport, Chancellor Scholz has threatened to pull the rug from under the European Green Deal in the interests of the oil and gas industry.

Despite all major carmakers publicly committing to a full transition to electric cars by 2035 or earlier, the oil, gas and automotive supplier lobbies claim that cars are better decarbonised by e-fuels. They claim theirs is an affordable and accessible solution, compatible with Europe's climate neutrality and energy security goals. This briefing dispels these claims as myths.

[56] https://web-assets.bcg.com/82/0a/17e745504e46b5981b74fadba825/is-e-mobility-a-green-boost.pdf
[57] https://www.transportenvironment.org/discover/how-not-to-lose-it-all/
[58] https://www.umlaut.com/en/stories/gigafactories-and-industry-4-0-a-match-made-in-heaven

Firstly, e-fuels will place a significant cost burden on drivers, and filling up with e-petrol in 2030 will be 50% more expensive than fossil petrol, meaning only the wealthiest drivers would be able to afford to do so. E-fuels are not only an expensive endeavour, but require enormous amounts of energy and hydrogen to produce. Under Scholz's plan, Europe will likely need to create new energy alliances and dependencies with non-democratic countries outside the EU. Switching from importing conventional to synthetic fuels will do nothing to promote Europe's energy security and solve Europe's current energy dependency on Russia.

Furthermore, while using e-fuels in new cars appears as a good solution to keep Big Oil profits stable, as old cars will continue to consume fossil petrol, this will do nothing for Europe's climate ambitions. If any e-petrol is available for cars, the optimal solution from the climate perspective is to use it in existing cars to have additional CO_2 savings from the current fleet. This means that e-petrol should not be included in any form in new car regulation, be it the car CO_2 and Euro 7 regulation as these options would only displace sales of new zero emission cars.

The discussion around 'carbon neutral' fuels also ignores the fact that cars powered by e-fuels still emit pollution at the tailpipe, damaging people's health. Based on optimistic assumptions about the availability of e-petrol, if 46 million new conventional and hybrid cars would be sold by 2050 and would be fuelled by pure e-petrol, these vehicles would emit 160 thousand tonnes of NOx - more than Italy's entire fleet NOx emissions in 2019.

Finally, muddying the waters by questioning the ICE phase out is risking up to €30 billion in battery plant investments in Germany alone, just as electric car sales and e-mobility value chains are gathering pace in China, the US and elsewhere in the world. Europe and Germany should be accelerating its efforts to continue to lead this transition, not creating confusion for industry and investment.

Further information

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Annex: methodology

E-fuel availability

As detailed in section 8, even if e-kerosene production is mandated by regulation, there would be no certainty that any e-petrol would be available for cars. Despite this constraint, we defined an illustrative scenario to estimate the maximum e-petrol available if the fuel industry chooses not to optimise by-products required by the industry. In this scenario, we assumed that a refinery output would contain 50% e-kerosene, 27% e-petrol, 21% e-diesel and 2% LPG[59]. Based on these by-product assumptions, the amount of e-petrol generated and driven by the RefuelEU mandate on e-kerosene[60] was calculated. According to Eurostat, 93% of the petrol demand in 2021 was used in road transport and we estimated that 99% of road transport petrol is allocated to cars[61]. From these hypotheses, the maximum amount available for cars is detailed below.

Table 1 - Optimistic scenario on e-petrol allocated to cars from e-kerosene by-products

	2030	2035	2040	2045	2050
E-petrol allocated to cars (PJ)	22	57	146	316	598

Emissions calculation methodology

In this report, the emission calculation methodology is based on T&E's Internal European Transportation Roadmap Model (EUTRM)[62]. The EUTRM makes use of the most recently available data to model the turnover of the whole car fleet on European roads (EU27). It is based on historical data on fleet behaviour (e.g. fuel consumption, emissions, car retirement, mileage change as a function of car age, …) and scenario inputs (e.g. car activity, electric cars sales share), the model's outputs include the fleet composition and its CO_2 emissions until 2050. The car activity used in EUTRM is aligned with the European Commission (EC) reference scenario 2020[63]. T&E modelled the minimum ZEV uptake in new car sales required to meet the latest EU car CO_2 Regulation[64]. EU ZEV sales are projected to increase from 12% of new sales in 2022 to 19% in 2025, 55% in 2030, before rising to 100% 2035. If e-petrol is used in new cars, it doesn't provide additional CO_2 savings and it would only displace new BEV sales by the number of new e-petrol cars sold (see below). If e-petrol is used in the existing fleet, it provides additional CO_2 savings. E-petrol emission savings are based on e-petrol availability described above which would fully

[59] From Concawe, 2022, an example of process output could contain 32% e-kerosene, 37% e-petrol, 28% e-diesel and 3% LPG. Given the regulatory pressure to provide e-kerosene, we assumed e-kerosene output would be optimised to reach 50% reported in different studies (e.g. Cerulogy, 2021 or Fasihi, 2021). The proportion of the remaining e-petrol, e-diesel and LPG in the non-kerosene output are assumed to remain similar.

