BRIEFING

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Assessing the risks of crediting alternative fuels in Europe's CO_2 standards for trucks and buses

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SUMMARY

The European Parliament and the Council of the European Union are currently proposing modifications to the European Commission's proposal to amend the CO_2 standards for heavy-duty vehicles (HDVs); the Commission's proposal would set more ambitious standards than those currently in place.[1] There is some interest in modifying the standards to allow the crediting of alternative fuels towards a vehicle's certified CO_2 emissions. This study explains how any mechanism to include alternative fuels in the CO_2 standards risks diluting the CO_2 emission reduction benefits of these standards. The study focuses on the impact of one proposed mechanism, the carbon correction factor (CCF), on CO_2 savings from the HDV CO_2 standards.

There are three main mechanisms which would allow manufacturers to meet the CO_2 standards through the use of alternative fuels: 1) a CCF, which would adjust the certified emissions of a vehicle based on the share of alternative fuels in Europe's road transport fuel mix; 2) a fuels crediting system, whereby manufacturers would pay fuel suppliers to blend additional alternative fuels and receive a credit in return which can be used to artificially reduce their vehicle emissions; and 3) a type-approval process whereby a vehicle running exclusively on alternative fuels would be certified as emitting less CO_2 than the same kind of vehicle operating on fossil fuels. Of these options, the CCF is the most common proposal from parties in the European Parliament. The latter two options pose a climate risk by creating inconsistency with

1 European Commission, "Proposal for a Regulation of the European Parliament and of the Council Amending Regulation (EU) 2019/1242 as Regards Strengthening the CO_2 Emission Performance Standards for New Heavy-Duty Vehicles and Integrating Reporting Obligations, and Repealing Regulation (EU) 2018/956," *Official Journal of the European Union*, February 14, 2023, https://climate.ec.europa.eu/system/files/2023-02/policy_transport_hdv_20230214_proposal_en_0.pdf.

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existing fuels policies, particularly by potentially allowing biofuels with high greenhouse gas emissions or fraud risk to count towards the standards beyond their limits in other European Union (EU) fuels policies like the Renewable Energy Directive (RED III).

We find that using a CCF to artificially reduce vehicle CO_2 emissions could reduce the emission reduction benefits of the standards from 1.4 billion tons of CO_2 savings to 1.2 billion tons between 2020 and 2050—a 15% reduction in CO_2 savings and approximately equal to the annual CO_2 emissions from the HDV sector in Europe today.[2] The European Commission's proposal already falls short of Europe's target to reduce CO_2 emissions in the transport sector by 90% by 2050 relative to 1990 levels, achieving only a 69% reduction over this period. Introducing a CCF reduces this value to 64%.[3] Lower emissions reduction benefits would occur because the CCF would count alternative fuels already incentivized by the EU's alternative fuels' policies like the RED III towards the CO_2 standards. This would mean more fossil fuels will be consumed in the HDV sector with a CCF than without. Further, the European Commission's Short Assessment of Renewable Energy Sources (SHARES) database, which would be used to calculate the CCF, is at present not suitable for accurately determining the CCF for trucks and buses.

INTRODUCTION

BACKGROUND ON EU TRANSPORT POLICY

The European Commission recently proposed to amend the CO_2 standards for heavy-duty vehicles (HDVs).[4] The proposal would increase the emissions reduction targets for new vehicles and apply to many vehicle types not covered by the current standards, such as buses, coaches, and trailers.[5] A recent ICCT study estimates that the proposal would avoid 1.4 billion tons of CO_2 between 2020 and 2050, reducing annual emissions from the heavy-duty sector by 69% relative to 1990 levels by 2050.[6]

In parallel, the most recent revision of the Renewable Energy Directive (RED III) and the new ReFuelEU aviation regulation will both incentivize the production of alternative fuels, including liquid alternative fuels suitable for trucks and buses. Specifically, the RED III provides targets for 2030 and ReFuelEU provides sustainable aviation fuel (SAF) mandates from 2025 to 2050.[7] SAF production could impact the amount of alternative fuel blended into road diesel since renewable diesel and jet kerosene are co-products, meaning they are always produced in tandem.

2 EEA, "National Emissions Reported to the UNFCCC and to the EU Greenhouse Gas Monitoring Mechanism" (Directorate-General for Environment, United Nations Framework Convention on Climate Change, June 31, 2021), https://www.eea.europa.eu/data-and-maps/data/national-emissions-reported-to-the-unfccc-and-to-the-eu-greenhouse-gas-monitoring-mechanism-17.

3 As this 90% target applies to the total transport sector, including the harder to decarbonize aviation and maritime sectors, likely the heavy-duty sector would have to go beyond this 90% average reduction to equitably comply.

4 European Commission, "Proposal for a Regulation of the European Parliament and of the Council Amending Regulation (EU) 2019/1242 as Regards Strengthening the CO_2 Emission Performance Standards for New Heavy-Duty Vehicles and Integrating Reporting Obligations, and Repealing Regulation (EU) 2018/956," (2023), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2023%3A88%3AFIN.

5 Eamonn Mulholland, "Europe's New Heavy-Duty CO_2 Standards, Explained," ICCT Staff Blog (blog), February 14, 2023, https://theicct.org/eu-co2-hdv-standards-explained-feb23/.

6 Eamonn Mulholland and Felipe Rodríguez, "An analysis of the revision of Europe's heavy-duty CO_2 standards" (Berlin, Germany: International Council on Clean Transportation, 2023), https://theicct.org/publication/europe-heavy-duty-vehicle-co2-standards-may23/.

7 For more details on RED III and ReFuelEU, see Chelsea Baldino, "Provisions for transport fuels in the European Union's finalized "Fit for 55 Package," (Berlin, Germany: International Council on Clean Transportation, 2023), https://theicct.org/publication/fuels-fit-for-55-red-iii-jul23/.

As this analysis explains, we expect diesel alternative fuels to represent around 9% of diesel demand in 2030. Further, there is also a possible 35 billion cubic meter (bcm) biomethane target for the EU natural gas grid in 2030, which the European Parliament voted to include in amendments to the Proposal for a Regulation on the Internal Markets for Renewable and Natural Gases and for Hydrogen (recast), referred to as the Gas Regulation.[8] As of September 2023, the Gas Regulation is still in "trilogue," where the European Parliament, Council of Member States, and European Commission negotiate the file. Were the European Parliament and Council of Member States to implement this target, it could represent around 18% of total natural gas demand in 2030.

At present, alternative fuels play no role in vehicle manufacturer compliance with CO_2 standards. This is because the European regulatory framework to decarbonize the transport sector is multifaceted—vehicle manufacturers and fuel suppliers are regulated separately. For manufacturers, CO_2 standards require them to reduce the emissions of their vehicles through improving vehicle efficiency or transitioning to more efficient powertrains, such as electric vehicles. For fuel suppliers, fuels policies require them to reduce the GHG intensity of fuels by incentivizing the production of alternative fuels to displace fossil fuels.

