**Symposium "Energy transition in heavy goods transport" at the Austrian Academy of Sciences on February 21 and 22, 2024**

**Extended abstract**

On February 21 and 22, the Austrian Academy of Sciences and netER (New Energy Transition Europe Research-Association) jointly organized a symposium addressing the energy situation in heavy goods transport and exploring possible pathways to achieve carbon neutrality. Interest groups and organizations from science and industry were invited to participate. The aim was to comprehensively explore possibilities to identify both new and existing solutions. Following the presentations, various viewpoints were critically examined in lively discussions.

In at least two of the presentations, proposed energy input solutions, such as electricity from batteries, hydrogen, and eFuels, were presented as clearly to be preferred options. However, it became evident that these solutions were conditioned or supported by specific legal frameworks. In one example, the legislator assumes the availability of $CO_2$-free charging electricity from the public grid. Additionally, competitiveness is ensured through adequate subsidies for acquisition and operating costs. Under these conditions, battery electric vehicles are superior to other technologies and thus considered the best solution.

However, the fact that $CO_2$-free charging electricity from the public grid is currently unrealistic distorts cost and $CO_2$ emissions comparisons between subsidized and non-subsidized vehicle technologies. Similarly, hydrogen-powered vehicles appear to be the most suitable technology when $CO_2$ emissions and the costs associated with establishing and operating the refueling infrastructure are not considered, and the availability of green hydrogen is assumed.

There is no clear technical preference among the energy concepts for defossilizing heavy goods transport; their evaluation depends on assumptions about future energy supplies. Therefore, a prompt and comprehensive reassessment of possible solutions is required, and explicit openness to various technologies, i.e., electricity from batteries, hydrogen, and eFuels, is essential.

For a balanced reassessment of the concepts, it is necessary to evaluate their energy balance (greenhouse gas emissions) over the entire life cycle using Life Cycle Assessment (LCA), rather than relying solely on "tank-to-wheel" (tailpipe) analysis. Science and industry are capable of developing concepts that consider technical, commercial, and social criteria for the respective decisions and to test these in practice.

This process must be supported by the government to provide the necessary basis for informed decisions on implementation. It is recommended that these developments be backed by techno-economic potential analyses and accompanying research to shape the development of resilient value-creation networks, enabling not only technical but also socially and ecologically beneficial sustainable changes. The criteria for this include the reduction of greenhouse gases, security of energy supply, and the financial feasibility of the measures. Lifestyle changes (such as goods preference and supply routes) are not to be considered as primary criteria.

A second critical issue highlighted during the presentations concerns the obstructive nature of current national and European regulations and laws. Many of these regulations actively impede the implementation of new and innovative methods for achieving carbon neutrality. They impose significant barriers that make it exceedingly difficult for a technology-open market to discover

and adopt optimal solutions. Strong criticism of the existing regulatory framework - laden with excessive prohibitions and restrictions - was evident in almost all presentations.

Current legal regulations are not geared towards achieving targets (results) but focus on specific solutions (technologies). These measures range from prohibitions and restrictions that render alternative solutions impossible to financial incentives that make politically preferred technologies more attractive. This dual strategy of incentives and restrictions significantly retards the reduction of greenhouse gases of the transportation sector. Instead, it allows vehicle manufacturers to maximize their revenues by exploiting subsidies for politically favored technologies, particularly to comply with $CO_2$ fleet limits. At the same time, consumers save money by purchasing these subsidized, more cost-effective vehicles and further benefit from additional financial advantages during operation. One example is the strong correlation between consumer interest in buying battery vehicles and state financial support.

The approach politically promoted nevertheless of being "technology-open" may actually harm climate targets rather than advance them. The current regulatory framework is detrimental to achieving carbon-neutral mobility, because the greenhouse gas emissions of the three approaches are not assessed openly using life cycle assessments. Instead, different legal regulations are applied to each technology, making comparisons difficult, if not impossible. Below are three examples of problematic policy packages.

(i) Battery electric vehicles (BEV) are given preferential treatment (e.g., no parking fees, use of lanes intended for public transport) and in Germany they receive an average of € 20,000 in financial subsidies over the vehicle's lifetime[1] (the purchase premium was withdrawn in Germany at the end of 2023). In Austria, the elimination of the NOVA[2] for BEVs increases the subsidy to around € 30,000. These subsidies also exist for hybrid vehicles (HEV), but at a lower level and some were completely abolished at the beginning of 2024. According to legal regulations, BEVs are considered emission-free, as the electricity used for charging in the "tank-to-wheel" approach does not cause any $CO_2$-emissions. The fact that the charging electricity from the public grid must be generated mainly by thermal power plants (residual or marginal electricity mix) and therefore has $CO_2$-emissions of approx. 800 - 1000 $gCO_2$/kWh across Europe[3] is not taken into account. The emissions from BEVs are generated in coal and gas-fired power plants that supply the charging current.

