eFUEL ALLIANCE – Position Paper on the European Industrial Carbon Management Strategy

Key Policy Recommendations:

1. Recognize carbon capture and utilization (CCU) as well as storage (CCS) as crucial technologies for climate protection.
2. Recognize the significance of carbon as feedstock in many industries with the goal to create closed-carbon cycles complementary to negative emissions via CCS.
3. Consider CO_2 demand to produce eFuels in policies and regulations.
4. Support the uptake of Direct Air Capture (DAC) Technologies also via milestones of captured CO_2 (in 2030, 2040, 2050) to be reached.
5. Review the sunset clause for industrial CO_2 point sources for eFuels production and distinguish between avoidable and unavoidable industrial emissions that can be used as CO_2 source to produce eFuels until DAC is industrialized.

Closing carbon cycles by means of Carbon Capture and Utilization and achieving negative emissions by Storage.

The findings of the International Panel on Climate Change (IPCC) have made clear that a rapid, global transition to net zero greenhouse gas emissions will be necessary to limit global warming to 1.5°C above pre-industrial levels and avoid irreversible damage to our climate and society. The scale of the challenge is significant[1]. Based on major energy system modelling studies by the European Commission[2], the IEA, and others, the EU will need to capture and utilize or store between 300 and 640 Mt of CO_2 per year by 2050 to meet its climate goals, with most estimates towards the upper range. This is broadly consistent with other assessments such as the IEA's 'Net zero by 2050' scenario[3], which includes 7.6 Gt of CO_2 captured per year globally by 2050 (of which roughly 350 Mt/year is in Europe). It is therefore clear that industrial carbon management is a global challenge. The strategy of the European Union is correspondingly to be welcomed and should aim to serve as a role model to promote the potential of negative emissions and closed carbon cycles at a global scale. Many of our arguments are transferable, but due to the concrete strategic planning of the EU, our arguments refer legislatively to the European legal framework.

In response to the urgency of the climate crisis, the European Union (EU) has set a legally binding target of achieving 'net zero' greenhouse gas emissions by 2050, as well as an interim target of a 55% reduction by 2030. CCU by means of eFuels, or as referred in legislation "RFNBO"s (Renewable Fuels of Non-Biological Origin), are part of all revised climate laws (e.g. FuelEU Maritime, ReFuelEU Aviation, Renewable Energy Directive). It is enshrined in law to scale-up the eFuel industry as part of the solution to substitute the use of fossil fuel.

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[1] Intergovernmental Panel on Climate Change (2022). Climate Change 2022: Mitigation of Climate Change.

[2] https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_22_6424

[3] https://www.iea.org/reports/net-zero-by-2050

Carbon will remain an essential feedstock for many industries like the chemical industry and for fuels in the transport sector (e.g. to defossilize the maritime, aviation and road sector). Carbon must be distinguished from the greenhouse gas CO_2. CO_2 in the atmosphere must be reduced by achieving closed carbon cycles (meaning no added CO_2 to the atmosphere) as well as through negative emissions. In the case of fuels, carbon sources need to be derived from fossil fuel alternatives in a net-zero Europe, but also at global scale. Given the limited availability of biogenic carbon, the conversion of atmospheric CO_2 to chemicals and fuels (carbon capture and utilization) will have a key role to play. If CO_2 cannot be avoided, CO_2 emissions must be reused - i.e. moved in a cycle - or stored in the long term. Both processes (CCUS) ensure that the CO_2 concentration in the atmosphere does not increase further or even enable negative emissions. Both technologies need to be treated equally as both pathways are needed as well as create synergies. This is for example true for the use of the same technologies such as "Direct Air Capturing" and infrastructures like pipelines and liquefaction terminals.

This position paper describes future CO_2 management from the perspective of the eFuels industry. For this purpose, the potential CO_2 quantities required for the production of eFuels are analyzed first. Then, the potential production sites, CO_2 sources and the necessary CO_2 infrastructure are discussed. Finally, we formulate our political recommendations.

What quantities of CO_2 are needed for eFuels production?