Keeping regulations for vehicle emissions and fuel life-cycle emissions separate is important for two reasons:

1. Incorporating alternative fuels into vehicle CO_2 standards could result in crediting one framework with the effect of another (double counting).
2. An ill-designed mechanism could credit additional volumes of biofuels with high greenhouse gas (GHG) emissions, such as those produced from food and feed, or fraud-prone biofuels, such as those produced from waste oils, in the CO_2 standards. Depending on how it is implemented, it could incentivize the use of these risky fuels beyond the caps and safeguards in existing fuels policies, undermining the climate impacts of both the fuel policy and the vehicle standard.

PROPOSALS FOR INCLUDING ALTERNATIVE FUELS IN VEHICLE CO_2 STANDARDS

Despite the risks, some stakeholders advocate for the inclusion of alternative fuels in the proposed CO_2 standards proposal for heavy-duty vehicles. There are three main mechanisms through which these frameworks could be mixed, described below and depicted in Figure 1:

1. A carbon correction factor (CCF), which would credit the certified emissions of a vehicle based on the share of alternative fuels in Europe's road transport.
2. A fuels crediting system, whereby manufacturers would pay fuel suppliers to blend additional quantities of alternative fuels and receive a credit in return which they can apply towards lowering their vehicle emissions.
3. A type-approval process whereby a vehicle running on pure alternative fuels would be certified as emitting less CO_2 than a conventional vehicle operating on fossil fuels.[9]

8 European Parliament, "Report on the proposal for a regulation of the European Parliament and of the Councili n the internal markets for renewable and natural gases and for hydrogen (recast)," (February 16, 2023), https://www.europarl.europa.eu/doceo/document/A-9-2023-0032_EN.html#_section1.

9 A similar mechanism was introduced in the final stages of the light-duty CO_2 standards.

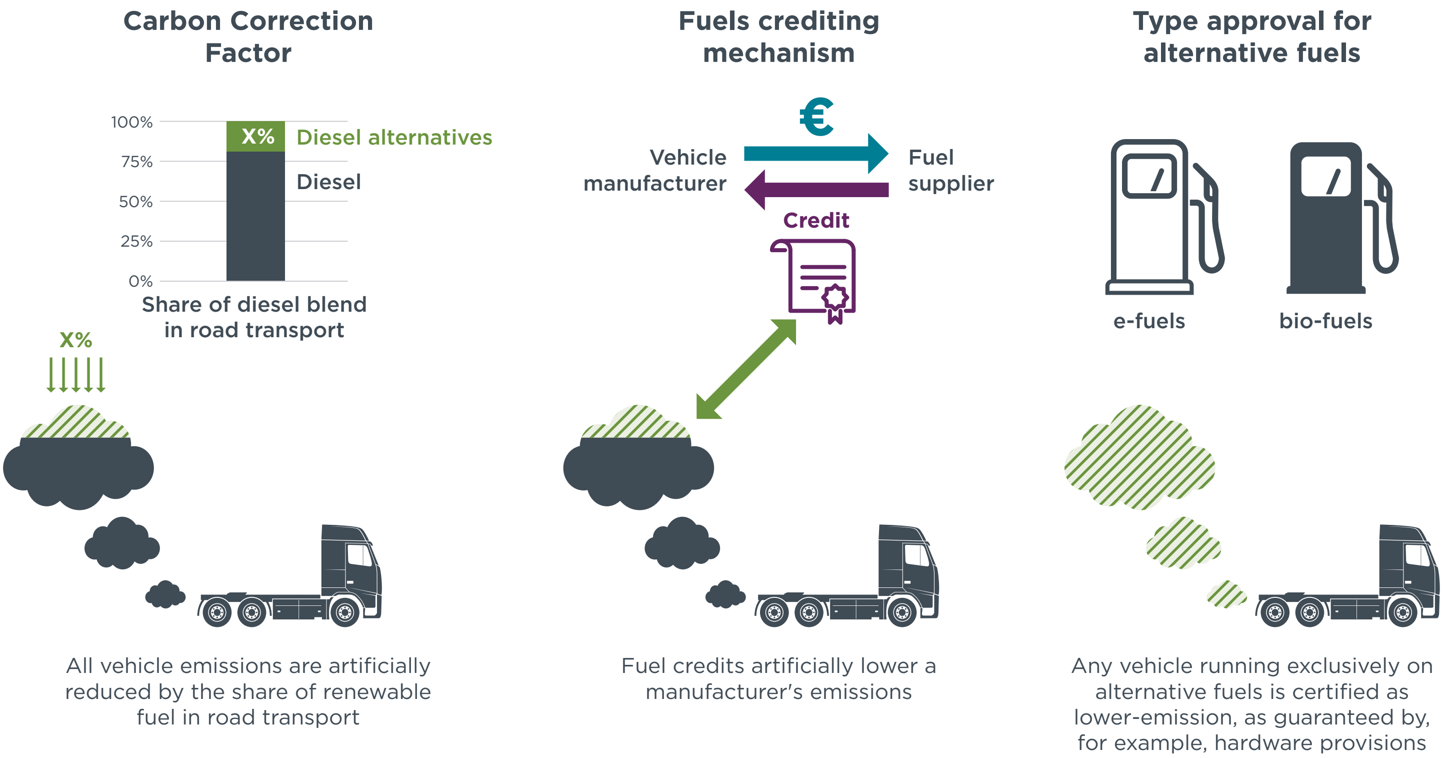

Figure 1. Alternative fuels crediting mechanisms.

Almost all EU manufacturers oppose the introduction of a CCF.[10] In the public consultation opened in advance of proposal for HDV CO_2 standards' release, Daimler Truck, MAN, Scania, and Volvo, which represent 68% of the truck market, opposed the introduction of a CCF mechanism. Most of these manufacturers have already committed to increasing their sale of zero-emission vehicles including 100% targets for 2040 by Scania and Daimler Truck, indicating they see no future in the role of alternative fuels. Fuel suppliers were the primary proponents of a CCF system in the public consultation.

This study quantifies the loss in CO_2 savings that would be associated with a CCF system. We first briefly describe the implications of a fuels crediting system and the type-approval process before presenting a detailed analysis of the proposed CCF system.

TYPE APPROVAL SYSTEM

A recital in the EU passenger car and van CO_2 standards requires the European Commission to create a new category for cars operating exclusively on so-called "CO_2-neutral fuels."[11] This option for incorporating fuels into the CO_2 standards would require the vehicle to operate only on alternative fuels. A delegated act, expected in 2023, would explain how use of these alternative fuels in these vehicles could count as reducing CO_2 emissions under the passenger car and van CO_2 standards.