(ii) Fuel cell vehicles powered by carbon-neutral hydrogen do not emit $CO_2$ and are subsidized during operation. However, even for hydrogen produced by electrolysis from water (green), a temporal and local correlation and additional **combination** between electricity generation from PV and wind and electrolysis is mandatory if electricity from the public grid is used. The laws enacted to date at European level attempt to use these regulations to ensure that electricity may

[1] Wolfgang Plank, Deutsche Bank: E-mobility bought dearly by the state, 12.8.2021, https://www.elektroauto-news.net/news/deutsche-bank-e-mobilitaet-vom-staat-teuer-erkauft, accessed 5.3.2024.

[2] NOrm-Verbrauchs-Abgabe: standard fuel consumption tax.

[3] VDI study on the life cycle assessment of passenger cars, 11-2023, https://www.vdi.de/ueber-uns/presse/publikationen/details/vdi-oekobilanz-studie-zu-verschiedenen-antriebssystemen, accessed 24.1.24 and
D. Bothe, Th. Steinfort, LCA study mobility sector, FVV, 6-2020, https://www.fvv-net.de/fileadmin/Storys/020.30_Bilanz_gezogen/FVV_LCA_Lebenszyklusanalyse_Frontier_Economics_R595_final_2020-06_DE.pdf, accessed: 15.4.2024.

only be used to generate green hydrogen in a way that is beneficial to the system and grid[4]. Direct electric consumers such as data centers, railroads and lighting do not have to comply with these requirements.

(iii) A vehicle running exclusively on synthetic fuel (eFuels) would have the same $CO_2$ emissions as a vehicle running on conventional fossil fuels, as measured at the tailpipe. This is due to the fact that the chemical compositions of both types of fuel - fossil fuel and eFuel - consist of hydrocarbons and no distinction is made in the evaluation of the measurement results as to whether the $CO_2$ comes from fossil or renewable sources. Together with the ambitious limit values and starting from today, these must be reduced by 100 % for cars and 90 % for trucks in 2035, which leads to a technological preliminary decision. This also has an impact on vehicle prices. If these regulatory targets are not met, there is a threat of severe penalties for the manufacturer. For passenger cars, these are above the annual average per vehicle of € 95 per gram of $CO_2$. In the past, Volkswagen, Jaguar and Land Rover, for example, have been fined hundreds of millions of euros. Other manufacturers such as Fiat Chrysler transferred € 1.8 billion to competitors such as Tesla in 2020 in order to pool new vehicles together. If the penalty payments are calculated over a vehicle life of 200,000 km, the $CO_2$-avoidance costs amount to € 475/t$CO_2$. Given the average $CO_2$-savings of eFuels compared to fossil fuels, this would be approximately 1.6 €/liter[5]. This means that up to this price, it would make more economic sense for manufacturers to procure eFuels than to accept penalties. The prerequisite for this is that eFuels would be regularly counted. Even if eFuels are primarily needed in aviation and shipping, this would eliminate an attractive target market in the long term, which would lead to significantly more investment from venture capitalists - and thus to more and cheaper eFuels.

This one-sided and limited view of new vehicles also has an impact on other regulations in many EU member states. These should include

- Purchase premiums (varying amounts, in the past sometimes up to € 10,000).
- Company car taxation: In Germany, only 0.5 % of the non-cash benefit of an electric vehicle has to be taxed. For a combustion engine - even with eFuels - it is 1 %. Depending on the purchase price, this represents a high subsidy and market distortion.
- Vehicle tax is also only measured on the exhaust and does not apply to electric vehicles in Germany, for example. This amounts to several hundred euros per vehicle per year.
- Toll charges are a decisive factor for the economic efficiency of truck operations. With the reform of the Euro-Vignette Directive, the EU has decided to completely exempt electric and hydrogen trucks from toll charges. The toll rates vary depending on the member state and can amount to several hundred thousand euros over the useful life of a truck. This regulation makes it possible to compensate for the higher acquisition costs for electric and hydrogen trucks and thus represents a cross-subsidization of combustion engine trucks, which continue to pay tolls, to electric and hydrogen trucks. For trucks with combustion engines, however, the proportion of renewable fuels is not considered when calculating the toll. In addition, the toll exemption for

[4] Energypost-eu, Strict rules stop Green Hydrogen production diverting clean power from the grid. What are they?, https://energypost.eu/strict-rules-stop-green-hydrogen-production-diverting-clean-power-from-the-grid-what-are-they/.

[5] https://www.efuel-alliance.eu/fileadmin/Downloads/crediting-system-for-renewable-fuels.pdf, accessed 30.3.24

electric and hydrogen trucks leads to a financing deficit for other necessary investments such as road infrastructure maintenance.

