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GRÜNER WIRTSCHAFTS DIALOG

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Expert Forum on Low-Emission Energy Sources

Scoping Paper

Fossil Natural Gas, Hydrogen, and E-Fuels

Scoping Paper for the Expert Forum on Low-Emission Energy Sources with the Grüner Wirtschaftsdialog

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This summary was prepared by Dr. Sebastian Timmerberg, Hamburg University of Technology, Institute for Environmental Technology and Energy Economics, on behalf of the Grüner Wirtschaftsdialog e.V. (Green Economic Dialogue reg. Soc.). The statements and assessments were discussed in several meetings of the Green Economic Dialogue's Fachforum Emissionsarme Energieträger (Expert Forum on Low-Emission Energy Sources). The concerns and perspectives of these companies have been incorporated into the paper, but it does not necessarily reflect their views in every respect.

Expert Forum on Low-Emission Energy Sources

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Expert Forum on Low-Emission Energy Sources

The Green Economic Dialogue reg. Soc. (Grüner Wirtschaftsdialog e.V. – GWD) was established based on the awareness of shared responsibility for our future. The members and supporters of the GWD are convinced that far-reaching changes with the goal of a sustainable economy are necessary and feasible (see preamble of the GWD). The dialogue between actors in economy, science, and politics constitutes the focus of the GWD's activities. The individual perspectives of the actors result in different evaluations of measures, procedures, and structural changes. These are to be made transparent in the following paper in order to show common solutions based on them.

The Green Economic Dialogue's Expert Forum on Low-Emission Energy Sources (Fachforum Emissionsarme Energieträger – FF EmE) is committed to the goal of the Paris Climate Agreement. This highly ambitious goal means that the supply and use of energy must be changed profoundly. Low-greenhouse gas emitting gaseous and liquid ('green') energy sources must be used for applications in various sectors – including chemicals, raw materials production, transport, and heating systems. The central topic of the expert forum for low-emission energy sources is the markets and infrastructure necessary for an increasing diffusion of these green energy sources. A successful energy transition towards climate protection requires prerequisites, which are not the subject of the Expert Forum. However, they are to be implemented with foremost priority and thus, they have to be mentioned here:

1. **Decreasing the energy demand**
2. **Increasing energy efficiency**
3. **Expanding supply of renewable energies, both nationally and internationally.**

The transformation must begin now if the climate target is to remain achievable. Its design must consider all dimensions of sustainability and thus include ecology, social issues and economy. This transformation will only be possible if all sectors of society contribute. Business representatives have a special responsibility for the technological challenges associated with the transformation.

A common basic understanding is that **politics** must **create reliable framework conditions** that promote responsible action and, conversely, regulate irresponsible behavior. The framework conditions for investments in energy infrastructure must be reliable in the long term, since only long-term planning security will allow industries to make the necessary (high) investments. **The**

framework conditions should therefore also lead to investments that will last in the long term and that are therefore needed in the future. A prerequisite for this involves framework conditions that enable – after necessary start-up support – **self-sustaining business models.** In view of the dramatically changing climate conditions, these **framework conditions** must be **created as quickly as possible** so that the transformation of companies and the entire economy can begin immediately. **Innovations** must be promoted above all by ensuring that appropriate framework conditions allow **competition in the market**. Particular attention must be paid to a **global level playing field** and an approach **coordinated in Europe**.

The change towards climate neutrality is a gradual shift from established to CO_2-neutral technologies. Accordingly, also **existing economic structures** are to be **considered.** An abrupt transition to a new system is not possible due to times for technical development and the ramp-up of green production capacities such as the conversion of air or sea transport to alternative energy carriers (hydrogen, SAF, PTX). The evaluations of timing shown in Fig. 1 are always based on current knowledge - and have to be permanently evaluated and, if necessary, adapted according to technical progress. .

As long as established energy supply technologies are applied, they must make their contribution to climate protection and realize the existing potential for greenhouse gas savings. Technologies and infrastructures must be **designed to accompany a change** in the energy system and not stand in its way. Thus, infrastructure decisions must consider future developments and already be adapted to them (e.g., hydrogen readiness). Furthermore, the **use of technical CO_2 avoidance technologies such as CCS (carbon capture and storage)** will play a role, however associated risks must be avoided.

Further social and technological changes will also have considerable influence on the climate balance and in particular on the topics of energy consumption, energy sources, and thus energy infrastructure. Among other things, we expect far-reaching changes in transport (keywords: intermodal networking, on-demand transport, automated driving) with respect to personal mobility, through digitization and technological developments in freight logistics, in the heating sector, and in industrial processes.

