Working Group P2X4A

Position Paper

ReFuel EU Aviation

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VDMA

The German Mechanical Engineering Industry Association (VDMA) is the largest European industrial association. VDMA represents more than 3.300 member companies in the SME-dominated mechanical engineering industry in Germany and Europe. With around 1,3 million employees in Germany and a turnover of EUR 230 billion (2019), the sector is the largest industrial employer and one of Germany's leading sectors of industry overall. The major players in a Power-to-X (P2X) value chain are organised in VDMA: from renewable energy generation to P2X plant manufacturers (electrolysers, Fischer-Tropsch- and Methanol-to-Gasoline-synthesis, methanation plants, etc.). It also includes the manufacturers for the use cases of hydrogen and P2X across all sectors (e.g. plant manufacturers for steel and chemicals, gas turbines, fuel cells manufacturer, mobile machines, hydrogen-based firing technology for high-temperature processes, shipping & jet engines). The VDMA platform "Power-to-X for Applications" (P2X4A) brings together all the competencies of the important stakeholders, including those from adjacent fields - such as the automotive and petroleum industries.

Introduction

VDMA very much welcomes the initiative of the European Commission to reduce aviation emissions by using sustainable aviation fuels (SAF). Even if there will be fuel efficiency improvements, there are not many alternatives to make aviation climate neutral. For the foreseeable future, long range flights will not be able to fly with batteries only. The same applies for hydrogen airplanes at least for longer distances. The potential and availability of biomass is limited, and its use involves unwanted environmental and ethical side-effects. Against this background, electricity based SAF (synonyms used are electro-fuels, e-fuels, power-to–liquid, synthetic fuels) offer a very promising solution. The technological approach to produce electricity based SAF is Power-to-X (P2X): to convert renewable electricity to hydrogen, synthetic fuels or other secondary products. P2X involves several environmental benefits. Compared to biomass, the water demand in P2X is significant lower. Also, it involves significantly less land use and does not compete with food production.
P2X is the perfect candidate for generation outside Europe in deserted and arid areas with abundant renewable energy resources (wind and PV) while technology, development and asset ownership come from European players.
P2X enables to replace fossil raw materials completely in the long term. Synthetic fuels produced with P2X can be distributed and used in the existing fleet stock without any further changes to the infrastructure. Together with CO_2 as another feedstock, P2X-technologies enable a closed carbon cycle and contribute immensely to the reduction of CO_2 emissions all over the world.
P2X is characterized by a high technology readiness level (TRL). The next stage for technology development is industrial scale-up and commercialisation – which cannot happen without an appropriate regulatory framework. To avoid lock-in investments, VDMA strongly recommends providing a regulatory framework for an early P2X market ramp-up. Only in this way the EU can create the necessary investment security for the development of the P2X value chain.

Seizing industrial opportunities for the EU

VDMA aims for an internationally competitive European P2X industry being able to export its technological solutions globally. P2X involves a long value-chain with all components still present in Europe: from renewable energy systems (RES) to electrolysis and P2X plants to

applications and CO_2 capture (from point sources or from direct air). P2X can defossilize existing industry and be an impetus for the formation of new ones. Comprehensive solutions in connection with digitalization, e.g. predictive weather forecasting, are supplementing the hardware delivery. Thus, the P2X value chain can contribute to creating many new jobs. This accounts both for European countries and other countries, where P2X can be produced in the future. P2X can contribute to a new quality of international cooperation between the EU and developing countries, e.g. in North Africa.
European technology firms are still technology champions of P2X, and it is now the time to adopt an industrial-policy approach to the market-ramp up. This can also contribute to overcoming the economic crisis we are facing due to the outbreak of COVID-19 and make the climate neutrality goal more achievable.