Different methods exist to estimate the long-term demand for synthetic energy carriers. On the one hand, global studies can be used, which also include the CO_2 demand to produce eFuels. On the other hand, estimates can be made based on policy targets and industry statements.

The Finnish LUT University has estimated the global CO_2 demand for the production of synthetic energy carriers for the transport, chemical industry and heat market[4]. The experts see a possible production of 2,789 TWh in 2030, with the majority (97%) coming from methanol synthesis. Methanol can be blended with gasoline at up to 3% and can be processed into conventional road fuels and kerosene. Recent announcements by the second and third largest shipping companies Maersk and CMA CGM show that more than 35 ships capable of running on synthetic methanol have been ordered[5]. This also highlights the use of methanol as a marine fuel. By 2050, global demand for CO_2-based eFuels will grow to 30,902 TWh (methane, methanol, Fischer-Tropsch). The study authors forecast that 13,728 TWh of this will be needed in the transportation sector, 12,174 TWh in the chemical industry, and 5,000 TWh in the heating market.

The study further examined the associated CO_2 sources and production locations by building a small-scale, regional model that includes industrial point sources. As can be seen in the graph below, it is assumed that until 2036, more concentrated point sources than ambient air will be

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[4] https://www.efuel-alliance.eu/fileadmin/Downloads/Global_Alliance_Powerfuels_Study_Powerfuels_in_a_Renewable_Energy_World.pdf

[5] https://www.maersk.com/news/articles/2023/06/26/maersk-orders-six-methanol-powered-vessels and https://www.argusmedia.com/en/news/2438212-cma-cgm-in-3bn-methanol-lng-ship-deal

used as CO_2 sources for eFuels production due to economic reason. In 2030, a global demand of 583 Mt of CO_2 from industrial point sources is required for eFuel production. In 2050, the CO_2 demand from industrial sources for eFuel production increases to 1,241 Mt. Of this, 65% comes from cement plants, 19% from the pulp and paper industry, and 17% from waste incineration plants. Nevertheless, in 2050, 4 times more CO_2 for eFuel production will come from ambient air than from industrial sources. Consequently, scaling up DAC technology is essential for the development of eFuel production.

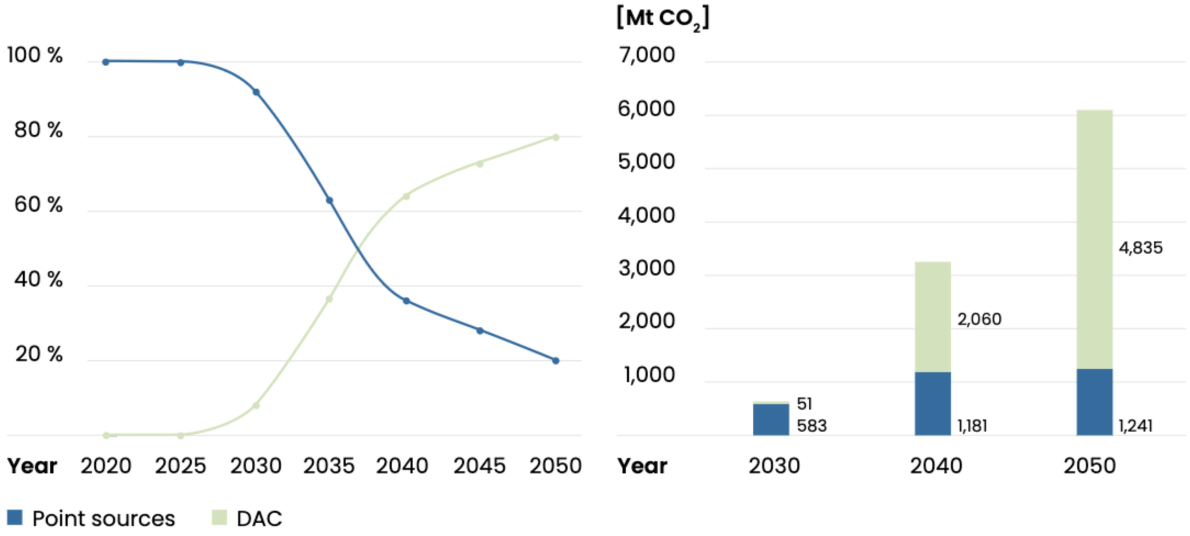

Figure 1, Development carbon sources

The theoretical, scientific derivation of the required CO_2 sources for eFuel production based on existing industrial CO_2 sources, renewable energy and the global demand is in contradiction to the current political framework and shows that there is a great need for action. The EU Commission has defined potential CO_2 sources in the so-called delegated acts for the production of hydrogen and eFuels[6]. The Commission limits the use of industrial point sources - including unavoidable CO_2 emissions from the cement industry or waste incineration plants – as of 2041. If the CO_2 sources come from the power supply, they can be used until 2036. Furthermore, industrial sources need to be integrated in an “effective CO_2 pricing system” like the EU ETS, which does not exist outside the EU – especially relevant since eFuels will be mainly imported to the EU. In 2050, the traded volume of synthetic fuels increases across the world, with Europe and Eurasia dominating the import volumes. Thus, investments in CCUs for eFuels production are severely limited. This leads to uncertainty among investors and slows down the market ramp-up. The production of eFuels from fossil fuels and CCS (so-called blue hydrogen and derivates) is also not defined yet and part of the gas package, which is in political negotiations at the moment. But most of the mandates of the EU Green Deal are focused on RFNBOs – means hydrogen and eFuels produced with renewable energy. For that reason, we have not considered impacts of low carbon hydrogen and eFuels in this strategy paper. We will update the paper once low carbon hydrogen is well defined and included in binging mandates.

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[6] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2023.157.01.0020.01.ENG&toc=OJ%3AL%3A2023%3A157%3ATOC

In addition, the political support for eFuels is growing but not sufficiently displayed in legislation. It is true that the EU has adopted very ambitious targets with the European hydrogen strategy - and increased them again with the RePowerEU package after the Russian war of aggression in Ukraine. The target is now two times 10 Mt of green hydrogen in 2030, equivalent to 667 TWh. As part of the Green Deal, many regulations were finalized that could define demand of this magnitude. Among the most important regulations is the Renewable Energy Directive (RED). It uses quotas to define the use of renewable energy in various sectors such as transport, heating and industry. Unfortunately, the RED's obligations don't go anywhere near that far. As an analysis of the eFuel Alliance shows, the targets of RePowerEU are missed by a factor of 10 due to too low targets in the Green Deal regulations. Consequently, it can be assumed that the demand for CO_2 sources to produce eFuels will also be significantly lower in the short term – even if member states are more ambitious in their national implementation of the RED. We assume a magnitude of 13-15 Mt CO_2 to produce about 60-65 TWh eFuels for industry and transport by 2030. However, an exponential growth of eFuels can be expected in the decade after 2030.

Firstly, this is due to the aviation and maritime sector where the share of eFuels will grow significantly as they are hard-to electrify. As example, with ReFuelEU Aviation a pathway until 2050 is laid down, although not yet aligned with the climate targets, as in 2050 the share of Sustainable Aviation Fuels has to reach 70% (with 35% share of synthetic fuels). Given the need to decarbonize the existing fleet of cars, trucks and other vehicles with combustion engine there is also significant demand in the transport sector. Throughout the world, more than 1.4 billion vehicles are currently powered by conventional internal combustion engines. Every vehicle that can be fueled by renewable fuels can contribute to lowering emissions.

What infrastructure for CCU is needed in Europe?

