



## Biofuels in Emerging Markets - Key Findings

Task 39 worked on the project “Biofuels in Emerging Markets”, in which the potential of biofuels production in countries of Africa, Asia, and Latin America was analyzed. Here is a list of key findings from this study:

- Biofuel production was analyzed in Argentina, Brazil, China, Colombia, Ethiopia, Guatemala, India, Indonesia, Malaysia, South Africa, and Thailand. Life cycle assessment of biofuels and fossil fuels indicated that **biodiesel reduces GHG emissions by 36%–84%** compared to regular diesel, and **ethanol reduces GHG emissions by 22–81%** compared to regular gasoline. A reduction of 87% in GHG emissions was calculated when comparing sugarcane ethanol to the gasoline used in South Africa (which contains synthetic gasoline produced via Fischer-Tropsch synthesis using coal syngas).
  - **IMPORTANT NOTE:** these reductions are possible only when completely replacing fossil fuels with biofuels, with potential to produce less life cycle GHG emissions than electric vehicles. **When used in blends with fossil fuels, reductions of 10-15% in GHG emissions are possible without engine modifications in the existing vehicle fleet.**
- These results do not include emissions related to land use change since this parameter comes with many uncertainties and soil carbon stock can decrease or increase where land is dedicated to biofuel crop cultivation. To make sure that GHG savings are not partly or fully counteracted by direct or indirect land use change effects linked to biofuel production, **countries should create and enforce policies to rule out that agricultural activities are expanded into high carbon stock land.**
- Biofuels are economically feasible in the studied countries, except for China and Malaysia. In China, competition with food makes feedstock too costly. Nevertheless, in this case, biofuels could be imported. In the case of Malaysia, fossil fuels are subsidized to control inflation, and this policy could be extended to biofuels as well to make them economically competitive.
- **GHG savings are very significant in India, Indonesia, and South Africa for different reasons.** In India, biofuels can be produced with a very low carbon intensity. In Indonesia, besides the low carbon intensity of biofuels, fossil diesel has a high content of sulfur, which causes acid rain. In South Africa, despite higher-than-average emissions in the production of biofuels, they still represent a very large reduction compared to synthetic fossil fuels produced via Fischer-Tropsch synthesis.
- **Land demand for biofuel production is low compared to each country’s total land area and, in most cases, the agricultural area.** However, it might pose pressure on cropland for food and feed purposes (in the case of China) or pastureland (almost inexistent in Malaysia). In this case, **countries could rely on partnerships with other countries with more land availability so that they can implement their biofuel programs**, with the condition that agriculture does not expand over areas of high carbon stock. Therefore, these **partnerships should include international certification schemes.**
- **Countries should create global restrictions on coal use.** This should include ammonia production (used for fertilizer) and synthetic fuel production via Fischer-Tropsch synthesis (in South Africa). Despite the aspect of security of the energy supply, the production of synthetic fuels from coal has very high GHG emissions. The use of biomass of dedicated energy crops or agricultural residues as a means of replacing coal to obtain syngas for the Fischer-Tropsch process may be a shortcut to reduce GHG emissions considering currently existing industrial infrastructure.
- **Countries should facilitate international trade of biofuels from countries with high domestic production potential to other countries and stimulate the use of the mechanisms and operating infrastructure already in use in the international trade of fossil fuels.** Initially, large producers of biofuels such as the United States and Brazil should increase their production and aim at international agreements. Domestic supply of biofuels is not always feasible, and imported biofuels present considerably lower global warming potential than fossil fuels – which are imported as well by many countries. Potential exporting countries in the Americas can expand their biofuels production without deforestation using existing pastureland of low productivity in integrated bioenergy and livestock production systems.
- **Country-specific comparison between vehicles running on biofuels and battery electric vehicles is necessary for emerging markets** considering their potential to produce biofuels and the forecasted growth of renewable electricity. Currently, even developed countries struggle to replace fossil electricity sources such as coal and oil. Among the seven countries analyzed in this study, six have electricity with carbon intensity beyond the 500 gCO<sub>2</sub>e/kWh mark. Consequently, a shift from internal combustion engines to electric vehicles in these markets is hardly beneficial in the short to mid-term.
- **The current vehicle fleet will stay in use for years to come.** Thus, the carbon intensity of the diesel and gasoline fuel pools should be decreased by adding biofuels while the global fleet renews. Meanwhile, governance measures should promote the expansion of renewable electricity and sustainable manufacturing of vehicles to avoid transport electrification compromising GHG reduction targets in the long term. Investment in public transport based on biofuels and/or renewable electricity should also be promoted as a means of reducing the number of car journeys, especially in large urban areas.
- **Policy schemes to promote and reward low carbon intensity biofuel production should be established globally.** Examples include the Renewable Fuel Standard in the United States and the RenovaBio program in Brazil. These schemes increase the business case and long-term perspective of biofuel producers, and they are fundamental for those producers to become cost-competitive, expand their capacity and replace fossil fuels. **These policies should include transparent and auditable certification of sustainability criteria to increase financial rewards to the most sustainable biofuel production pathways (as in RenovaBio), incentives for the use of pastureland and degraded areas, and restrictions on the expansion of bioenergy crops over high carbon stock areas.**
- Considering the urgency of the climate crisis and how much GHG emissions have grown since the Paris agreement was signed, **solutions with a greater technology readiness level and better fitness to the current infrastructure should be preferred and promoted to reduce GHG emissions in the short term.** In parallel, policies should stimulate research to incentivize the maturation of biofuel processes using lignocellulosic feedstock as well, which is a strategy that has potential to produce biofuels with lower GHG emissions and increase the yield of biofuel by cultivated area.