Organise the market ramp-up with a market-neutral approach

While P2X solutions will be especially crucial in the hard-to-abate sectors such as aviation, VDMA argues for a market-neutral political framework.
Firstly, a market-neutral approach facilitates the ramp-up of P2X. The cost drivers for producing P2X are the high levelized costs of energy and the capital costs for electrolysis, as well as CO_2-capturing and purification. The smaller part of the costs can be attributed to the synthetic fuel production (via Fischer-Tropsch or Methanol route). VDMA emphasises the need to reduce those cost drivers. Currently, electrolysers are tailor-made. Given the limited demand for electrolysers the manufacturers do not invest in automated production lines. Yet, the technology is ready for industrial scale-up. The regulatory framework should therefore address those use cases first, where immediate business cases can evolve, and potential clients are willing to pay the higher price. This supports scaling-up of the electrolysis industry and leads to more competitive prices. The approach will ultimately help those sectors to adopt P2X solutions that are highly competitive and where there are few alternatives to P2X – as it is the case with aviation.
Secondly, a market-neutral approach enables fundamental changes in the refinery and chemical processes making these industries fit for climate neutrality. The production of electricity-based SAF via P2X (both Fischer-Tropsch and Methanol route) generates a high spectrum of by-products (see figure 1). These by-products can be used as base molecules for further synthesis routes and enable the necessary replacement of fossil crude oil in other chemical processes. The more incentives there are for marketing these by-products, the more economical and efficient SAF production through P2X becomes.

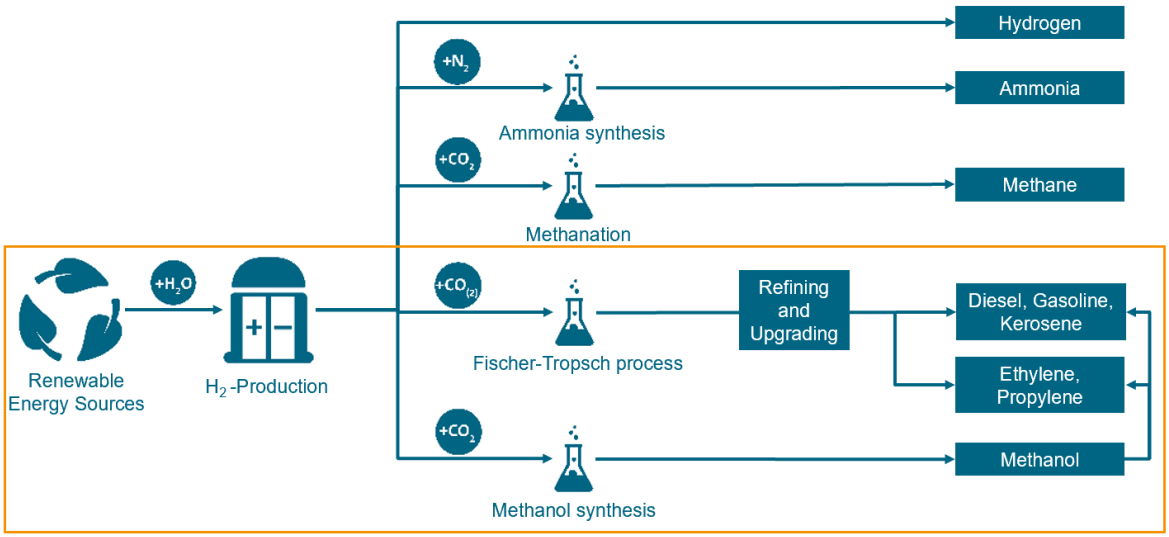

Figure 1 - Overview of P2X fuel production pathways and products (Source: VDMA)

Technology Readiness Level (TRL)

All individual process steps for kerosene synthesis using P2X are proven technologies with high TRLs (see figures 2 for methanol and Fischer-Tropsch pathway). The “start-to-end” interconnection of the entire process is technically feasible and is currently being demonstrated in over 40 pilot and demonstration projects in Europe. No further basic research is necessary. The first plants on an industrial scale will go into operation within the next 3-5 years. The barriers towards full commercialisation are not technical ones but a missing regulatory framework. Hence, what is needed now is an appropriate regulatory framework that enables developing business cases and the commercialisation of P2X plants.