[60] https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/698900/EPRS_BRI(2022)698900_EN.pdf

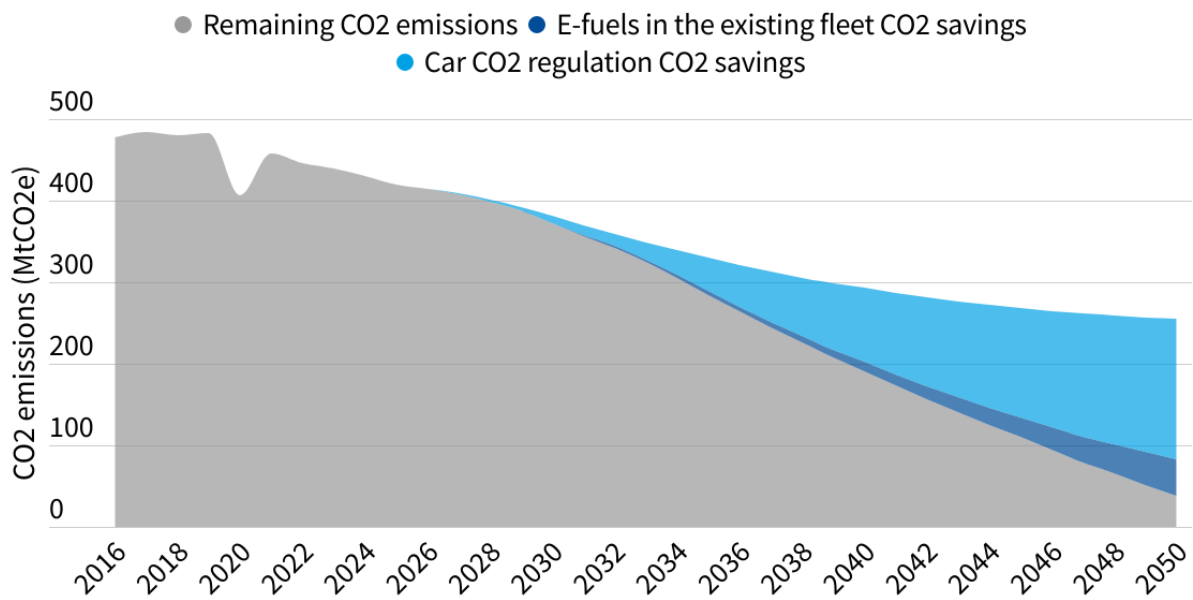
[61] Based on T&E modelling of fuel demand from road transport implied by regulations.

[62] https://www.transportenvironment.org/transport-emissions-modelling-and-analysis/

[63] https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en

[64] The methodology was described in T&E 2022 car CO_2 report. In this report, the new scenario includes the latest development on the zero and low emission vehicle benchmark agreed in the final regulatory proposal. The total sales number is projected within the EUTRM model.

displace petrol that has a 73.4 gCO_2/MJ emission factor. This methodology assumes e-petrol would be carbon neutral (assumption highly debated and discussed in section 6). Additional savings when e-fuels are used exclusively in the existing fleet are displayed in Figure 6 below:



Scope: EU27
Source: T&E EUTRM modeling of the car fleet emissions.

Figure 6 - Additional CO_2 savings if e-petrol is exclusively used in the existing fleet

Number of new car driven on e-petrol

Based on the fuel availability described above, the maximum number of new cars that could be driven on e-petrol is calculated each year. This assumes new e-petrol specific cars would be available from 2030. In the first year, new sales would be as high as allowed by the e-petrol availability based on new cars fuel consumption. In the second year, 1-year-old e-petrol cars would keep consuming e-petrol, therefore the e-petrol available for new cars is reduced by the consumption of 1-year-old e-petrol cars. This principle is applied every year until 2050, taking into account the lifespan of each generation of cars. The average fuel consumption of new ICE/HEVs in 2035 is assumed to be 5.4L/100km while new PHEVs would consume 3.2L/100km.

Germany BEV share to meet the regulation

To estimate the BEV sales in Germany, we modelled the BEV and PHEV sales share required to meet the adopted car CO_2 standards for the EU. Our modelling accounts for a country's ambition level as defined by BloombergNEF (2021).[65]

[65] BloombergNEF (2021) Hitting the EV inflection Point. Available: https://www.transportenvironment.org/publications/hitting-ev-inflection-point