### GHG savings per biofuel according to feedstock and country

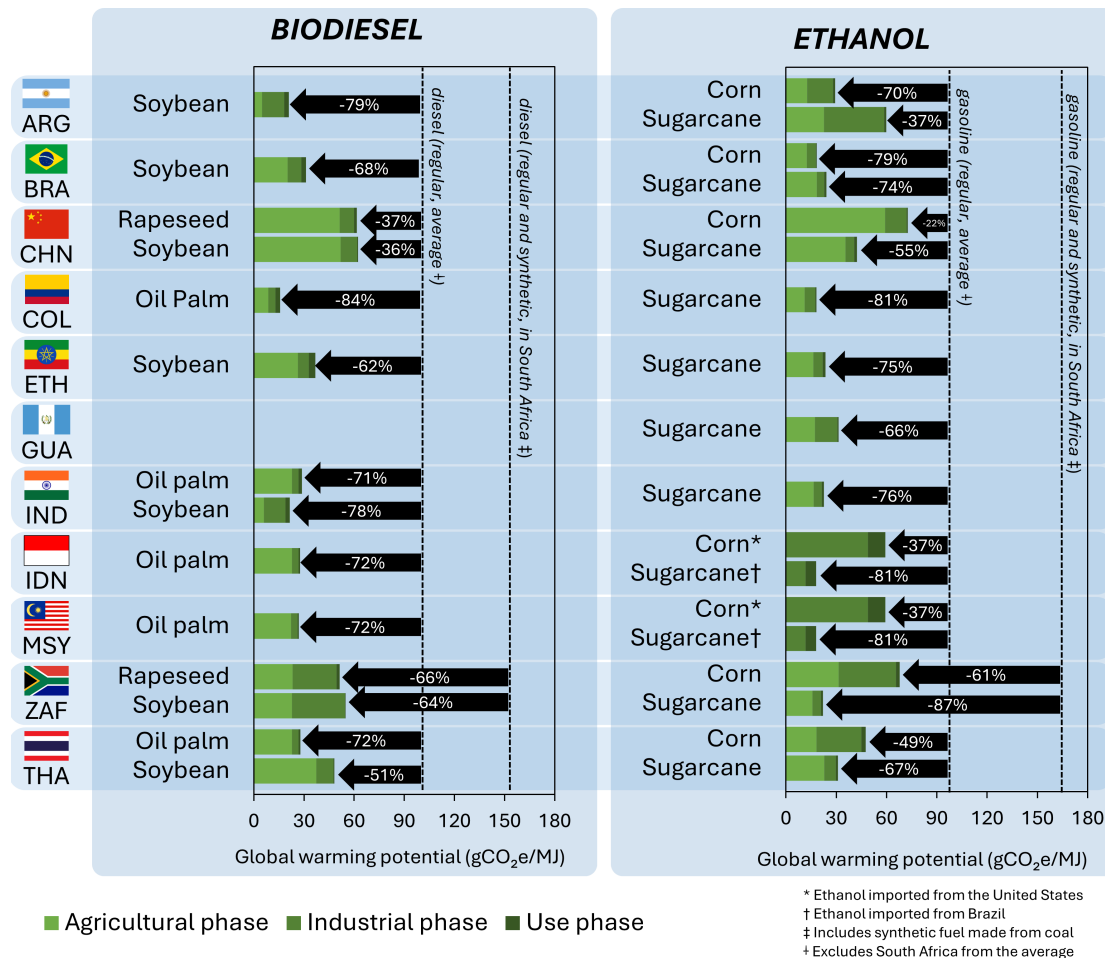


Figure 1. Results of global warming potential (GWP), in terms of gCO<sub>2</sub>e/MJ of biofuels for each biofuel pathway considering different feedstock and countries. Results do not include impacts of land use change. Potential reduction in GWP was compared to the GWP of fossil fuels considering the average blend of synthetic (from coal) and regular fossil fuels (from oil) in South Africa or the average for regular fossil fuels in the other countries. The graph demonstrates the burden of the agricultural phase in the total GHG emissions of each biofuel pathway, and this can be reduced using best management practices and incentivizing green ammonia production. The graph also presents the reduction