- In addition, there are subsidies for charging and hydrogen infrastructure, which run into the millions in many countries.
- Another disadvantage for eFuels is the current energy tax regulation, which provides for identical tax rates for fossil fuels and eFuels, while electricity benefits from significantly lower rates and hydrogen is completely excluded from the energy tax rate. Although the European Commission has proposed equal treatment for renewable energy sources, the revision of the Energy Tax Directive is not making any progress in the EU Council, because this requires unanimity.

**Approaches to a solution.** Climate change is a major challenge, and time is pressing. The remaining global emissions budget to limit the temperature rise to 1.5°C is the subject of controversial scientific debate and, according to the IPCC, could be exhausted in a few years if emissions are not drastically reduced worldwide. Excluding technologies such as combustion engines with renewable fuels and putting all our eggs in one basket is a risky strategy. We risk missing climate targets, which could cause irreversible long-term damage. Instead, we need EU-wide regulations that create a level playing field for a wide range of technologies, including electricity from batteries, hydrogen, and eFuels.

Effective and credible climate protection requires a comprehensive consideration of the climate impact of different mobility options - in other words, a life cycle perspective. This should include real emissions along the entire value chain, from the production of batteries and vehicles to the energy and fuel mix, all the way through to recycling. Implementing a crediting system that encompasses the production of fuel ("well-to-tank" phase) and complements the "tank-to-wheel" approach would be an important step toward an integrated system. This would better link and coordinate the climate protection efforts of fuel suppliers and vehicle manufacturers. Switzerland, for example, recently adopted a parliamentary decision to credit eFuels for car manufacturers[6].

**Temporary state subsidies are necessary to accelerate the energy transition**. New technologies need these in order to be competitive from the outset. These subsidies for the implementation of the **energy transition** should only be granted **for the achievement of targets**[7] that have been determined on the basis of life cycle assessment. **Subsidies should not** be awarded **for the use of specific technologies**[8], as a mix of all technologies is necessary for a successful energy transition.

The discussion unequivocally underscores the **critical need for immediate dialogue** with political decision-makers. Existing regulations that **obstruct technological openness must be jointly repealed without delay**. Moreover, the legal framework for state technology funding **must be fundamentally reformed** to align with the pressing goals of the energy transition. This

[6] https://transport-online.de/news/strassengueterverkehr-schweiz-beschliesst-anrechnung-von-efuels-159257.html.

[7] e.g. for exceeding the limit value for certain greenhouse gases, e.g. fossil $CO_2$ emitted per kWh of electricity generated, or per tonne-kilometer of transport performance or per km of driving distance

[8] e.g. for battery electric vehicles or for vehicles with fuel cells or combustion engines powered by hydrogen or eFuels

strong consensus from the symposium can serve as a **powerful catalyst to initiate a bold, more open policy** for the energy transition in heavy goods transport.

Information on the speakers at the symposium "Energy transition in heavy goods traffic" on January 21 and 22, 2024 at the Austrian Academy of Sciences in Vienna

**Tobias Block**, eFuel Alliance e.V., Brussels, "*eFuels - political framework conditions in heavy load transport in the EU*"

**Martin Fellendorf**, Graz University of Technology, "*Freight transport in Austria - figures and options for action*"

**Alexander Klacska**, Federal Transport Division WKÖ, "*The new fuels - availability keit, infrastructure, competitiveness*"

**Roger Cracknell**, Shell London, "*Fuels and Energy Carriers for Decarbonization of Heavy Duty Transport*"

**Markus Bachmeier**, Linde GmbH, Germany, "*Clean hydrogen and its relevance for mobility*"

**Andreas Kopf**, International Transport Forum, Paris, "*System perspective & possible strategies for the decarbonization of the heavy-duty mobility sector*"

**Stefan Hausberger**, Graz University of Technology, "*Carbon footprint of heavy transport drive systems based on a life cycle assessment*"

**André Bardow**, ETH Zurich, "*Driving in (carbon) circles: An environmental perspective on sustainable transport*"

**Manfred Gronalt** and **Martin Posset**, Boku Vienna, "*Data vs. strategies: basics for the implementation of decarbonization paths in freight transport*"

**Sonja Wogrin**, Graz University of Technology, "*The future of the Austrian electricity system*"

**Leonhard Schitter**, energieAG Upper Austria, "*Hydrogen as a driver of the future: new perspectives ven in the energy and mobility transition*"

**Vanja Subotic**, TU Graz, "*eFuels - climate-neutral fuels of the future*"

**Siegfried Kiss**, rag Austria AG, "*Gaseous energy sources: $CH_4$ and $H_2$ - proven, storable and promising*"