Of the three possible mechanisms, type approval is the only one where the vehicle would run strictly on alternative fuels throughout its lifetime. However, for a type-approval system to deliver its intended effect, it would be critical for policymakers

10 European Commission, "Reducing carbon emissions- review of emission standards for heavy-duty vehicles (consultation)," (Accessed 13 September 2023), https://ec.europa.eu/info/law/better-regulation/have-your-say/ initiatives/13168-Reducing-carbon-emissions-review-of-emission-standards-for-heavy-duty-vehicles/ public-consultation_en.

11 Jan Dornoff, "CO_2 emission standards for new passenger cars and vans in the European Union," (Berlin, Germany: International Council on Clean Transportation, 2023), https://theicct.org/publication/eu-co2-standards-cars-vans-may23/.

to restrict eligibility to only fuels with the lowest GHG emissions. Many types of fuels eligible under the RED III are not fully "CO_2-neutral" or even low-GHG—some food and feed-based biofuels pose additional sustainability risks and could have even higher life-cycle emissions than conventional fossil fuels. We illustrate the lifecycle GHG emissions (gCO_2e/MJ) of hydroprocessed vegetable oil (HVO), including indirect land use change emissions from a European Commission-funded report,[12] compared to the RED's fossil comparator, in Figure 2.

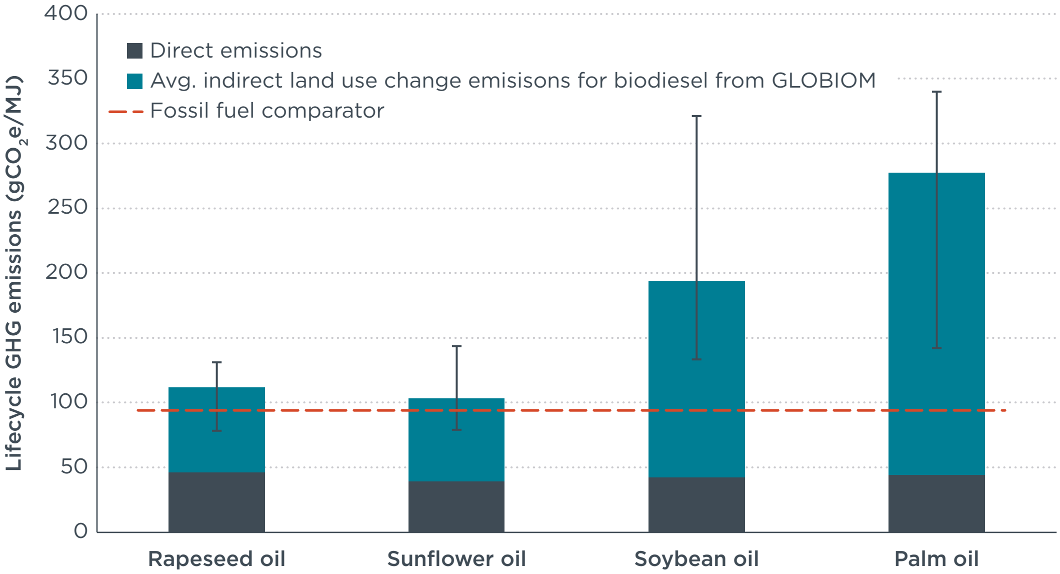

Figure 2. Lifecycle GHG emissions of HVO produced from vegetable oils. Direct emissions are the typical value for each pathway from the RED III. Indirect land use change emissions are from the 2015 European Commission GLOBIOM report, including error bars from their uncertainty analysis. The dashed red line represents the RED's fossil comparator.

Fuels made from fats and oils would be a financially attractive option under such a scheme, since they are the only materials that can be used to produce the only commercially available alternative liquid fuels for the HDV sector—biodiesel and HVO. At present, vegetable oils represent the majority of feedstock used to produce biodiesel and HVO. Palm oil, the second most common vegetable oil for biofuel production in the EU, can generate land-use change emissions in excess of emissions of fossil diesel.[13] It can also be used to produce one of the cheapest biofuels on the market, at only 1 euro per liter.[14] Used cooking oil also poses a risk—a type approval sytem could prompt increased imports, exacerbating the existing fraud risk of this feedstock and undermining both the RED III and the HDV CO_2 standards.[15]

To be carbon-neutral, fuels would need to achieve 100% reduction in life-cycle emissions reduction compared to petroleum. Fuels that could potentially meet this threshold include e-fuels, which are defined as renewable fuels of non-biological origin (RFNBOs) in the RED III. To meet the RED III targets, RFNBOs must comply

12 Hugo Valin et al., "The land use change impact of biofuels consumed in the EU: quantification of area and greenhouse gas impacts," (Ultrecht, Netherlands: Ecofys, IIASA, E4tech, 2015), https://energy.ec.europa.eu/publications/land-use-change-impact-biofuels-consumed-eu_en.

13 Bob Flach, Sabine Lieberz, and Sophie Bolla, "Biofuels annual," (The Hague: U.S. Department of Agriculture Foreign Agricultural Service, 2022).

14 Nikita Pavlenko, Stephanie Searle, and Adam Christensen, "The cost of supporting alternative jet fuels in the European Union," (Washington, D.C.: International Council on Clean Transportation, 2019), https://theicct.org/publication/the-cost-of-supporting-alternative-jet-fuels-in-the-european-union/.

15 Tenny Kristiana, Chelsea Baldino, and Stephanie Searle, "An estimate of current collection and potential collection of used cooking oil from major Asian exporting countries," (Washington, D.C.: International Council on Clean Transportation, 2022), https://theicct.org/publication/asia-fuels-waste-oil-estimates-feb22/.

with requirements described in a delegated regulation ensuring the use of renewable electricity in their production does not displace renewable electricity on the grid.[16] These requirements ensuring "additionality" would also be necessary for any type-approval mechanism allowing these fuels in the CO_2 standards. In addition, referencing the RED II's methodology for measuring the GHG emissions from these fuels would help ensure the emission reduction requirement is actually achieved.[17] Further, the type-approval system would require a tracking mechanism to ensure that fuels credited under this system are produced in excess of existing blending requirements under the RED III; otherwise, they would be double-counted.

Successful implementation of type approval would be difficult due to the chemical similarity between most types of drop-in alternative diesel fuels and conventional fossil diesel.[18] The alternative fuel would require a blending agent to signal their fuel type, but this blending agent could also be fraudulently mixed into fossil diesel. Since e-fuels or any other low-GHG fuel costs considerably more than fossil fuels, there will be a high incentive for customers to either tamper with sensors or blending agents so they could purchase fossil fuel instead. To reduce these risks, a type-approval system could require a physical test of the fueling monitor, which checks that a vehicle is running in the type-approved fuel, and of the fueling inducement system, which would prevent the vehicle from starting if it is fueled with anything other than the type-approved fuel. This test could be conducted throughout the vehicle's lifetime, and particularly, could be incorporated into conformity of production and in-service conformity provisions, with testing frequency requirements as stringent as for the type-approval of pollutants emissions.