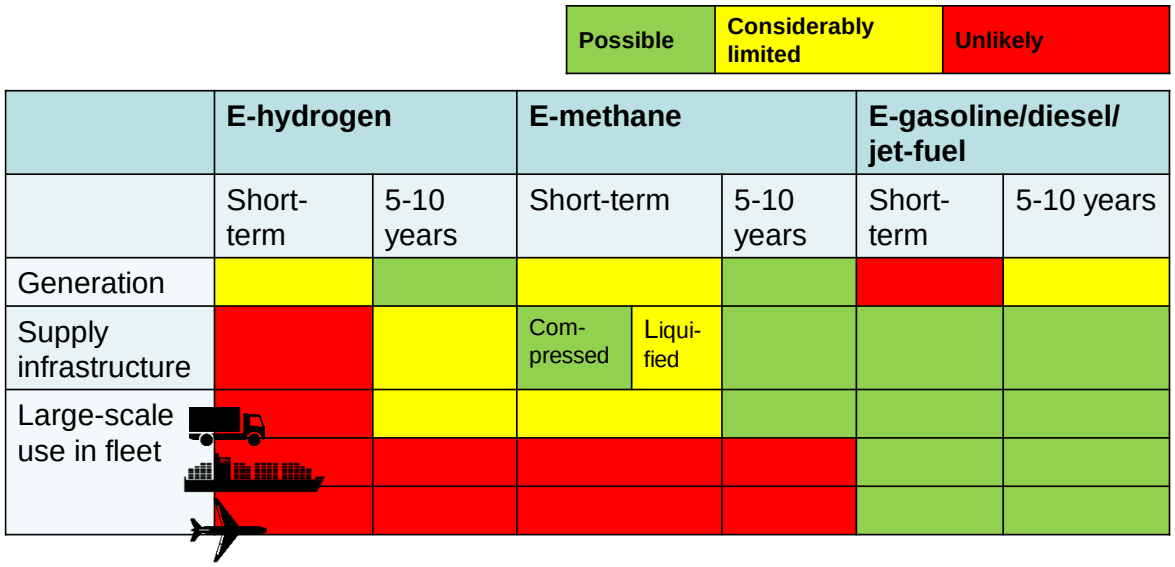

Figure 1: Evaluation of electricity-based "e-"fuels to be produced in large quantities and used in transport (Sebastian Timmerberg, TU Hamburg, 2019)

All measures are to be assessed in the light of the Paris climate targets – these targets are non-negotiable and they will consequently determine the speed of implementation. In some cases – for example, concerning the results of the "Coal Commission" – compensation or **transitional assistance** must be provided for companies that are no longer economically viable due to the transformation through no fault of their own.

Positions

Natural gas technologies are seen by the members of the Expert Forum as transitional technologies, because their proper use meets high standards in terms of environmental protection (lower pollutant emissions) and leads to lower greenhouse gas emissions compared to other fossil fuels such as coal or oil. At the same time, there are technologies with a high level of technical maturity that can gradually replace natural gas with low-greenhouse gas alternatives. These include, in particular, biomethane based on residual and waste materials, as well as methane generated by power-to-gas processes. A roadmap is necessary to organise a transition towards these alternatives

step by step. As an expert forum, we are aware that the use of natural gas is also associated with risks. Measures must be taken to ensure that environmental damage caused by natural gas (especially methane slip throughout the supply chain) is kept to a minimum. New investments in the natural gas infrastructure (e.g., LNG import terminal) are supported by the Expert Forum, provided that the requirements for environmental and climate protection are met and a path toward greenhouse gas neutral use is taken into account.

In the future, ***hydrogen*** and the associated technologies will complement or replace natural gas technologies and enable a greenhouse gas-neutral operation. Like natural gas, hydrogen is a gaseous energy carrier, and natural gas as well as the associated infrastructure will contribute to the success of hydrogen. For example, parts of the **natural gas infrastructure,** such as geological natural gas storage facilities or natural gas pipelines, can be **converted to hydrogen** with limited effort. **For a transitional period, blue, and possibly turquoise hydrogen from fossil sources will make a contribution**, since it can be produced short term at lower costs and in larger quantities. This must not result in the 'green path' being pursued with lower priority (avoidance of a lock-in effect). On the way to 100% green hydrogen, RE generation capacities must be expanded with high priority. When assessing the use of this hydrogen from fossil sources, the entire ecological footprint from extraction to final storage of the fossil sources (including methane losses) must be taken into account. Under these conditions, blue and possibly turquoise hydrogen will become the precursor for green hydrogen until the latter is available in sufficient quantities and at marketable production costs.

Several energy demands cannot be covered by the gaseous fuels natural gas and hydrogen. For example, long-distance airplanes/ships will depend on liquid energy carriers such as kerosene/diesel in medium to long-term perspective (see Fig. 1). Sufficient quantities of **bio-based as well as electricity-based fuels** (so-called e-fuels / power-to-liquid fuels) must be made available for such applications, which enable low-greenhouse-emission operation. These fuels continue to have the advantage that they can be used in the existing infrastructure. Pathbreaking framework conditions are necessary to ensure that these fuels become available in time and in quantities sufficient to achieve the goals of the Paris Climate Agreement.

