BEE
German Renewable Energy Federation

BEE Position Paper

A European Hydrogen Strategy

Berlin, 2nd February 2021





Preface

There are many reasons why hydrogen will play an important role for the energy transition in Europe. Alongside electrification with electricity from renewable energy sources, hydrogen will be needed for the decarbonised integrated energy system of the future. To ambitiously implement the goals of the European Green Deal and building on the Commission's new industrial strategy and recovery plan, an enabling framework is needed to ramp-up markets for a hydrogen economy in Europe.

However, the introduction of hydrogen in Europe raises questions to which answers must be found. Meeting these challenges will require extensive investment, the right regulatory framework, new markets, research and innovation, and appropriate infrastructure.

Renewable hydrogen produced from renewable energy sources is the option that is most compatible with the EU's climate neutrality target and an integrated energy system in the long term. Renewable hydrogen, as a substitute for fossil fuels in sectors that are difficult to decarbonize, can help reduce greenhouse gas emissions by 2050 and provide new economic stimulus in the EU. Investing in renewable hydrogen will help create sustainable growth and jobs, which will be crucial in the context of recovery from the COVID-19 crisis.

Introduction

The European Union aims to become climate neutral by 2050. In order to meet this target, immediate and substantial emissions reductions are necessary in the areas of electricity, industry, transport and heat.

The target of comprehensive decarbonization of all end-use sectors of the energy system should be pursued first and foremost through direct use of renewable energies (RE). The use of hydrogen and its downstream products is particularly useful where the direct use of renewable energies is not possible or difficult to implement.

Hydrogen and its downstream products can be used in production processes in the steel and chemical industries, as well as in certain areas of the transport sector, such as heavy-duty and long-distance transport or air and sea transport. It can also contribute to reducing greenhouse gas emissions in the heating sector, for example in climate-neutral district heating.

However, the greatest contribution for climate action can only be achieved with green hydrogen from renewable energies and its downstream products, as this is the only way to sustainably minimize emissions. The production of grey or blue hydrogen, on the other hand, entails significantly higher greenhouse gas emissions. Green hydrogen is therefore the only reasonable way of using hydrogen for climate action.

The European Union should therefore firmly commit to green hydrogen development and reap the benefits of creating a strong domestic market for green hydrogen only.

Demand should be covered primarily through intra-European production of green hydrogen both by large wind and solar farms as well as by small and medium-sized operators of renewable energy installations. Although a share of the demand will have to be covered by imported hydrogen, developing and exploring domestic European potentials should clearly be prioritised.

In addition to developing a supportive regulatory framework for the rapid ramp-up of a domestic market for green hydrogen and its derivatives, it must also be ensured that sufficient renewable electricity is available for its production. The additionally needed electricity for hydrogen production must be calculated as accurately as possible and the trajectories for increasing capacities for production of electricity from renewable sources needs to be adjusted accordingly.

The gas infrastructure must also be adapted and designed for 100% renewable gases in the future. Further development should be planned on a trans-European basis. In addition, the development of a dedicated hydrogen / RE gas infrastructure and the use of the existing gas infrastructure should complement each other in a meaningful way. Furthermore, the regulation of gas supply networks must be designed in such a way as to allow for effective and undistorted competition and to apply strict rules of unbundling.

Finally, for the hydrogen market to function efficiently and to avoid negative environmental impacts, international standards for hydrogen and its downstream products must be established. In addition to technical standards to harmonize production and trade, this also includes sustainability standards to ensure that the necessary social and environmental requirements are met along the entire hydrogen value chain.

Setting the right framework

Today various processes are available to produce hydrogen. The European Commission has defined different types of hydrogen in its hydrogen strategy paper. These are the following:

(1) The term "fossil-based hydrogen" covers those types of hydrogen which are based on fossil energy carriers. This primarily includes hydrogen produced in the process of steam reformation using fossil gas.

(2) The term "low-carbon hydrogen" includes "low-carbon, fossil-based" hydrogen, which is also produced in the process of steam reformation, but carbon emissions generated in the production process are largely captured and stored (CCS, Carbon Capture and Storage). The term also includes "low-carbon, electrolysis-based" hydrogen, which, regardless of the source of the electricity used for electrolysis, must significantly reduce carbon emissions compared to fossil-based hydrogen. Since electrolysis-based hydrogen based on renewable energy is assigned to a separate terminology (see "renewable" hydrogen), this primarily refers to hydrogen based on nuclear electricity.