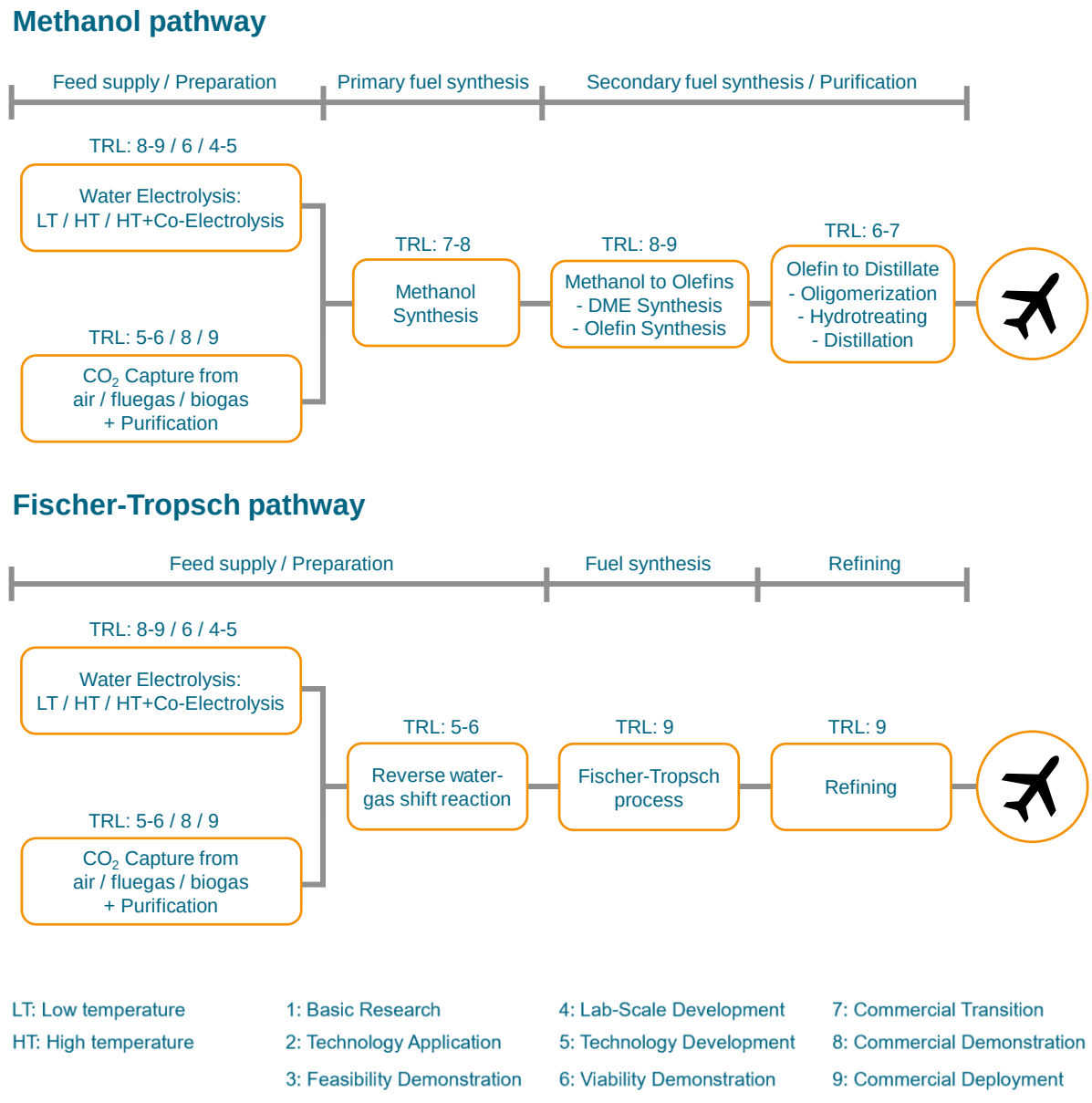

Figure 2 - Overview Technology Readiness Levels (Source: VDMA)

Establish a domestic market for P2X

A strong domestic market is crucial for European technology firms to defend their current technological leadership in P2X. The Smart Sector Integration Strategy should lay out a comprehensive approach towards making use of renewable energy across all sectors. This

will lead to a significant increase in gross electricity demand in the coming decades. By comparison, the expansion of renewable energy is progressing far too slowly. Europe therefore needs higher and binding RE targets linked to the increasing demand of sector integration and the P2X market-ramp-up.

Taking a global perspective towards P2X

Europe has a huge potential for homegrown renewable energy. Yet, with regards to space and public acceptance, there will be limits in expanding RE at some point. Globally, however, RE capacity is abundant. The EU will remain an energy importer. P2X can be used on a grand scale for producing kerosene and we can cooperate with other regions of the world. P2X allows to easily store and transport imported renewable energy from places where wind and sun-derived energy is plentiful and cheap, through an existing infrastructure. In the long run, P2X should be produced in those regions of the world where the levelized costs of renewable energy are most favourable. This is a crucial factor for driving down the costs for P2X. Taking such a global perspective not only involves export opportunities for European technology firms, and opportunities for European project developers and asset owners. It also ensures that oil-producing countries and other regions of the world can create a new economic base for the climate transformation and will not be left behind. The EU should therefore promote P2X as a crucial technology for reaching the goals of the Paris Agreement and engage in P2X partnerships with interested countries.