of GHG emissions compared to the emissions produced when burning the same energy content of fossil fuel – which includes synthetic liquid fuels produced via coal gasification and Fischer-Tropsch synthesis in the case of South Africa. This figure was published with additional details in the T20 policy brief; please scan the QR code below to have access to the full version (a downloadable PDF file) of the policy brief or access the following link:

[https://www.t20brasil.org/media/documentos/arquivos/TF02\\_ST\\_02\\_The\\_Role\\_of\\_Liquid66cce667dd0eb.pdf](https://www.t20brasil.org/media/documentos/arquivos/TF02_ST_02_The_Role_of_Liquid66cce667dd0eb.pdf)



### Impact of biofuel blending mandates on the cost of fuels

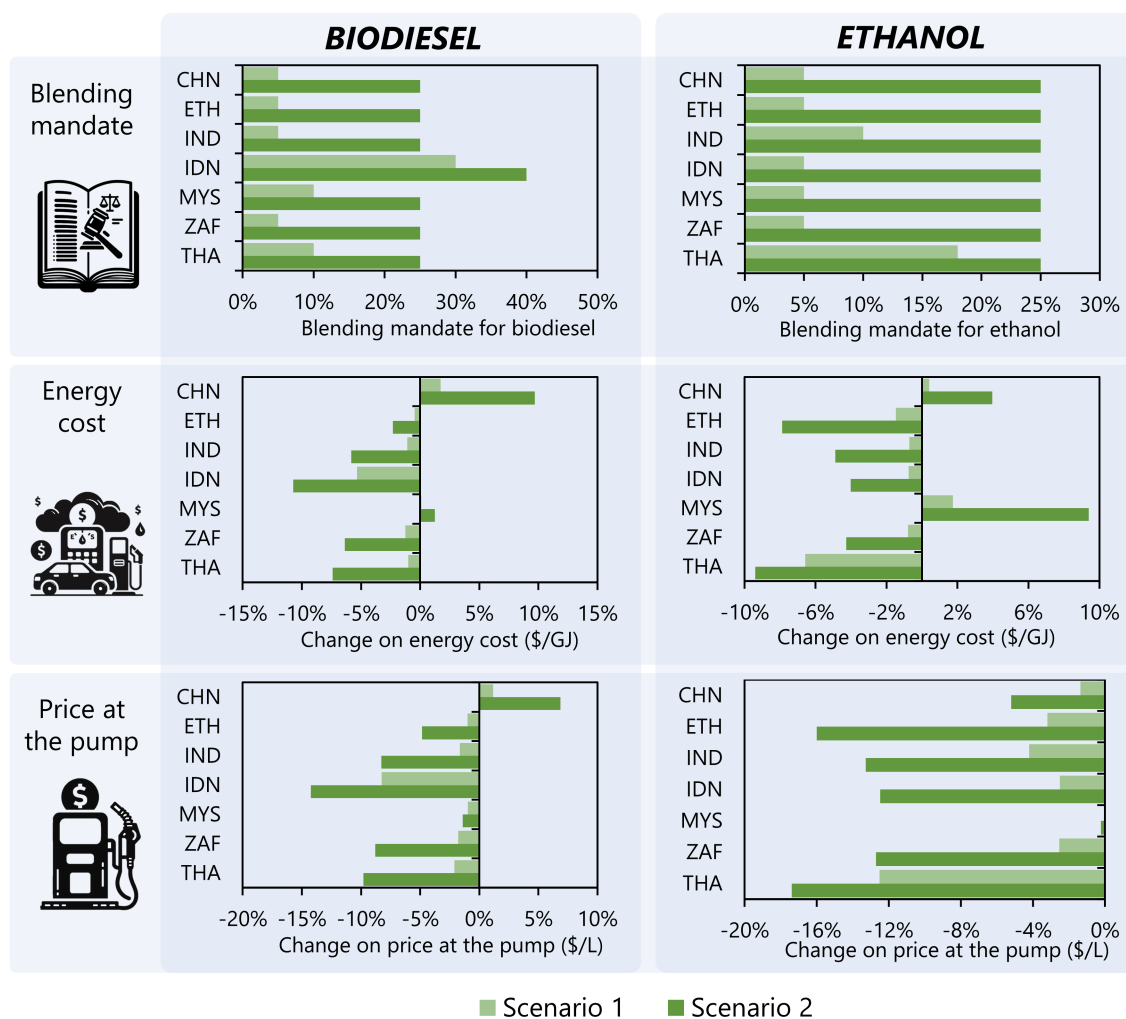
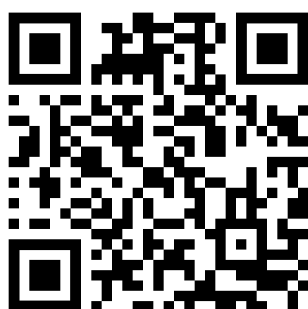