(3) The European Commission defines "renewable" hydrogen as hydrogen which is produced by water electrolysis using only renewable electricity. In addition, the definition of renewable hydrogen correctly includes all those hydrogen types that are based on production processes that rely exclusively on renewable energy, e.g. steam reforming from biogas or methane pyrolysis based on biogas. According to the European Commission, the term "clean" hydrogen refers exclusively to renewable hydrogen.[1]

BEE considers these definitions introduced by the European Commission for different types of hydrogen to be at least partly misleading and therefore uses the classification of different hydrogen types according to colours, which is another common approach. For clarification, therefore, a comparison of the definitions:

Hydrogen production process	**Term in the EU Commission's hydrogen strategy**	**Hydrogen color code in German (used in this paper)**
Water electrolysis using only renewable electricity. In addition, all production processes which use only renewable energy, e.g. steam reforming from biogas or methane pyrolysis based on biogas.	renewable / clean	green
All processes which are based on fossil energy carriers. This primarily includes the process of steam reforming using natural gas.	fossil-based	grey
Steam reformation process with capture and underground storage of parts of the carbon emissions (CCS, Carbon Capture and Storage	low-carbon, fossil-based	blue

[1] European Commission (2020), p. 4

Water electrolysis using any type of electricity. Since electrolysis-based hydrogen from renewable energies is assigned to a separate concept (see "renewable" hydrogen), this refers to hydrogen based on nuclear power.	kohlenstoffarm, Elektrolyse-basiert	pink/red

Only green hydrogen can be produced in an environmentally friendly and at the same time climate-neutral way. While the average greenhouse gas impact of grey hydrogen over its entire life cycle (life cycle assessment) is 398 g CO2eq./kWh H2, the emissions of green hydrogen are reduced to 26 g CO2eq./kWh H2.[2] The low emissions level is due to the fact that only the construction of the wind or solar plants and the electrolysers produce a few emissions, but not the process of electrolysis itself.

When comparing CO2 emissions, it is also clear that green hydrogen produces much less emissions than blue hydrogen. A recent study by Parkinson et al. (2019) calculates an average greenhouse gas impact of 168g CO2eq./kWh H2[3] for this type of hydrogen, including the upstream emissions caused by extraction, processing, and transportation of the natural gas. While this is significantly lower than emissions from grey hydrogen without CCS, it illustrates that blue hydrogen is not even close to being climate neutral.

Pink hydrogen is hydrogen based on nuclear power. While this produces less greenhouse gas emissions than fossil-based hydrogen, there are other serious risks to consider. Wealer et al. (2019)[4] dispel the concept of "clean" nuclear power and address these risks. In addition to the radioactive radiation associated with nuclear power, which poses a risk to humans and the environment for millions of years, and the unresolved question of nuclear waste disposal, there is a significant proliferation risk and resulting use for nuclear weapons. Nuclear power-based hydrogen can therefore certainly not be considered as "clean". Only hydrogen based on renewable energy sources deserves this frame. For these reasons, only green hydrogen is an acceptable choice for the environment and for climate ambition.

Green hydrogen should also be preferred in terms of costs. It is true that the production costs of blue hydrogen are currently only half of those for green hydrogen.[5] However, blue hydrogen projects are subject to various risks in the future. In addition to capacity risks (limited number of high-quality CCS storage sites) and acceptance risks (local resistance to CO2 storage sites and CO2 pipelines), these are primarily cost risks: fossil gas prices are difficult to predict and rising CO2 and CCS prices are likely to slightly increase the costs of blue hydrogen .[6] With simultaneously falling prices for electrolysis, the cost gap between green and blue hydrogen will therefore shrink. The prerequisite is reducing costs for electrolysers through fast upscaling of the market.

Pink hydrogen would also benefit from decreasing costs of electrolysis. However, considering all the societal costs, nuclear electricity is significantly more expensive at 18.7 to 47.3 ct/kWh than renewable electricity from PV (7 to 12.7 ct/kWh) or wind onshore (4.1 to 8.5 ct/kWh)[7].

[2] Parkinson et al. (2019), p. 29.
[3] Parkinson et al. (2019), p. 29
[4] Wealer et al. (2019), p. 2f
[5] GP Energy (2020), p. 50
[6] GP Energy (2020), p. 50
[7] FÖS (2017), p.13

The European Commission should therefore introduce the right regulatory framework. Instead of the risky use of expensive nuclear power or the lengthy development of a nationwide infrastructure for blue hydrogen, which is associated with the risk of locking in the use of fossil fuels, green hydrogen should be developed and implement without detours. By setting the right incentives, a rapid market ramp-up of electrolysers of various sizes powered by renewable energies would be made possible and a technology path would be taken which, compared to blue or pink hydrogen, offers a more cost-effective and less risky alternative.