Scientists at RWTH Aachen University have studied different CO_2 sources in Europe and Germany[7]. The largest CO_2 point sources in Europe are caused by coal-fired power plants. Using these avoidable CO_2 sources for CCUS makes neither ecological nor economic sense - especially since their use would only be possible until 2036 for regulatory purposes (see delegated act above). Sensible, industrial point sources exist, for example, in Scandinavia with paper and pulp mills. These have a CO_2 concentration of 7-20% in the exhaust gas stream. This requires much less energy - and therefore cost - than DAC (ambient air has a CO_2 concentration of 0.04%). Furthermore, in sunny southern Europe along the coast there are many cement factories and refineries, which can also be used here. Exhaust gases from cement plants contain 14-33% CO_2. Refineries have a CO_2 concentration of 3-13%. Using unavoidable CO_2 emissions at a point source makes sense as it is economically cheaper than capturing them at a later stage with higher cost.

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[7] https://www.ltt.rwth-aachen.de/cms/LTT/Forschung/Publikationen/~ivor/Details/?file=566641&lidx=1

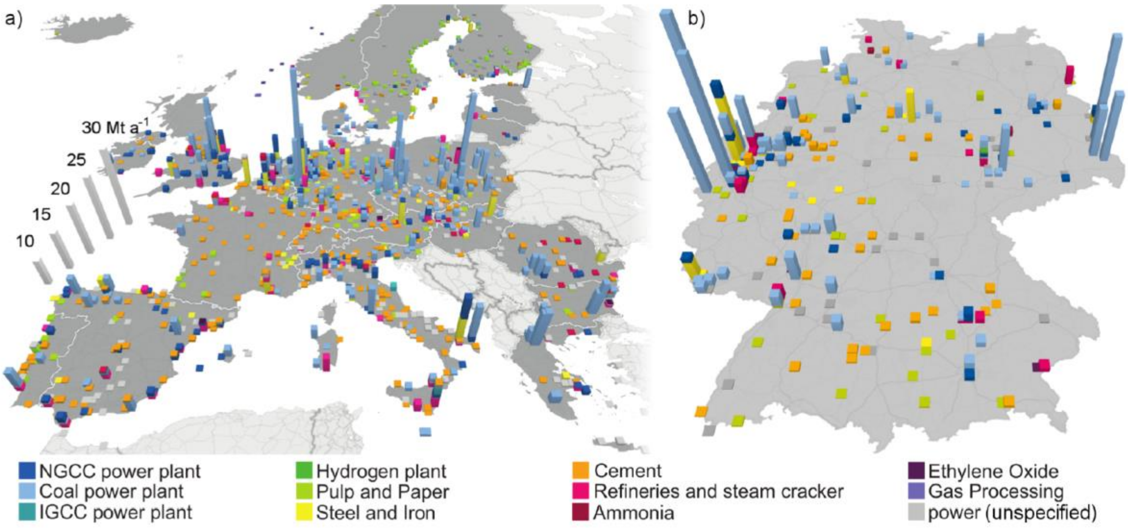

Figure 2, CO_2 sources in Europe and Germany

It makes sense to combine industrial and biogenic CO_2 point sources in order to increase the CO_2 quantities for further use or storage. Especially in case of identical CO_2 sources, the processing (CO_2 capturing) can be done much more efficiently than if each plant captures the CO_2 individually. In chemical parks often different carbon sources exist. Especially for smaller biogas or biofuel plants, bundling via pipelines or transport of liquefied CO_2 can make ecological and economic sense. Ensuring a positive climate impact from the conversion of CO_2 to products and materials requires a consistent life cycle analysis to be applied in legislation, a climate-focused approach to a circular carbon economy, and a clear strategy to transition from the use of fossil CO_2 to atmospheric, biogenic, and unavoidable industrial CO_2. Specifications for storage and transport of CO_2 should be standardized to create a single market. Under the reform of the Emissions Trading System (EU-ETS), in combination with the Carbon Border Adjustment Mechanism (CBAM), emitting energy intensive industries will progressively be fully exposed to the ETS over the next few years, via the elimination of free allowances. This is a market-driven approach that ensures that CO_2 emissions are consistently reduced. To incentivize negative emissions and the use of CO_2, integration of carbon capture technologies into the ETS-CBAM pricing regime is desirable. Supporting mechanisms, i.e. free allowances, for the production of SAF, green marine fuels and green hydrogen are a welcomed starting point that need to be pursued in the future.