Figure 2. Percentage of biofuels assumed in scenarios 1 (at least 5% of biofuels) and 2 (at least 25% of biofuels) for blending mandates in each country and their impact on energy cost and price at the pump. The comparison of biofuel blends needs to include both the energy cost and the final price at the pump because stimulating biofuel usage depends on consumer’s acceptance, which is directly linked to the cost of the fuel at the pump. This figure is available in a policy brief that will be published by IEA Bioenergy TCP Task 39 (open access). IEA Bioenergy Task 39 website can be accessed via the QR code below or through the following link: <https://task39.ieabioenergy.com/>



### Impact of biofuel blending mandates on land use demand

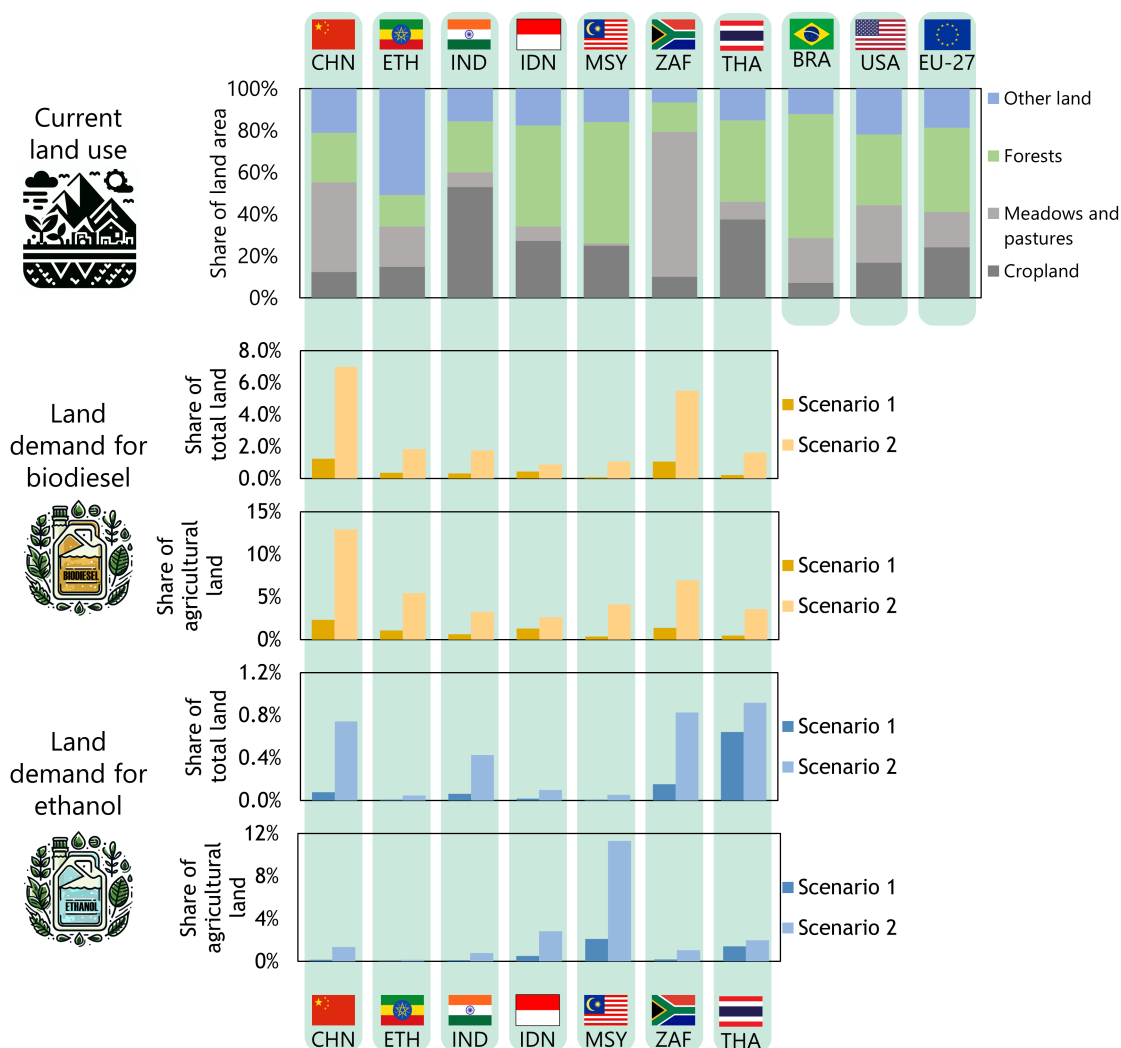


Figure 3. Land use for each country in 2022 and demand for land to produce biofuels in each scenario as a share of total land and agricultural land. Agricultural land includes land under temporary crops, land under temporary fallow, land under permanent crops, land under temporary meadows and pastures, and land under permanent meadows and pastures. Additionally, land use statistics for Brazil, the United States, and the European Union are shown as well. In the case of ethanol in Indonesia and Malaysia, the share of land area refers to land used in the ethanol-exporting countries (Brazil and the United States). This figure is available in a policy brief that will be published by IEA Bioenergy TCP Task 39 (open access). IEA Bioenergy Task 39 website can be accessed via the QR code below or through the following link: <https://task39.ieabioenergy.com/>