FUELS CREDITING SYSTEM

In a fuels crediting system, manufacturers would purchase credits representing certain quantities of alternative fuels, which could be applied to a fleet or individual vehicles.[19] A reduction in certified CO_2 emissions would be based on the CO_2 savings of the fuel and the assumed lifetime of the vehicles. As we describe a recent study,[20] a fuels crediting scheme could undermine the intent of EU fuels policies to limit alternative fuels that pose a climate risk. Proponents of such a system argue that the fuels purchased for crediting towards the CO_2 standards would be additional to those required to comply with the RED III. However, the RED III limits the contribution of those alternative fuels with the greatest climate risk towards its transport target. There is a 7% cap on food and feed biofuels, which are associated with substantial land use change emissions, towards the directive. The RED III also caps the contribution of waste oil biofuels, including those produced from used cooking oil, which pose a fraud risk. While these alternative fuels can be certified as RED III-compliant, the fuels crediting system could ignore these guardrails by allowing fuels to count that are produced in excess of their caps.

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16 Directorate-General for Energy, "Delegated regulation on Union methodology for RFNBOs," (Brussels, Belgium: European Commission, 2023), https://energy.ec.europa.eu/publications/delegated-regulation-union-methodology-rfnbos_en.

17 Directorate-General for Energy, "Delegated regulation for a minimum threshold for GHG savings of recycled carbon fuels and annex," (Brussels, Belgium: European Commission, 2023), https://energy.ec.europa.eu/publications/delegated-regulation-minimum-threshold-ghg-savings-recycled-carbon-fuels-and-annex_en.

18 Jan Jencik et al., "Advanced biofuels based on Fischer-Tropsch synthesis for applications in diesel engines," *Materials (Basel) 14*, no. 11 (June 2021): 3077, doi 10.3390/ma14113077.

19 Christoph Gatzen, Michael Zähringer, and David Bothe, "Crediting system for renewable fuels: Functionality and benefits," *Frontier Economics* (November 2020), https://www.frontier-economics.com/media/0e2dkkim/crediting-system-for-renewable-fuels.pdf.

20 Eamonn Mulholland and Felipe Rodríguez, "Recommendations for revising the modalities of Europe's heavy-duty vehicle CO_2 standards," (Berlin, Germany: International Council on Clean Transportation, 2022), https://theicct.org/publication/recs-eu-hdv-co2-standards/.

In practice, it would be difficult to ensure the fuels credited would be additional to the RED III because, as a directive, it is implemented by all 27 Member States individually. The European Commission would need to implement its own system to track each liter of alternative fuel in the EU and determine whether it is already counted towards any of the 27 national implementations of the Renewable Energy Directive. The alternative fuels union database required in the RED II (and RED III) would not include such information about whether the fuel received incentives.

CARBON CORRECTION FACTOR

CALCULATING THE CARBON CORRECTION FACTOR

Under the CO_2 standards, HDV emissions are calculated (i.e., certified) using a simulation tool, VECTO. In the European Parliament's Committee on the Environment, Public Health and Food Safety (ENVI) proposals, the certified emissions of every truck simulated through VECTO would be reduced by a carbon correction factor, the CCF. That is, the emissions of every truck would be equal to the **CO_2 emissions calculated from VECTO, multiplied by (1-CCF).** The CCF is calculated using the following formula:[21]

$$CCF_i = \frac{SHARES_{n,i}}{100}$$

CCF_i is the carbon correction factor for a specific blend of fossil fuel and carbon-neutral alternative fuel *i*; $SHARES_{n,i}$ is the percentage of carbon-neutral fuel *i* over the total consumption of the fuel *i* for road transport, in the reporting period *n*, calculated using the European Commission's Short Assessment of Renewable Energy Sources (SHARES) database.[22] A carbon-neutral fuel is defined in these proposals as any renewable or synthetic fuel as defined in the Renewable Energy Directive, 2018/2001, such as biodiesel, e-fuels, biogas, renewable liquid and gaseous transport fuel of non-biological origin, and recycled carbon fuels. Thus, any biofuel qualifying towards the RED II, including food and feed biofuels that are associated with significant land use change emissions, would be included in the CCF.

The proposed CCF mechanism is fuel and transport sector dependent. For example, the CCF for diesel trucks would be calculated based on the share of diesel alternatives (biodiesel, renewable diesel, and HVO) in the diesel mix in road transport, whereas the CCF for natural gas trucks would be calculated based on the mix of natural gas alternatives (biomethane) consumed in road transport.

The SHARES database, however, does not differentiate by fuel type or transport sector and only reports the total volume of RED-compliant fuels in each Member State across all transport. This means, at present, it is not possible to use SHARES to determine the alternative fuel that is blended into diesel, gasoline, or natural gas in the road transport sector.

The Member State bodies reporting to the SHARES database would need to report more detail about the fuel types and how they are used to accurately account for alternative fuels in the road sector; it is unclear whether this would happen with the CCF implementation. It is unlikely that the SHARES database could account for road fuel used in the passenger car or heavy-duty sector, since these sectors utilize the same fueling infrastructure. This would mean that the heavy-duty sector would be credited with all alternative diesel bended into the diesel fuel pool, even if those fuels

21 There are some slight variations in each proposal, so we focus on that put forward by the largest party, the European People's Party (EPP).

22 Eurostat, "Short assessment of renewable energy sources," accessed 14 September 2023, https://ec.europa.eu/eurostat/web/energy/database/additional-data#Short%20assessment%20of%20renewable%20energy%20sources%20(SHARES).

are used in passenger cars. Finally, some CCF proposals in the European Parliament amendments state that fuels designated as carbon neutral must meet a 70% GHG reduction threshold, in accordance with RED methodology. In this case, Member State bodies would need to create separate categories within the SHARES database for food and feed-based biofuels, since these fuels must only meet a 50%–65% reduction, depending on when they were originally certified.

Table 1 shows our estimates of the CCF from 2023 to 2050. We project the liquid and gaseous alternative fuel volumes incentive by ReFuelEU, the RED III, and the proposed 35 bcm biomethane target in the Gas Regulation, as explained in the Annex. We assume that the European Commission would modify the SHARES database to properly account for different fuel types. We find the diesel CCF could be 8.7% in 2030, while in 2040 it could be over three times higher, at 30.8%. Much of this increase is due to the projected decline in future liquid diesel consumption and an increase in the share of alternative fuels. In 2050, the entirety of diesel fuel demand could be displaced by alternative fuel (i.e., a CCF of 100%). This increase in alternative diesel fuels is largely driven by the increasing ambition of the SAF targets under ReFuelEU; the overall SAF target is 34% of aviation fuel in 2040 and 70% in 2050. Even when SAF producers maximize their product output for jet kerosene, they will still produce some diesel-range hydrocarbons as a co-product of SAF.[23] For example, under these assumptions 10.6 million tonnes of renewable diesel would be produced as a co-product in 2040. In addition, we assume 12.5 million tonnes of biodiesel will be produced in 2040, with the same share of food and feed biofuels as allowed today.