Both the absorption of CO_2 from point sources and its transport should be supported by government at the outset. As long as the cost of DAC is above 200 € per ton CO_2, capture, cooling and transport from industrial sources incl. EU-ETS price can be more economical. As eFuel Alliance, we advocate for CCU to be included on an equal footing with CCS in the Net Zero Industry Act. Different absorption technologies exist and should be further investigated.

The crucial importance of the uptake of Direct Air Capturing

In addition to the use of point sources, DAC is becoming the critical technology for CCUS. As shown in the chart above, more CO_2 for eFuels production will likely come from DAC than from point sources by mid-2030. DAC is also the only way to produce negative CO_2 emissions, which the IPCC report states is necessary to meet climate goals. For these reasons, DAC should be prioritized for support. For example, in the Inflation Reduction Act, the U.S. promotes DAC with \$130 per ton of CO2 tax credits for 12 years. Recently, the U.S. Department of Energy (DOE) announced up to \$1.2 billion to advance the development of two commercial-scale direct air capture facilities[8]. These projects are expected to remove more than 2 Mt CO_2 emissions each year from the atmosphere. Such support, in combination with CO_2 pricing such as the EU ETS, should enable business models and thus investment in DAC that finally lead to a cost-competitive business model. DAC costs can be lowered significantly with commercialization in the 2020s followed by massive implementation in the 2040s and 2050s – being cost competitive with point source carbon capture solution[9]. This paper estimates current DAC costs between 730-815 €/t. The levelized cost of CO_2 DAC development in the mainly depends on the learning curve of capital expenditures, its energy demand and the cost development of renewable electricity. According to the paper mentioned above, DAC costs of 79-89 €/t can be reached in 2050. The EU should support this development by setting dedicated incentives for products, which have been produced via DAC. This can be done e.g., with additional multipliers in RED, ReFuelEU Aviation and FuelEU Maritime for those prodcuts or lower tax rate in the revision of the European Energy Taxation.

To achieve a Carbon Management Strategy that fits into the pathway to reach our climate goals as well as to enable business cases that deliver on the targets **we recommend**:

- Clearly communicate the role, scope, and requirements for CCS and CCU in achieving Europe’s climate goals – providing confidence to project developers and investors, aligning definitions and expectations, and raising awareness of the need for these technologies among other stakeholders.
- Take into account CO_2 demand for the production of eFuels (CCU) in policies and regulations. Ensure the needs of CCU is comprehensively considered in forthcoming legislation and revisions of existing legislation.
- Review and differentiate in the delegated act ((EU) 2023/1185) between avoidable and non-avoidable industrial CO_2 emissions. Non-avoidable industrial emissions should also be available for CCU and CCS in the long term.
- Promote CCU and CCS on an equal footing. CCU should also be included in the Net Zero Industry Act.
- A European CO_2 infrastructure should be built so that industrial and biogenic point sources can be effectively used for CCU and CCS.
- Promotion of necessary CCUS technologies such as DAC via European Funding and the requirement for member states to include support for DAC in their National energy and climate plans.
- Clear milestone targets in 2030/2040/2050 for direct air capture and industrial CO_2 capture.
- Continuation of support schemes like free allowances in the European Emission Trading System as its the case for green hydrogen, sustainable aviation fuels and green maritime fuels.

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[8] https://www.energy.gov/articles/biden-harris-administration-announces-12-billion-nations-first-direct-air-capture

[9] https://doi.org/10.1016/j.jclepro.2019.03.086

>>>The eFuel Alliance e.V.<<<

The eFuel Alliance is an interest group committed to promoting political and social acceptance of eFuels and to securing their regulatory approval. We represent more than 170 companies, associations and consumer organizations along the eFuel production value chain. We stand for fair competition and equal competitive condition for all relevant emission reduction solutions. We are firmly committed to further climate change mitigation and seek recognition for the significant part eFuels can play in sustainability and climate protection. Our aim is to create the conditions for the industrial production and widespread use of CO2-neutral fuels from renewable sources of energy.