The Role of Renewable Fuels in Decarbonizing Road Transport

Policy Relevance

Renewable fuels, in addition to all forms of electric vehicles, can make an important contribution in decarbonizing the road transport sector, especially in the short and medium term and for all modes of transport.

Major Conclusion

Bringing the GHG emissions of the road transport sector down to zero by 2050 cannot be achieved by one measure alone.

Countries that deploy a set of different measures such as reducing transport demand, improving vehicle efficiency, and adding renewable energy carriers such as biofuels, e-fuels, renewable electricity and renewable hydrogen have the best chances to meet ambitious decarbonization goals.

Our assessment shows that biofuels contribute most to decarbonization now and up to 2030, 2040, or even 2050, depending on the country. In Germany, efficiency gains become the main contributor after 2030, and in Finland and Sweden the impact of biofuels remains largest until around 2040 when the use of electric vehicles takes over. In Brazil, biofuels remain the largest contributor until 2050.

Background

In the light of climate change, there is an urgent need to decarbonize our societies. The road transport sector is specifically challenging, as transport demand is growing, and so are the sector´s GHG emissions. Electric mobility will not be able to solve this on its own, and renewable transport fuels will be needed to bridge the gap between GHG emission reduction targets and the prospected actual emissions.

A team of experts has assessed the transport sector and its projected development up to 2030 and 2050 for a number of countries, including Germany, Sweden, Finland, USA, and Brazil. The work was initiated and carried out jointly by two Technology Collaboration Programmes of the International Energy Agency, namely the IEA Bioenergy TCP and the Advanced Motor Fuels TCP, with support of the Directorate General for Energy of the European Commission. The analysis is based on current national policies, projections of the vehicle fleet, and on the availability of renewable transport fuels.

The **objective of the assessment** was to quantify the role that renewable fuels play in decarbonizing the road transport sector, and to provide insights to policy makers on how individual countries differ from one another, which options for decarbonization they have, and best practice examples for successful policies.

Research Protocol

The core of the project was the assessment of the possible evolution of the road transport sectors of five individual countries. Fleet data was provided by country experts and modelling assumptions as well as the calculation results were discussed with these experts online and in an expert workshop.

The road transport sectors of Finland, Sweden, Germany, USA and Brazil were modelled in the VTT-owned ALIISA model. This model includes 5 vehicle categories, 6 propulsion systems and 12 fuel options. Input data for each country includes assumptions on total sales in each vehicle category for future years, on the distribution between the available powertrain/fuel options in sales, on the evolution of energy efficiency, and on the annual driven distance, variable between categories, age classes and powertrain/fuel combinations. The model then calculates the fleet composition for each year up to 2050, the total energy demand of this fleet, and the resulting tank-to-wheel (TTW) CO_2 emissions. CO_2 emissions of renewable shares and electricity are considered zero.

These calculations were performed for four different scenarios, the Current Policies Scenario, MORE EV Scenario, MAX BIO Scenario, and E-FUELS Scenario.

Other parts of the project described the key strategies of 7 countries to achieve cleaner transport sectors; renewable fuel production pathways, technology readiness levels, GHG emissions, and costs, feedstock availability, and the applicability of fuels in engines; and implementation barriers, policy recommendations and best practice policy examples.

Participants

- Contracting Parties of IEA Bioenergy from Brazil, the European Commission, Finland, and USA;
- Contracting Parties of AMF from China, Finland, Germany, Japan, Sweden, and USA;
- AMF Annex 28, AMF Annex 59

Key Messages from AMF Research

AMF Annex 58 / IEA Bioenergy Task 41 Project 10

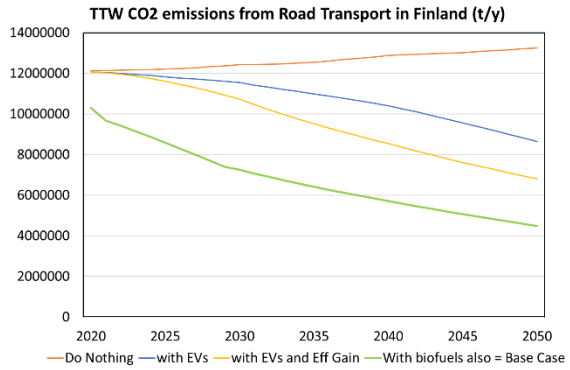
Key Findings

Renewable transport fuel basics

- Renewable transport fuels such as biofuels and e-fuels can, depending on the component, be used in low blends, as drop-in fuels with up to 100% substitution, and as special fuels in dedicated or adapted engines/vehicles. However, dedicated alternative fuel vehicles are not yet widely introduced globally.
- Substantial volumes of sustainable feedstock could be made available for biofuels production, sufficient to replace up to 30% of transport fuel demand in 2060 .
- When assessed in life cycle assessments, biofuels offer significant GHG emission reductions over fossil fuels. The current average carbon intensity of biofuels provided to California ranges from 15 to 65 gCO_{2e}/MJ (with fossil diesel and gasoline at a carbon intensity of 95). Future biofuel carbon intensities are expected to go further down, and can also be negative when obtaining credits for avoided GHG emissions from waste disposal or if combined with CCS.
- Costs of advanced biofuels depend on the production pathway and with a range from 0.35 to 1.58 EUR/l gasoline equivalent are in most cases significantly higher than the current costs of fossil fuel equivalents. Advanced biofuel technologies are currently in their early stages of development, and therefore significant potential for cost reduction exists.

Country assessments – base scenario

- Transport sector indicators such as number of vehicles per capita, transport work per capita and transport work per geographic area for the countries assessed (Finland, Sweden, Germany, USA and Brazil) vary highly.
- Already in the current policies scenario, biofuels provide the largest contribution to the reduction of TTW CO_2 emissions now and up to 2030, 2040, or even 2050, depending on the country. Electric vehicles catch up with biofuels only by 2040.



Country assessments – further scenarios

- Also if electric vehicles are introduced at higher speed biofuels remain the largest contributor to decarbonization in the short to medium term.
- Depending on the fuel qualities available in the region, maximizing the use of biofuels, and in particular drop-in biofuels, can reduce TTW CO_2 emissions to almost zero by 2050.
- The use of e-fuels could close the gap between emission reductions achieved by other measures and ambitious targets. The amount of e-fuels needed to fully displace fossil fuels however would require significant amounts of non-fossil electricity and captured CO_2 emissions, not likely to be available in many countries.

Implementation barriers

- Well-established fossil system to compete with
- Fluctuating policy drivers, lack of long-term stable policies
- Incomplete or unbalanced set of policy measures
- Public perception of technical performance, potential and sustainability
- Requirement to build up infrastructure for alternative fuels and alternative fuel vehicles

Successful policy examples

- Blending mandates for biofuels
- Low Carbon Fuel Standard types of policies that reward transport fuels based on their carbon intensity
- Strict and consistent sustainability guidelines
- Advanced biofuels require specific support, such as separate obligations, RD&D support, and risk guarantees

Policy suggestions from the expert workshop (Brussels, 18 November 2019)

- Focus on the carbon intensity of biofuels
- Get oil majors involved and leverage their existing fuel supply chains and distribution networks to make biofuels accessible to the marketplace in a cost-efficient way
- Turn the tables and establish a requirement to phase out fossil fuels
- Allow automakers to make use of the GHG emission reductions that the use of renewable fuels offers and count these against their CO_2 fleet targets