Table 1. Projected CCF values for natural gas and diesel under the RED III and ReFuelEU Aviation.

	2023	2025	2030	2035	2040
CCF diesel	7.5%	7.8%	8.7%	16.5%	30.8%
CCF natural gas	4.8%	8.0%	17.9%	22.7%	27.7%

In our assessment, we assume all renewable diesel and biodiesel incentivized by the RED III and ReFuelEU is blended into road transport diesel. In reality, at least some of this alternative fuel will be blended into bunker fuel for marine vessels, especially given that e-fuels and some advanced biofuels receive a multiplier when consumed in the maritime sector under the RED III. The FuelEU Maritime regulation will also provide a separate incentive to encourage low-carbon alternative diesel fuels into the marine sector. Together, this means that Member States will likely provide higher incentives when alternative fuels are consumed in the maritime sector rather than the road sector, since that would allow these fuels to count more towards the RED III targets. Thus, the CCF's we calculate here represent the higher end of the range given current EU fuels policy. At the same time, the SHARES database would need to require Member States to differentiate alternative diesel blended into the road and maritime sectors.

For the natural gas pool, we calculate a CCF of 17.9% in 2030 and 27.7% in 2040. The 17.9% CCF estimate for 2030 is derived from the proposed 35 bcm target in the Gas Regulation, while the 27.7% estimate for 2040 is based on the assumption that the EU would achieve the gaseous bioenergy volume of 66.9 bcm in 2050 projected in the European Commission's Climate Impact Assessment. We calculate the natural gas CCF by estimating the percentage of biomethane that would be blended into the entire EU natural gas grid; we do not do a transport-specific analysis. That is, we do not consider the fact that any biomethane included in the transport energy category in the SHARES database would probably need a guarantee of origin or some other proof that it was

23 Pavlenko, Searle, and Christensen, "The cost of supporting alternative jet fuels in the European Union."

purchased for use in this sector. Thus, the CCF we calculate in this study may not accurately demonstrate what the biomethane CCF could be in the future.

THE EFFECT OF THE CARBON CORRECTION FACTOR FOR CO_2 EMISSIONS FROM TRUCKS AND BUSES IN THE EU

To determine the impact of a CCF, we quantify the loss in emissions reductions that a CCF mechanism in the HDV CO_2 standards could cause, relative to the European Commission's original proposal to revise the CO_2 standards. We project tailpipe CO_2 emissions in the heavy-duty sector using the ICCT's Roadmap model over three scenarios:[24]

1. Current standards: The existing CO_2 standards, which include a 15% reduction by 2025 and 30% by 2030.
2. Proposed standards: The European Commission's proposed standards, which include a 45% reduction by 2030, 65% by 2035, and 90% by 2040.
3. Proposed standards including CCF: The European Commission's proposed standards with the inclusion of a CCF in accordance with the ENVI committee proposal.

The methods used to model these scenarios are described in previous ICCT publications.[25] We disaggregate the heavy-duty sector into every VECTO group,[26] assume a constant efficiency for each regulated category, and assume an S-curve uptake in zero-emission vehicles to meet the standards. This process is also detailed in a previous ICCT publication.[27] When including the CCF, we apply the same methodology but reduce the emissions of every regulated vehicle based on its fuel type by the values presented in Table 1.

The resulting shares of zero-emission vehicles required to comply with the standards is presented in Figure 3. In total, the CCF could correspond to approximately 300,000 fewer electric HDVs sold between 2020 and 2030, and 1.3 million fewer between 2020 and 2050, compared to the proposed standards. The CCF could reduce the share of zero-emission trucks and vans by up to 7 percentage points in each year between 2025 and 2040.

The impact narrows under higher shares of zero-emission vehicles, as the CCF only applies to fossil fuel vehicles and, thus, higher shares of zero-emission vehicles result in fewer vehicles impacted by the CCF. For buses and coaches, the reduction is less pronounced since city buses and interurban-buses, which make up roughly two thirds of the sale of all buses and coaches, are proposed to be regulated by a zero-emission share target (100% by 2030) rather than a CO_2 target. This means a CCF would have no bearing on these vehicles. Both sides of the figure also include unregulated vehicles, for which we assume a low yet increasing share in zero-emission vehicles despite the lack of CO_2 standards. This is most apparent for buses, where the share of zero-emission city buses has been rising rapidly in recent years despite the lack of CO_2 standards.[28]

24 "Roadmap Model Documentation," ICCT, 2022, https://theicct.github.io/roadmap-doc/.dllan.

25 Eamonn Mulholland et al., "The CO_2 standards required for trucks and buses for Europe to meet its climate targets" (Washington, D.C.: International Council on Clean Transportation, 2022), https://theicct.org/publication/hdv-co2standards-recs-mar22/; Mulholland and Rodríguez, "An analysis of the revision of Europe's heavy-duty CO_2 standards."

26 Europe's heavy-duty vehicles are categorized by various characteristics such as body type and axle configuration. Combinations of these characteristics are assigned a VECTO group.

27 Mulholland et al., "The CO_2 standards required for trucks and buses for Europe to meet its climate targets."

28 Eamonn Mulholland and Felipe Rodríguez, "The rapid deployment of zero-emission buses in Europe" (Berlin, Germany: International Council on Clean Transportation, 2022), https://theicct.org/publication/the-rapid-deployment-of-zero-emission-buses-in-europe/.

The CCF would have a bearing on coaches, with a drop in the ZEV shares evident from 2030 onward.