Green hydrogen as an important component to decarbonize all end use sectors

Whether in industry, transport, the heating sector, or electricity generation: Renewable energy is the solution for the European Union to become climate neutral by 2050 at the very latest. In terms of efficiency the direct use of renewable energies should be prioritised over the use of electricity-based energy carriers. However, in some cases, the use of green hydrogen may have advantages over the direct use of renewable energies. The use of green hydrogen should be prioritized where viable alternative options for decarbonization are not (yet) available.

In terms of hydrogen the industrial sector is highly relevant. To achieve climate targets, industry must significantly reduce its CO2 emissions. In parts of the chemical industry, hydrogen is already indispensable for many applications. The grey hydrogen that is primarily used today can be replaced by green hydrogen without having to adapt the process. It is for example needed as a basic material to produce ammonia.[8] Green hydrogen can also be used to decarbonise processes in the production of olefins and aromatics and in the recycling of parts of the plastics produced via gasification.[9]

For steel production, green hydrogen can be used in so-called direct reduction plants. Technically, the direct reduction of iron ore has already been used for some time - but only on natural gas basis. Only the conversion to green hydrogen as a reducing agent enables the production of almost climate-neutral steel - a CO2 reduction of 97% compared to the emission-intensive blast furnace process with hard coal coke is possible.[10] Many industrial processes require temperature levels that can only be achieved in combustion processes. The provision of high-temperature process heat can help to significantly reduce emissions. For example, if biomass or fuels based on green hydrogen are used in the cement industry instead of fossil fuels, the total emissions in cement production are reduced by 35 %.[11]

In the transport sector, renewable fuels, which in addition to biofuels also include synthetic hydrocarbons and pure green hydrogen, are an alternative due to their high energy density for applications that cannot be supplied directly with electricity or only with great effort in the long term. In future, especially in aviation and maritime transport, the increasing demand for climate-neutral fuels can be met by hydrogen-based energy sources from PtX processes. In coastal and inland shipping, fuel cells can be used in addition to battery-electric drives. Fuel cells can

[8] VCI (2019), p. 30
[9] Agora Energiewende (2019), p. 177
[10] BDI (2018), p. 182
[11] Agora Energiewende (2019), p. 202

also complement battery-electric mobility in local public transport (buses, trains), in heavy road transport (trucks) and in logistics (delivery traffic, forklifts).[12]

In the heating sector, green hydrogen and its derivatives can contribute to the reduction of greenhouse gas emissions. In the building sector, green hydrogen can be used to supply space heating in certain applications. The green gas is also suitable for the climate-neutral provision of district heating. However, it is important to emphasise that all local potentials of the direct use of renewable energies, waste heat and transportable biomass should be used first (e.g. using heat pumps, pellet stoves, biogas). This is likely to cover a large part of the heat demand. Only after these potentials have been exhausted the use of green hydrogen and its downstream products can reasonably contribute to 100% decarbonisation of the heat supply.[13] Last but not least, green hydrogen and its derivatives can also make an important contribution to decarbonising the electricity sector: renewable gases can be used in gas-fired power plants or fuel cells and represent a CO2-free reserve capacity, if no other renewable energy sources are available.

Creating a strong domestic market for green hydrogen production

As an important element of sector coupling, hydrogen has a broad range of potential applications in all areas of the energy system. However, hydrogen for decarbonising the individual sectors will require large amounts of it in the future. With its hydrogen strategy, the European Commission has committed itself to a roadmap for the development of hydrogen capacities within Europe by 2050. BEE welcomes the concrete targets for additional electrolysis capacities to be built which are set for the years 2024 and 2030, i.e. 6 GW by 2024 and 40 GW by 2030. However, the capacities for 2030 in particular is not ambitious enough. After an initial phase of market ramp-up, a higher renewable electrolysis capacity of at least 60 to 80 GW should be targeted by 2030.

To this end, incentives urgently need to be put in place to make the decentralised construction and operation of electrolysers in the various European member states profitable for medium-sized companies as well as citizens' energy associations. It is important to ensure that competition between different market participants is developed on a level playing field.