Measures

Transition from fossil natural gas

- **Making existing use of natural gas more climate-friendly.** Natural gas consists largely of methane, which can cause major climate damage. Current measures are not sufficient to reduce methane emissions and methane concentrations in the atmosphere. In addition to more stringent reporting obligations for natural gas suppliers, economic instruments are to be installed that impose substantial additional costs on high upstream emissions (including methane emissions). The capabilities for the production of biomethane, especially from biological residues, are to be exploited while strictly observing sustainability criteria.

- **Promoting the transition to low-greenhouse gas alternatives (PTG, biomethane)**: Natural gas must be gradually replaced by climate-friendly biomethane and electricity-based methane (power-to-gas). Due to the foreseeably low environmental impact of PTG technologies, capacities must be increased. In this context, particularly issues of international import need consideration, since other countries have significantly more beneficial environmental conditions (e.g., higher solar radiation and wind speeds). Specifically, the import of PtG and biomethane from abroad should become eligible und current GHG reduction schemes.

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Promotion of hydrogen

- **Creating conditions for large-scale hydrogen use**. A number of prerequisites must be met and frame conditions adjusted before large-scale use is possible. These include the development of a transport and distribution infrastructure. In existing gas infrastructure projects, care must be taken to ensure that they can also pave the way for hydrogen use.

- **Promoting various competing approaches to hydrogen transport**. So far, no technology is established for long-distance transport of hydrogen. Pipeline transport competes with hydrogen transport as cryogenic liquid or stored in carrier molecules such as DBT, ammonia, or toluene (LOHC /LHC). Large-scale demonstration projects are to be set up to advance the technical development of hydrogen transport and thus enable cost reductions. These can build on Germany's very competitive technological position in research as well as the chemical and plant engineering industry. The legal and regulatory framework must be adapted to integrate the existing gas infrastructure for hydrogen transport.

- **Allowing low-cost means of hydrogen production**. So-called blue and turquoise hydrogen can be produced on the basis of natural gas. This has the advantage that production costs are today lower than those of green hydrogen, while at the same time greenhouse gas emissions are low. It should be possible to use these hydrogen production technologies at least for a transitional period to pave the way for hydrogen. In this context, these technologies must not cannibalize the development of green hydrogen production, but support it. For this reason, blue and turquoise hydrogen should be eligible for inclusion in CO_2 emissions trading, for example, insofar as they result in low GHG emissions over the entire life cycle. Given the high demand for hydrogen and renewable energy sources, the use of these energy sources in climate protection must be organized as a top priority.

Promotion of renewable fuels (especially e-fuels)

- **Implementing tenders for large-scale e-fuel production.** Existing production capacities for e-fuel production are very small scale (several liter per year). However, large quantities of e-fuel will be required in the decades ahead. Secure investment incentives are needed to

realize the first large-scale production plants and thus to create the conditions for ramping up production. Tenders for production volumes similar to the German Renewable Energy Sources Act [Erneuerbare-Energien-Gesetz – EEG]) are a well suited instrument to reduce the risks for investments. Furthermore, it is necessary to build international partnerships at an early stage. Considering the necessary high additional capacities for renewable energies and due to regional conditions more favorable, sunny regions in Southern Europe, in North Africa/Middle East but also worldwide (Asia, Australia, South America) will be able to develop the necessary renewable energy for the production of electricity-based fuels. The first projects in Saudi Arabia and elsewhere are already underway.

- **Ambitious implementation of the EU Renewable Energy Directive (RED II)**. The implementation of the RED II into German law (Federal Immission Control Act – Bundes-Immissionsschutzgesetz – BimSchG) is the main political lever with which the use of renewable fuels will be determined for the coming years. The requirements in RED II should be implemented ambitiously so that fuels, too, make a major contribution to climate protection. Electricity-based fuels in particular must be explicitly included so that they can demonstrate their potential. This requires paying attention to ensure that electrification and the use of renewable fuels are not competitors; both having their significance in different applications, both must be used to their potential extent to achieve maximum climate protection.

Framework conditions must allow for sustainable business models

In effect, framework conditions have to be created in such a way that the above-mentioned technologies can be used economically in the long term. For this purpose, essentially four measures and framework conditions are necessary:

1. A clear and transparent path toward pricing of climate-damaging gases based on environmental costs (**internalization of external (environmental) costs**).

2. During a transitional period, it may be necessary to set **quotas** for the addition of green energy sources in the mix.

3. The creation of an international **level playing field,** so that distortions of competition caused by national frameworks do not lead to international market losses or carbon leakage (reference to BTA, CCfDs, climate levy).

4. The **global availability of** the new (green) fuels is indispensable for international modes of transport (aircraft, ship).