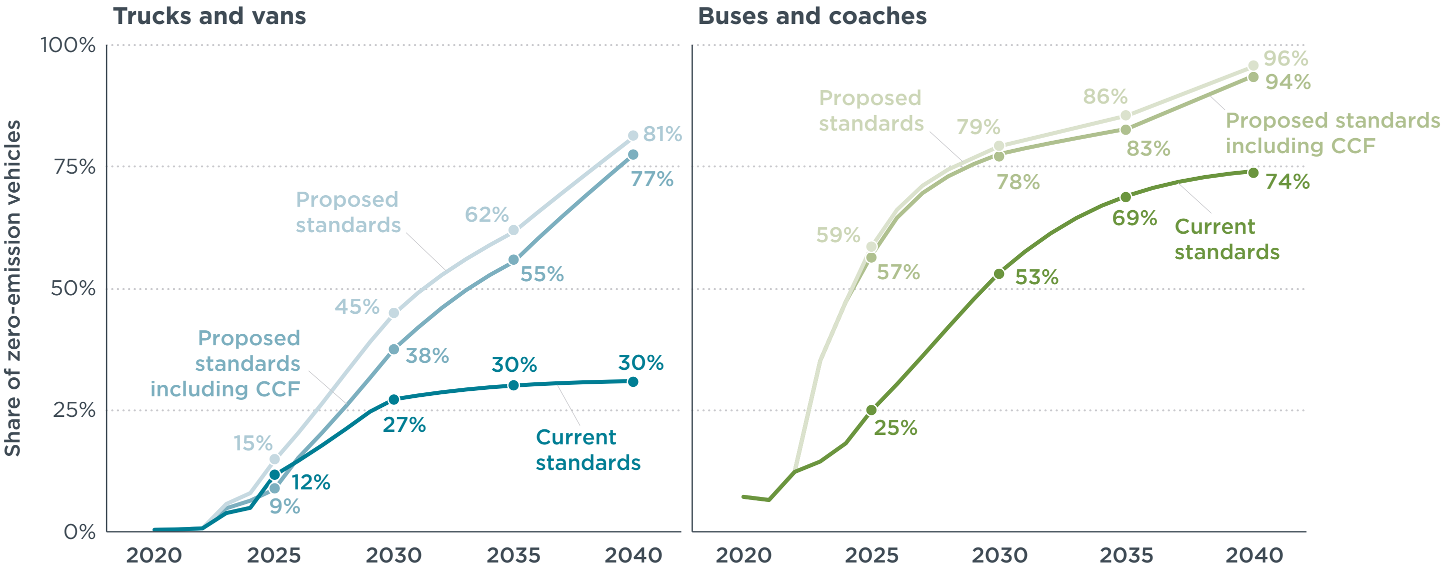

Figure 3. Share of zero-emission vehicles in the EU under the European Commission's proposed revision of HDV CO_2 standards with and without a CCF.

The reduced zero-emission vehicle shares in the case that a CCF is included in the HDV CO_2 standards could result in 200 million tonnes of tailpipe CO_2 emissions savings lost from 2020 to 2050 compared to the savings provided by the Commission's proposal (Figure 4). This represents 15% of the total savings we estimate in the current proposal. The loss in CO_2 savings is equivalent to reducing the Commission's proposed targets for 2030, 2035, and 2040 by 8 percentage points, each. The European Commission's proposal already falls short of Europe's target to reduce CO_2 emissions by 90% by 2050 relative to 1990 levels, achieving only a 69% reduction by 2050 relative to 1990. Introducing a CCF reduces this value to 64%.

We note that the 35 bcm target for 2030 is only a proposal in the Gas Regulation, since the trilogue for this regulation is ongoing. Were there to be no biomethane target, the lost CO_2 emission savings would change only slightly to 196 million tonnes. The biomethane CCF makes little difference in our analysis, as natural gas vehicles make up a minor share of annual sales; in 2022 just 4% of annual sales of regulated HDVs were fueled by natural gas.

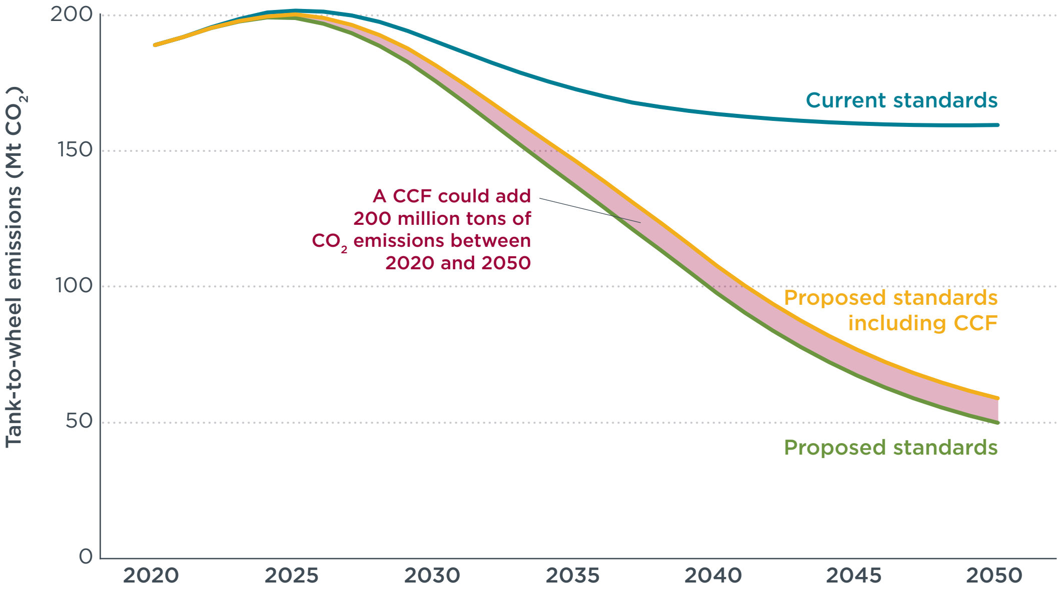

Figure 4. Tailpipe CO_2 emissions (million tonnes) in the EU under the European Commission's proposed revision of HDV CO_2 standards with and without a CCF.

The loss in CO_2 savings is due to the CCF system crediting alternative fuels already incentivized by EU alternative fuel policies, specifically the RED III, ReFuelEU aviation regulation, and any biomethane mandate in the Gas Regulation. The CCF would facilitate double counting within EU transport policy and would not incentivize any additional production of alternative fuel. In addition, food-and-feed-based biofuels made from crops such as soy and palm oil may generate land use change emissions that would erase their climate benefits (Figure 2). Palm oil-derived biofuels can have GHG emissions over two times higher than fossil diesel, and soy oil-derived biofuels can generate GHG emissions 1.6 times higher when accounting for their indirect land use change emissions, which are not included in the GHG emissions accounting in the RED III.[29] Yet under the CCF mechanisms, these biofuels would allow manufacturers to receive a reduction in their vehicles' certified CO_2 emissions. Thus, in addition to counting the GHG savings of fuels which are already incentivized under other policies towards the CO_2 standard, the proposed mechanism further overestimates the contribution of these CO_2 savings.

The projected loss in CO_2 savings due to the CCF implementation in Figure 4 represents a worst-case scenario, wherein all future growth in alternative diesel volumes flows to the road sector rather than marine. However, this worst-case scenario is not unrealistic, given that the SHARES database does not presently delineate between different fuel types and alternative fuels used in different sectors. If the SHARES database is not adjusted, then even if alternative fuel is being consumed in the maritime sector, this fuel may actually be credited towards the CO_2 standards. When the CCF is calculated assuming all the current RED III-compliant biofuels reported in SHARES could be blended into diesel, then the CCF is 2% higher for 2021 than our estimation.[30]

29 The RED III only quantifies the emissions direct, supply chain life-cycle emissions attributable to fuel production for the purposes of demonstrating eligibility. High-indirect land use change risk fuels are phased out, and other food and feed crops with indirect land use change risk are subject to a cap on their contribution to the program to mitigate the risk of indirect land-use change. See Hugo Valin et al., "The land use change impact of biofuels consumed in the EU: Quantification of area and greenhouse gas impacts," https://energy.ec.europa.eu/publications/land-use-change-impact-biofuels-consumed-eu_en.

30 Calculated by retrieving the 2021 volume of RED II-compliant fuels from SHARES and calculating the CCF assuming a denominator of total diesel demand in 2021. The calculation of total diesel demand is explained in the appendix.