## Biofuels can reduce the GHG emissions of the existing fleet

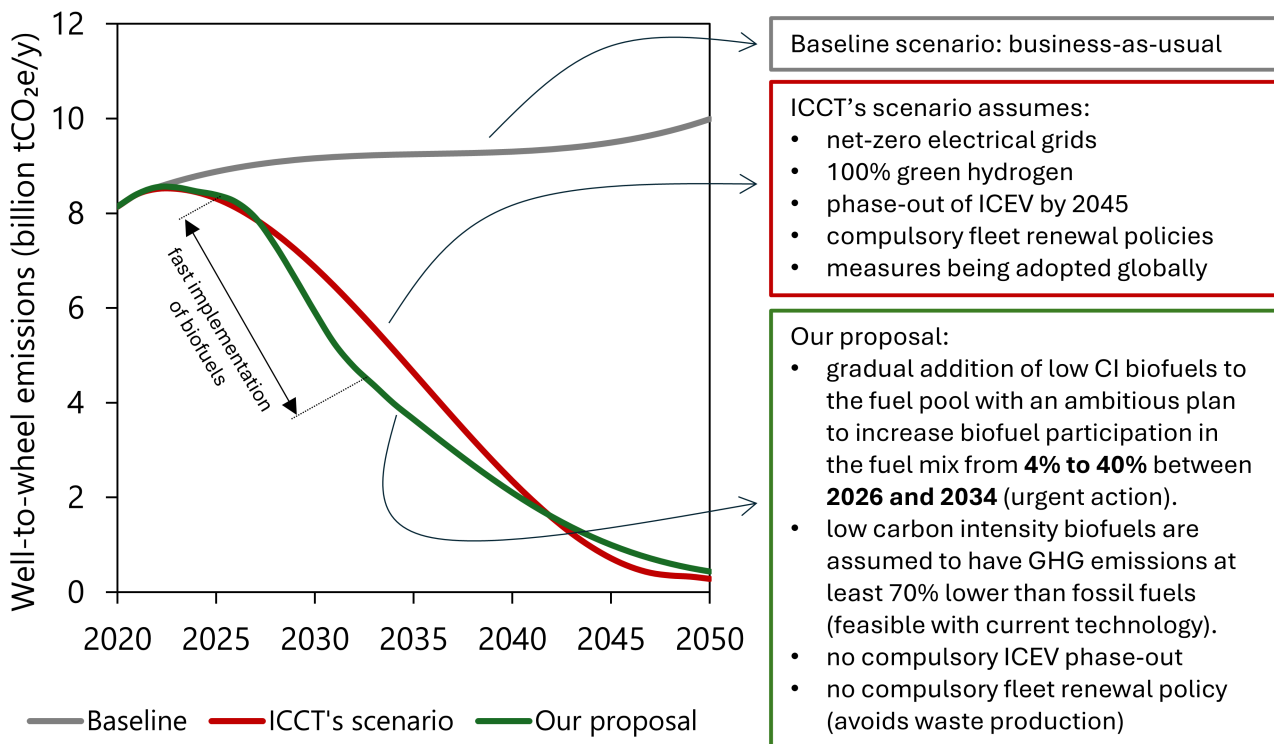


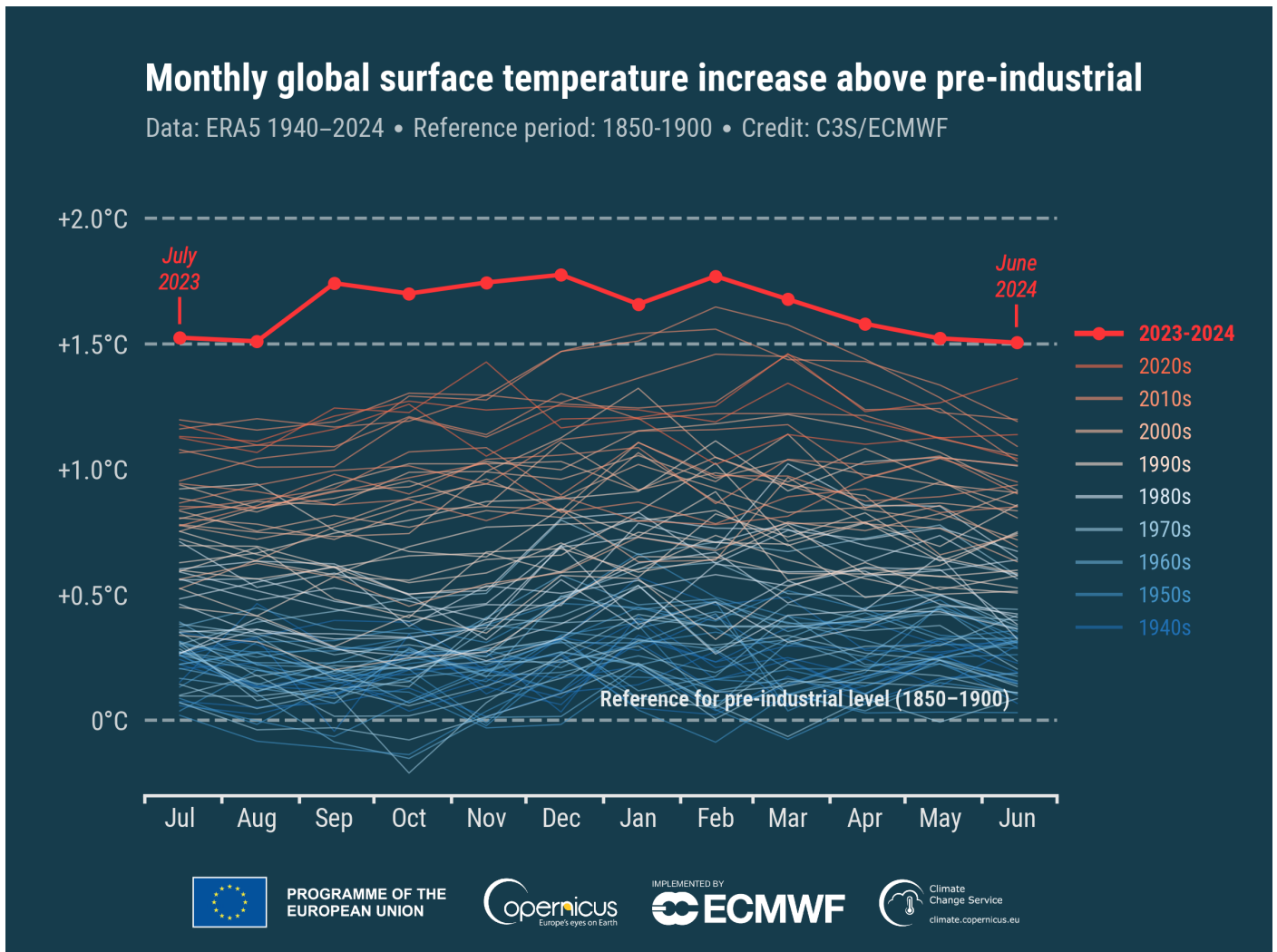
Figure 4. Potential reduction in well-to-wheels GHG emissions from the transportation sector for different scenarios, based on the study of the ICCT (*“Vision 2050: Strategies to Align Global Road Transport with well below 2 °C”*), with the addition of an ambitious growth of biofuel production between 2025 and 2034. Please notice that this graph only accounts for well-to-wheel emissions. Take the following number into account to think about what technologies make more sense in the energy transition:

- The manufacturing process produces 2.5-7.0 tCO<sub>2</sub>e for ICEV and 7.0-13.0 tCO<sub>2</sub>e for BEV.
- An ICEV running 200,000 km on a blend of 40% low-CI biofuel and 60% gasoline produces 20 tCO<sub>2</sub>e.
- An ICEV running 200,000 km on 100% low-CI ethanol produces 7 tCO<sub>2</sub>e.
- A BEV running 200,000 km on the German electric grid produces 14 tCO<sub>2</sub>e.

The ICCT study considered aggressive measures to net-zero including net-zero electrical grids, 100% green hydrogen, phase-out of ICEV by 2045, and compulsory fleet renewal policies, with all measures being adopted globally. However, the results are at least disappointing since these measures will mitigate only 51% of the cumulative GHG emissions of the transportation sector between 2020 and 2050. Moreover, the aggressive fleet renewal strategy incentivizes new purchase and creates more waste, and the well-to-wheel GHG emissions do not include the burden of BEV manufacturing and disposal.

Alternatively, we propose the gradual addition of low-carbon biofuels to the fuel pool (Figure 4), with an ambitious plan to increase biofuel participation in the fuel mix from 4% to 40% between 2026 and 2034. Low-carbon biofuels are assumed to have GHG emissions at least 70% lower than fossil fuels which is a reality with current technology. The addition of an ambitious biofuels policy combined with more efficient combustion engines and avoided travel can yield a cumulative reduction of 154 billion tonnes of CO<sub>2</sub>e by 2050, 6% more than the “all out” scenario described in the ICCT report that included aggressive fleet renewal policies that might face challenges in most countries. The main triumph of the biofuels’ strategy relies on the early reduction of GHG emissions by replacing fossil fuels with biofuels.

## We are already passed the 1.5 °C of global warming



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The Special Report on Global Warming of 1.5 °C (SR15) published by the Intergovernmental Panel on Climate Change (IPCC) on 8 October 2018 forecasted that we would reach this mark between 2030 and 2052. However, results show that we are already there. More details in the Copernicus Climate Change Service website:

