Task 64: E-Fuels and end-use perspectives

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Policy Relevance

E-fuels and biofuels must be considered together in the energy strategy, as both will play a crucial role in hard-to-electrify sectors (aviation, shipping, heavy-duty road transport and industry), where the availability of renewable energy resources is limited.

Major Conclusions

Several countries have launched strategic programs to increase the production of e-fuels. These initiatives provide incentives, support research or enact regulations that mandate a certain percentage of e-fuel use.

Due to the energy-intensive production of e-fuels, it is being discussed that their use should be prioritized in sectors that are difficult to electrify, such as aviation, shipping, heavy-duty road transport and industry. Water electrolysis, which is crucial to produce e-fuels, has a significant impact on production costs and carbon intensity.

Background

The net-zero policy of most countries requires actions to reduce and replace the use of fossil fuels. These fuels are energy carriers that are currently used for mobility, industry, heating, and other purposes. There are some applications, such as aviation or international shipping and other “hard-to-abate” sectors, which cannot easily be electrified for long distances and involves difficulty to obtain low emission fuels. Therefore, demand for fuels will remain and these fuels will need to be produced from renewable energy or lower carbon intensity sources in the coming decades. The energy transition means that new technologies are tested and deployed to replace the fossil fuels. One option for fuels with low-carbon emissions could be e-fuels.

The technologies for e-fuel production and application are being developed around the world. Task 64 on e-fuels and end-use perspectives was set up in the AMF TCP to assess their significance at international level. The aim was to gain an overview of the status of e-fuels in the various countries involved. The application of these fuels, some of which are new, is relevant for AMF TCP as they can be used for motorized processes. At the same time, there is still little experience in the use of these new fuels, as their production is still in infancy.

Research Protocol

The collaborating countries were Brazil, China, Denmark, Finland, Germany, Japan, Switzerland and the USA (see list of participants). Furthermore, collaboration and exchanges with IEA Bioenergy TCP, IEA Hydrogen TCP, IEA HEV TCP, IEAGHG and the International Transport Forum took place. The task was managed by Zoe Stadler, OST Eastern Switzerland University of Applied Sciences.

In the task, workshops around different e-fuel specific topics were organized, during which the task participants formulated key messages and joint conclusions that served as the basis for the final report. Eight specific e-fuel topics were included: demo sites and pilot programmes, resources, application,

regulations, life-cycle assessments, techno-economic assessments, and stakeholders.

The final task report provides an overview of ongoing activities in the participant countries, as well as past and current technical, economic, and regulatory challenges. In addition to the exchange of information, the report is intended to help raise awareness of the importance of global activities in the field of e-fuels.

The duration of the task was two years with the main findings presented at a webinar.

Key Findings

- E-fuels and biofuels will play an important role in the energy transition and to reach net-zero targets. There will be an increase in the technology diversity (see table 1).
- Some e-fuels can be produced with mature technologies, but the combination of several technologies in an e-fuel production plant can have a low overall technology maturity level.
- Strategic programs to support e-fuel production have been implemented in several countries. They consist of incentives for e-fuel production, support for research projects and/or regulations that make the proportionate use of e-fuels mandatory.
- The energy-intensive production of e-fuels leads to the discussion as to whether they should primarily be used for applications that are difficult to electrify. These hard-to-abate sectors are the aviation industry, maritime applications, and industrial processes.
- Hydrogen production via water electrolysis has the largest impact on the carbon intensity of the product. Life-Cycle Assessments results show that using renewable electricity is key to having low-carbon e-fuels.
- The most important cost driver in the production of e-fuels is hydrogen production by water electrolysis, and production costs depend primarily on electricity prices, which depends on the geographical location, and capital costs.

Table 1: Different application sectors for e-fuels and their marketability, according to the authors' own assessment.
Dark green: is already in use or can be replaced easily (e.g., replacement of fossil diesel with renewable diesel).
Light green: is in use, but only in small numbers, and a significant number of orders have been placed.
Yellow: could become relevant; currently either certification is missing, or technology is still in development and not yet available on the market.
Grey: combination is not relevant.

	Ships	Planes / Helicopters	Trains	Trucks and busses	Cars / motor cycles
Hydrogen					
Methane					
Methanol					
Ammonia					
Gasoline					
FT Diesel					
Jet fuel (ATJ, FT)					