Further, the CCF structurally overstates the emissions savings from alternative fuels. In the CCF formula, the percentage of fuels is directly applied towards the vehicle's CO_2 emissions value. Structuring the formula this way assumes that the tailpipe emissions from all alternative fuels are zero-carbon. Since tailpipe emissions represent nearly 80% of fossil fuel's life-cycle emissions, this means these alternative fuels are assumed to provide nearly 80% life-cycle GHG savings relative to fossil fuels. Most alternative fuels do not achieve this level of GHG savings, and there is no requirement in the RED III for alternative fuels in the transport sector to meet such a high threshold. The highest threshold in the RED III is 70%, and some biofuel producers certified before 2015 only need to reach a 50% GHG savings.

CONCLUSIONS

Any mechanism for incorporating alternative fuels, such as CCF or type approval, would reduce the effectiveness of the EU HDV CO_2 standards. Incorporating a CCF based on the EU alternative fuel share into vehicle CO_2 emission values could reduce the ambition of the HDV CO_2 standards considerably. A CCF proposal could lead to 200 million tons less CO_2 savings from 2020 to 2050 and 1.3 million fewer heavy-duty ZEVs by 2050. The loss in CO_2 savings is equivalent to reducing the Commission's proposed targets for 2030, 2035, and 2040 by 8 percentage points, each.

Almost all EU manufacturers oppose the introduction of a CCF. Fuel suppliers were the primary proponents of a CCF system in the public consultation.

A CCF would double count the achievements of other EU policies, since alternative fuels are already counted towards the RED III. This would mean more fossil fuels would be consumed in the HDV sector as a result of the CCF. Further, the SHARES database, which would be used to calculate the CCF, is presently not suitable for accurately determining the CCF for trucks and buses, as it does not delineate by fuel type or sector.

APPENDIX: METHODOLOGY

Here we describe the methodology used to assess alternative fuel production for the HDV sector, which would be incentivized by the RED III, ReFuelEU, and the proposed biomethane target in the Gas Regulation. We illustrate the results for the diesel fuel mix in Figure A1, which we used to calculate a CCF for liquid fuels. Since the CCF is intended to be for different fuel pathways, we modeled a CCF for both natural gas and diesel.

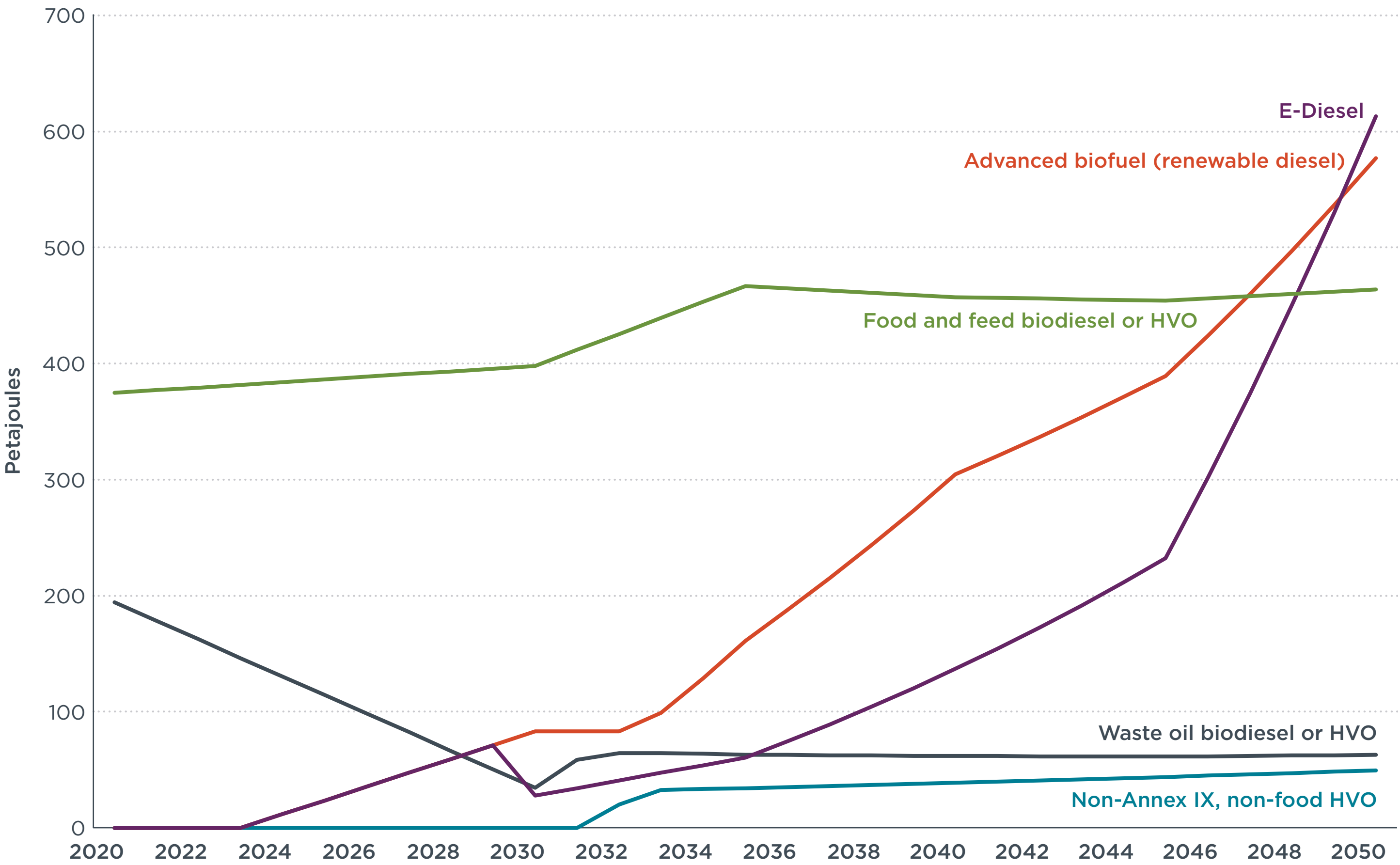

Figure A1. Alternative diesel fuels in the EU road diesel mix, incentivized by the ReFuelEU aviation regulation and RED III) from 2020 to 2050.