Iin addition to grid requirements such as the use of surplus electricity, demand-side arguments such as the proximity to the hydrogen centres should be considered when designing incentives.[14] In order to meet the future demand for hydrogen, the hydrogen strategy for the European Union considers non-European countries, from which natural gas is imported or which have great potential for renewable energies as "being potential suppliers of low-cost green hydrogen"[15]. In addition to the production in Europe with its huge potential for solar, wind and hydro power, hydrogen imports from non-European countries can also play a role and contribute to security of supply. The prerequisite for this is the establishment of and compliance with clearly defined technical and sustainability standards (see chapter 7).

[12] BDI (2018), p. 84
[13] Ifeu (2019), p. 12
[14] Wuppertal Institut et al. (2020), p. 13
[15] EU hydrogen strategy, p. 19

It should also be noted that in some cases high transport costs are incurred and political availability risks must be expected. Especially for long distances, these costs are often higher than the production costs. For an import to Germany, for example, Navigant calculates production costs of 1.0 - 1.3 €/kg H2 for green hydrogen produced in North Africa, and estimates the total costs to triple to 2.8 - 4.8 €/kg H2 due to the expensive transport by ship[16]. Agora Energiewende also clarifies that transport significantly increases the total cost of imported hydrogen and quantifies import prices at €3.30/kg H2 in 2030 and €2.90/kg H2 in 2050[17], which is close to the expected cost of on-site production.[18]

When estimating the costs of imported hydrogen, possible pricing strategies of the suppliers should also be considered. If import demand is high, hydrogen exporters are not expected to offer their product far below the price of hydrogen produced in Europe. The IEA assumes that imported hydrogen is in many cases at a disadvantage compared to domestically produced hydrogen when further risks are considered, such as potential cartelisation between exporting states, dependence on political crises and severe weather[19].

The EU and its member states should not rely on purchasing large quantities of hydrogen from abroad correlating with many uncertainties. Instead, it is important to concentrate on developing facilities to produce hydrogen within Europe. To this end, the large potentials of wind, solar and hydropower that exist within the territory of the European Union should be fully utilised.

Overcoming barriers to the ramp-up of a domestic hydrogen market

To ensure an ambitious ramp-up of the domestic market, barriers must be removed to both use and production of green hydrogen within Europe by setting the necessary regulatory framework. Incentive systems for hydrogen use must not lead to a distortion of competition to the detriment of other technologies that make sense in terms of climate policy; the „level playing field" must be maintained. It must be ensured that incentives do not result in the use of hydrogen in applications in which other renewable energy appliances would be more appropriate from a climate policy perspective.

In industry, investments in the conversion of conventional technologies that use fossil fuels and basic materials to supportive technologies from a climate protection perspective should be consistently promoted. The upcoming investment cycles in the individual sectors should be used for a direct shift to renewable energies. Against the background of long technical lifetimes of industrial plants, which in some cases exceed 40 years, a switch to technologies impeding climate protection and the objectives of the Paris Agreement (from coal to fossil natural gas or non-renewable hydrogen), on the other hand, runs the risk of perpetuating the use of fossil fuels and thus setting the course away from achieving the climate protection goals.

A legally binding minimum share for climate-friendly basic materials such as green steel can decisively boost demand for these products and thus contribute to economic viability.

[16] Navigant (2019), p. 173
[17] Schneider et al. (2019) p. 33
[18] GP Energy (2019), p. 56
[19] IEA (2019), p. 81

In the steel and chemical industry with its process-related emissions, the introduction of so Carbon Contracts for Difference (CCfD) can also minmise investment uncertainties in the production of climate-friendly basic materials. With CCfDs, the state guarantees that it will compensate for the differential costs incurred. Payments are always due, if the certificate price is below the market price for CO2 emissions. In the opposite case, the state receives the difference from the contractually bound company. It is important to emphasise that CCfDs are only one option to incentivise the production of climate-friendly basic materials and that the use of public funds must under no circumstances be hindering or delaying the expansion of renewable energies.

In those areas of the transport sector where the direct use of renewable electricity is not (yet) possible or only possible with difficulty (heavy goods vehicles, air traffic, shipping), the use of sustainable biofuels and renewable hydrogen-based fuels is a central element of climate protection. To encourage their use, the European Union should agree on ambitious targets for greenhouse gas reduction in transport. On the other hand, further target setting is needed for other minimum shares beyond the mandatory minimum share of advanced biofuels according to EU Directive 2018/2001 (RED II). For example, a separate, additional minimum share should be established for renewable fuels based on green hydrogen and its derivatives. Only in this way can it be ensured that a successful market ramp-up takes place for both types of renewable fuels.

In the heating sector, the European Commission should support measures of individual Member States that aim to promote "hydrogen-readiness" installations. The possibility of being able to operate RE CHP plants with hydrogen as well as biogas makes them even more flexible in terms of a climate-neutral transformation of the heat sector.

In addition to incentives in the different areas of hydrogen use, it is particularly important to set the right stimuli for hydrogen production: The focus must be on ensuring that as few GHG emissions as possible are released during the electricity generation required for hydrogen production. Effective CO2 pricing in all sectors can reflect the costs of fossil energy production in a way that is fair to the polluter and help to make renewable gases economically competitive. European emissions trading as a market-based instrument already provides a technology-neutral, EU-wide incentive model with which cost-effective decarbonisation can be achieved. BEE therefore advocates an ambitious expansion of this instrument.

In addition to the ETS, Member States must also be able to create supportive conditions for the market ramp-up of domestic green hydrogen production to pick up speed quickly by designing their tax and levy systems. A Europe-wide definition of green hydrogen is an important prerequisite for this. Enabling policies and frameworks should therefore be established as soon as possible, so that member states can immediately transpose these specifications into national legislation.

In addition to a reform of the state-induced components of the electricity price oriented towards climate goals, targeted financial support for the construction and operation of electrolysers and other climate-friendly installations for power-to-gas/power-to-liquid synthesis, such as direct air capture and biogas upgrading plants, can also contribute to advancing economic viability and encourage companies and investors to embrace corresponding technologies. The European Commission should support and incentivise cross-border competition between individual players through suggestions for appropriate directives, bearing in mind that a broad spectrum of different market participants can participate and that not only industrial companies with large plants can compete.

A consistent expansion of renewable energies is necessary

Green hydrogen produced in Europe can be used in a variety of applications where direct use of renewable energies is difficult to realise in the medium term, and thus contribute to decarbonising all sectors of the European energy system. Renewable electricity capacities are the basis to produce green hydrogen from electrolysis.

A prerequisite for the provision of the required renewable electricity is a significantly increased expansion of all renewable energies. When calculating the required expansion of renewables, the additional electricity demand from hydrogen-based applications must be adequately assessed .[20] The European Commission should propose for each concrete expansion targets for renewable energies which include the respective additional electricity demand for hydrogen-based PtX applications.

Due to the huge potentials of wind, hydro and solar power in Northern and Southern Europe, the goal of covering most of the European hydrogen demand with domestically produced green hydrogen is achievable. The prerequisite for this is consistent action now and significant expansion of renewables in each member state.

Adapting the infrastructure

Fossil gas is a potent greenhouse gas and should therefore be replaced by renewable gases, such as green hydrogen, as soon as possible. The European gas infrastructure must be re-designed for accomodating 100% renewable gases. Measures for the long-term conversion of the infrastructure must be assessed whether they are needed for the transport, as well as the decentralised feed-in and storage of hydrogen and other RE gases.

For further development of a trans-European gas infrastructure, appropriate frameworks and respective guidelines for long-term planning need to be developed. The current widely differing regulatory provisions for feeding hydrogen into the gas infrastructure in the individual member states form obstacles to the cross-border development of a green hydrogen economy. The European Commission should therefore develop a European roadmap in which, for example, uniform hydrogen tolerances and the interoperability of network codes are established. The goal must be the fastest possible convergence of national gas infrastructure. The development of specific hydrogen / RE gas infrastructure and the use of existing gas infrastructure should complement each other in a meaningful way.

It should be noted that high blending shares of hydrogen in the existing gas network can have negative effects on various materials, lead to permeation and corrosion and reduce the calorific value of the gas mixture.[21] There are technically narrow limits to the admixture of hydrogen. The future main users of hydrogen - industry and transport - need hydrogen primarily in pure form or in processed derivatives, but not in the form of a gas mixture. In this context, research

[20] Öko-Institut (2019), p. 12
[21] Fraunhofer (2019), p. 199

approaches for the separation of hydrogen from gas mixtures, for example with the help of membranes[22], must be mentioned. These approaches should be supported by the European Commission.

Despite such approaches, there is no way around the construction of a separate and specialised hydrogen network. However, the development of such a hydrogen network must be cost-optimised and limited to those applications and areas where no alternative decarbonisation options are available (yet). The large-scale supply of hydrogen to consumers in the building sector, for example, would be too costly, especially since heat pumps are an alternative with much lower efficiency losses.