Fuel quality

Due to the special conditions in aviation, SAFs properties must meet strict safety requirements. These properties are achieved by a combination of different classes of hydrocarbons, but with very narrow specifications for their distribution in the finished fuel. In contrast to the biogenic-based aviation fuel substitutes, which tend to have higher proportions of oxygenates, the P2X synthesis and upgrading process produces fuels that are more similar in structure to the original fossil refining fuels. As a result, P2X fuels can also be added to fossil kerosene in higher quantities without any problems, even without the need for further additives.

Enabling a business case for P2X with the Renewable Energy Directive (REDII)

The Renewable Energy Directive (REDII) offers a timely and very promising opportunity to turn sector integration into a business case. It offers the framework to replace fossil-based energy-carriers with renewable hydrogen and P2X in transport, including the refinery process. There is however a clear mismatch between the new climate ambition and the context in which the REDII was negotiated. The focus has now shifted from the need to integrate RE into the electricity system to achieving climate neutrality and the need for sector integration. Therefore, the delegated acts of the REDII need to be implemented in a way that they facilitate an industrial scale-up of P2X. This applies particularly to question under what conditions electrolysers can take electricity from the grid (Art. 27(3) and rec. 90 REDII). The specification of the correlation in time and geography of synthetic fuel production and RE generation will prove to be a barrier for the uptake of hydrogen and P2X-derived fuels in the transport sector. Those specifications should be relaxed. Guarantees of origins and Power Purchase Agreements (PPAs) should be sufficient proof for the renewable origin of electricity and additionality.
The multiplier for the SAF discriminates P2X against bio-based fuels. VDMA argues for a technology neutral approach. This could be achieved by an immediate increase of the multiplier for P2X. In the long run, technological neutrality in the REDII should be achieved by removing the multipliers and substituting them with a focus on the life cycle assessment of CO_2.

Reform of the Energy Taxation Directive: CO_2 pricing as leverage

To optimise the costs of P2X-production, a reform of the Energy Taxation Directive is important. To supplement the European emissions trading system (EU ETS), the introduction of a CO_2 price should be included in the Energy Taxation Directive. VDMA advocates that the minimum tax rates should be based on the CO_2 content of energy carriers. In order to reach the levels of renewable "climate neutral" energy needed for the transition, taxation of renewable energy e.g. on electricity needs to be reduced, whilst fossil oil needs a higher price. In order to attain the desired climate protection effect, there should be no artificial overall increase in price but a reallocation according to climate damaging effect of the energy source. A CO_2 price on energy carriers would create a market-based instrument with a cross-sector approach thus incentivising the use of low emission fuels. As P2X in aviation necessarily needs a CO_2 component, CO_2 pricing should create a level playing field for technologies such as Carbon Capture and Usage (CCU) from unavoidable point sources, bioenergy and direct air capture (DAC) to support entry into the carbon cycle.

Market introduction programme

To incentivise the use of P2X in a highly international sector like aviation, a carbon pricing policy on the international level would be the most effective. If the CO_2 price is not able to send a strong investment signal for P2X, a market introduction programme can support its uptake. The programme should be limited in time and degressive, include an auctioning approach, reward technological innovation, avoid deadweight effects and should be reviewed regularly. The market introduction programme should stimulate the market ramp-up in all the different use cases of P2X (land transportation, shipping and aviation).

Incentivising carbon re-cycling

To produce P2X that can be used for aviation, CO_2 is needed. The CO_2 may come from unavoidable point sources, from the use of bioenergy or from the atmosphere using DAC. The use of CO_2 point sources should be limited to unavoidable industrial emissions in the EU ETS, such as from cement industries. Other emissions from fossil refineries, steel or chemical industries could be used as a bridge. Carbon capture and utilisation (CCU) should be acknowledged and rewarded under the EU ETS, subject to a life cycle analysis and clear carbon accounting rules (i.e. avoid double counting and double penalties).

The VDMA is happy to contribute with its expertise to the further political process of ReFuel EU Aviation.

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