PROJECTING ALTERNATIVE FUEL PRODUCTION IN THE EU FROM PRESENT DAY TO 2050 AND CALCULATING THE CCF

At present, most alternative fuels in the EU come from conventional biofuels. Vehicles in the heavy-duty sector mainly consume diesel fuel; biodiesel and HVO are the two conventional biofuels that can be produced for this fuel type. We estimate current and future biodiesel and HVO production in the EU using 2020 biofuels data, as well as the total biofuel from food and feed-based feedstocks using the feedstock and fuel-specific data, from the U.S. Department of Agricultural (USDA) Foreign Agricultural Service.[31]

The amount of food and feed-based biofuels allowed under the RED III is the lower of 7% of total transport energy in 2030 or the 2020 food and feed-based biofuel share plus 1%. We calculate total transport energy by calculating 2030 EU aviation fuel

31 Flach, Lieberz, and Bolla, "Biofuels annual."

demand using the methodology described in a previous ICCT report.[32] We retrieve the remainder of transport energy in 2030 from the European Commission's EU Reference 2020 scenario, which contains energy consumption and energy demand from the road, rail, and maritime sectors in 2030.[33] In line with the RED III, international maritime energy represents 13% of total transport energy. We find that the 2020 food and feed-biofuel share plus 1% is lower than 7%. We assume this share and the ratio of biodiesel and HVO to ethanol from food- and feed-based feedstocks will remain the same in future years as it was in 2020. We also retrieve the current volume of HVO and biodiesel produced from waste oils and fats from the USDA Foreign Service report.[34] These feedstocks, found in Annex IX, B of the RED II, are only allowed to contribute to the RED III at a maximum of 1.7% of transport energy.

In 2030, the RED III is forecast to contain a 5.5% advanced biofuel and renewable fuel of non-biological origin (i.e. e-fuels) target, which in practice is a 2.75% target since these fuels receive a multiplier of two towards the target. Advanced biofuels are defined as those made of the materials found in Annex IX, A of the RED III, which are mostly wastes and residues. We assume half of this 2.75% target is met with renewable electrolysis hydrogen used in petroleum refining, with the remainder of the target met with equal shares of e-fuels and advanced biofuels.

When producing alternative fuel to meet the advanced biofuel and e-fuels sub-target in the RED III, fuel producers will produce renewable diesel and SAF as co-products. Since the RED III's 5.5% target is for all transport energy, it will incentivize more advanced biofuels and e-fuels than is needed to meet the 6% SAF target, with a minimum share of 0.7% synthetic fuels, under ReFuelEU. In light of this, we assume that all e-kerosene incentivized by this RED III target will be consumed in the aviation sector and that, when producing e-fuels, fuel producers will maximize for jet fuel production. This is because, in addition to the regulation mandating the use of these fuels in ReFuelEU, the RED III contains a multiplier of 1.5 for e-fuels. In a previous paper, we found that a multiplier of 1.2 is close to the value necessary to shift refining to maximize for jet fuel.[35] We assume the remaining volume of SAF needed to meet ReFuelEU will be met with hydroprocessed esthers and fatty acids (HEFA), a co-product of HVO. We also assume that when producing HEFA, fuel producers maximize for jet fuel. At present, more HVO is consumed in EU transport than we calculate will be needed to meet the SAF target in 2030, so we assume a linear decline in the volume of HVO from waste oils and fats between 2020 and 2030. We assume all advanced biofuel incentivized under the RED III 5.5% target, including jet fuel, is blended into the diesel pool, which is common practice.[36] We assume production of advanced biofuels and e-fuels begins in 2024 and grows linearly until 2030. We assume all these fuels are blended into the diesel pool.

The RED III targets do not extend beyond 2030. Thus, starting in 2031, we develop a set of conservative assumptions to project continued growth in liquid fuel production based on ReFuelEU. Starting from the mix of e-fuels and advanced biofuels necessary to meet the 2030 RED III targets, we assume continued growth in alternative diesel

32 Dan Rutherford, Sola Zheng, Brandon Graver, and Nikita Pavlenko, "Potential tankering under an EU sustainable aviation fuels mandate," (Washington, D.C.: International Council on Clean Transportation, 2021), https://theicct.org/publication/potential-tankering-under-an-eu-sustainable-aviation-fuels-mandate/.

33 European Commission Directorate General for Energy, "EU reference scenario 2020," accessed 13 September 2023, https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en.

34 Flach, Lieberz, and Bolla, "Biofuels annual."

35 Pavlenko, Searle, and Christensen, "The cost of supporting alternative jet fuels in the European Union."

36 Abdullah M. Aitani, (2004), Oil Refining and Products, in Cutler Cleveland (Ed.), the *Encyclopedia of Energy*, (pg. 715-729), https://www.sciencedirect.com/science/article/abs/pii/B012176480X00259X.

fuels based on the ReFuelEU aviation mandate, which will generate a diesel co-product of aviation fuel.

Like we do for the food and feed cap, we assume that the 1.7% cap on waste oils and animal fats defined in Annex IX, B extends beyond 2030, adjusted based on the growing overall total transport energy. ReFuelEU also contains a 3% cap on non-Annex IX feedstocks. We assume non-Annex IX materials (such as edible animal fats) are used to produce HEFA. We assume these caps on HEFA are met before advanced biofuel production increases. We assume that fuel producers continue to maximize for jet fuel production.

We also assume all renewable diesel incentivized by the RED III and ReFuelEU will be blended into diesel going to the road sector to illustrate as a worst-case scenario of how much CO_2 savings could be lost were a CCF system be implemented. In reality, there are also multipliers of 1.5 for e-diesel and 1.2 for advanced biofuel consumed in the maritime sector, which would incentivize renewable diesel in this sector as well. To calculate the CCF for road diesel, we calculate the share of the total alternative fuel pool (biodiesel, renewable diesel, and HVO) out of the projected diesel demand in each year. We project the diesel demand in each year based on the Commission's proposed HDV CO_2 standards. More details on the model can be found in a recent ICCT analysis.[37]

For the alternative fuels in the gas sector, we retrieve the 2020 and 2021 volumes of biomethane in the EU from the European Biogas Association.[38] We assume the proposed 35 billion cubic meter biomethane target in the Gas Regulation is implemented. In 2050, we assume the EU would achieve the biomethane volume projected in the European Commission's Climate Impact Assessment, under the most ambitious regulatory scenario ("ALLBNK").[39] In this scenario, there is 66.9 bcm gaseous bioenergy in the EU in 2050, which we assume would be entirely biomethane. In the years between 2020 and 2030, and 2030 and 2050, we assume biomethane increases linearly. We retrieve projections for gas demand from the EU Reference Scenario 2020.[40] The CCF is calculated by dividing the total biomethane projected in each year by the total estimated gas demand in that year.

37 Mulholland and Rodríguez, "An analysis of the revision of Europe's heavy-duty CO_2 standards."

38 Angela Sainz Amau et al., "Annual Report 2020: European Biogas Association," (Brussels, Belgium: European Biogas Association, 2021), https://issuu.com/europeanbiogasassociationeba/docs/annual_report_2020; European Biogas Association, "EBA Statistical Report 2022," accessed September 13, 2023, https://www.europeanbiogas.eu/SR-2022/EBA/.

39 European Commission Directorate General for Climate Action, "2030 Climate Target Plan," https://climate.ec.europa.eu/eu-action/european-green-deal/2030-climate-target-plan_en.

40 European Commission Directorate General for Energy, "EU reference scenario 2020," accessed September 13, 2023, https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en.