In the transition phase, it is particularly important that the use of fossil gas does not impede the use of RE gases. Furthermore, the use of hydrogen in the gas infrastructure must not prevent the feed-in of renewable methane-rich gases from existing plants and the development of new production potentials.

It must also be ensured that the regulation of gas supply networks enables effective and undistorted competition. Potential projects by individual network operators, such as the construction of large, subsidised electrolysers, distort the market and potentially lead to immense cost shifts for other players. Sector coupling plants and storage facilities should be built preferentially by market participants. A transparent and open-ended market consultation is necessary to determine whether market participants plan concrete projects that are classified by the grid operators as suitable for grid development.[23]

Only if no market participant is willing or able to provide the desired solution to support network operation, network operators should be allowed to operate storage or sector coupling facilities themselves. In this case, strict rules of unbundling must apply. Since plants built and/or operated by network operators are not subject to actual competition but would influence both the electricity and the gas market, strict transparency requirements for construction and operation as well as clear market rules are imperative.

Establishing international standards for hydrogen and its derivatives

For developing an efficiently functioning hydrogen market reliable technical standards must be established. In addition, a sophisticated quality infrastructure must ensure a high level of safety to avoid risking the general acceptance of hydrogen technology by accidents or negative events. Against the background of growing international trade in hydrogen and its downstream products (e.g. synthetic methane), corresponding standards and norms must be coordinated within the EU and beyond. International harmonisation should take place, for example, with regard to pressure levels, purities, or pipeline transport. The introduction of and compliance with quality standards for safety in fuel cell mobility is part of this. Furthermore, ambitious standards and verification procedures for the transfer of the "green property" of electricity and gas volumes must be coordinated across countries.

22 DVGW (2020)
23 BEE (2019), p. 2

It is imperative to prevent the "greenwashing" of fossil gas used through freely tradable certificates for renewable electricity and renewable gases. A potentially secure purchase of renewable electricity to produce green hydrogen is possible through the invalidation of guarantees of origin from renewable energy plants, available through other direct marketing. In addition, there must be a level playing field between all forms of renewable energy sources in terms of verification procedures. Sustainability standards must also ensure that the production of hydrogen and its derived products has the desired positive effects without negative collaterals. Meeting social and environmental standards in the production of hydrogen and its derived products is particularly important. They must apply to all steps of the production process. All production plants of hydrogen from electrolysis and its downstream products require large amounts of electricity. The greenhouse gas intensity of this electricity is therefore decisive for the greenhouse gas intensity of such hydrogen products. Only electricity from renewable energy sources should be used. The necessary renewable electricity generation should also fulfil the criterion of additionality.[24]

There are two options for this additionality: RES-E could be used that would otherwise remain unused due to a lack of customers or transport capacities (market or grid-related surplus electricity), or additional RES capacities must be installed. Additionality is not only relevant for production in Europe, but also for imported hydrogen products, for example from countries of European development cooperation. The additionality criterion would prevent local governments from using fossil energy sources for their own consumption and thus increasing their own carbon emissions, whilst selling “green” hydrogen for emissions reduction in Europe.[25]

In the production of hydrogen downstream products such as synthetic methane, the CO2 reference is relevant for the climate protection assessment in addition to the electricity reference. Here it must be ensured that the CO2 required for the synthesis process was previously taken from the atmosphere or a biogenic source. Only biogenic or atmospheric carbon sources allow a circular process that does not cause additional greenhouse gas impact. Purchasing CO2 from industrial processes based on fossil sources, on the other hand, should be avoided, as it attributes an economic value to CO2 and thus limits incentives for industrial plant operators to further reduce their emissions. Beyond electricity and CO2, it must be ensured, especially when importing green hydrogen from European development cooperation countries, that there are no negative environmental impacts along the hydrogen value chain. This applies in particular to the use of water in the electrolysis process, which must not impair the local drinking water supply in the countries of origin.

[24] Öko-Institut (2019), p. 12
[25] Adelphi (2020), p. 7

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As German umbrella association for the renewable energy sector, the German Renewable Energy Federation (BEE) bundles the interests of 45 specialised associations and companies. We connect the wind, bio, solar, geothermal and hydropower sector. We represent 30,000 individual members, among them more than 5,000 companies, 316,000 jobs and more than 3 million power plant operators.

Our goal: 100 percent renewable energy in electricity, heating and transport.

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