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Energiepartnerschaft
DEUTSCHLAND - CHINA

FACTSHEET

PRIORITY SECTORS FOR HYDROGEN DEPLOYMENT FROM A CLIMATE PERSPECTIVE

Green or low-carbon hydrogen will remain a scarce resource at least for the next decade. Therefore, the necessity arises to prioritize sectors and thereby guide the flow of hydrogen. The logic of prioritization can follow different lines of argumentation.

The different motives for prioritization

At least in the first phase of the market ramp-up, hydrogen will remain a scarce and therefore expensive resource. The approaches to hydrogen distribution across industrial sectors can be motivated by different arguments or world views.

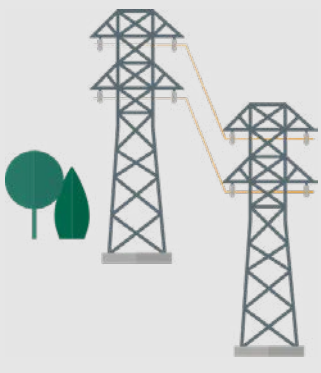
One way of looking at the issue is by simply asking which sectors of industry have no known technological alternative for decarbonisation available. This way, the industry sectors with available alternatives face increasing pressure to develop and implement these technologies due to a rise in CO_2 certificate prices.

A different approach to sector prioritization would be to first serve and support the industries with the largest climate impact in their transition to hydrogen. This way, due to the accumulating nature of CO_2 in the atmosphere, other sectors have more time for the transition or net zero is within reach at a lower total CO_2 concentration in the atmosphere.

The market-driven approach would simply distribute the hydrogen according to market forces. This way, hydrogen would first be deployed where it is cheapest to do so or the willingness to pay for a price premium is the highest. The expected result is that this way the transition maximizes cost efficiency.

Germany combines the approaches. Partly, the market dynamics for cheap allocation are incentivized by a rising CO_2 price on a national and European level. This approach is complemented by targeted subsidies for industries with no technological alternatives and the largest climate impact at the same time as the steel industry.

In addition to replacing the fossil hydrogen already used in the German chemical and refining industries, Germany expects renewable or low-carbon hydrogen to be used in other, new fields of application. Since the available quantities of climate-neutral hydrogen will initially be limited, there are different approaches to prioritising the application sectors. For example, it can be used first where competitiveness with fossil fuels is given or expected earliest. By pricing the CO_2 emissions of industry in Germany, this competitiveness increases in conjunction with the possible emission reduction quantities per kilogram of hydrogen used.



Sector prioritization with the greatest leverage for climate action

The German Hydrogen Council published a report in January 2023, which uses real, aggregated data to calculate forecasts for the greenhouse emissions savings potential. The report considered the following sectors:

— Chemical industry: production of methanol, ammonia and the substitution of fossil resources for basic chemicals

— Steel: conversion to direct reduction iron and high-temperature processes

— Mobility: hydrogen and derivatives in refineries and direct use as fuel for aviation, heavy-duty transport, ships and trains

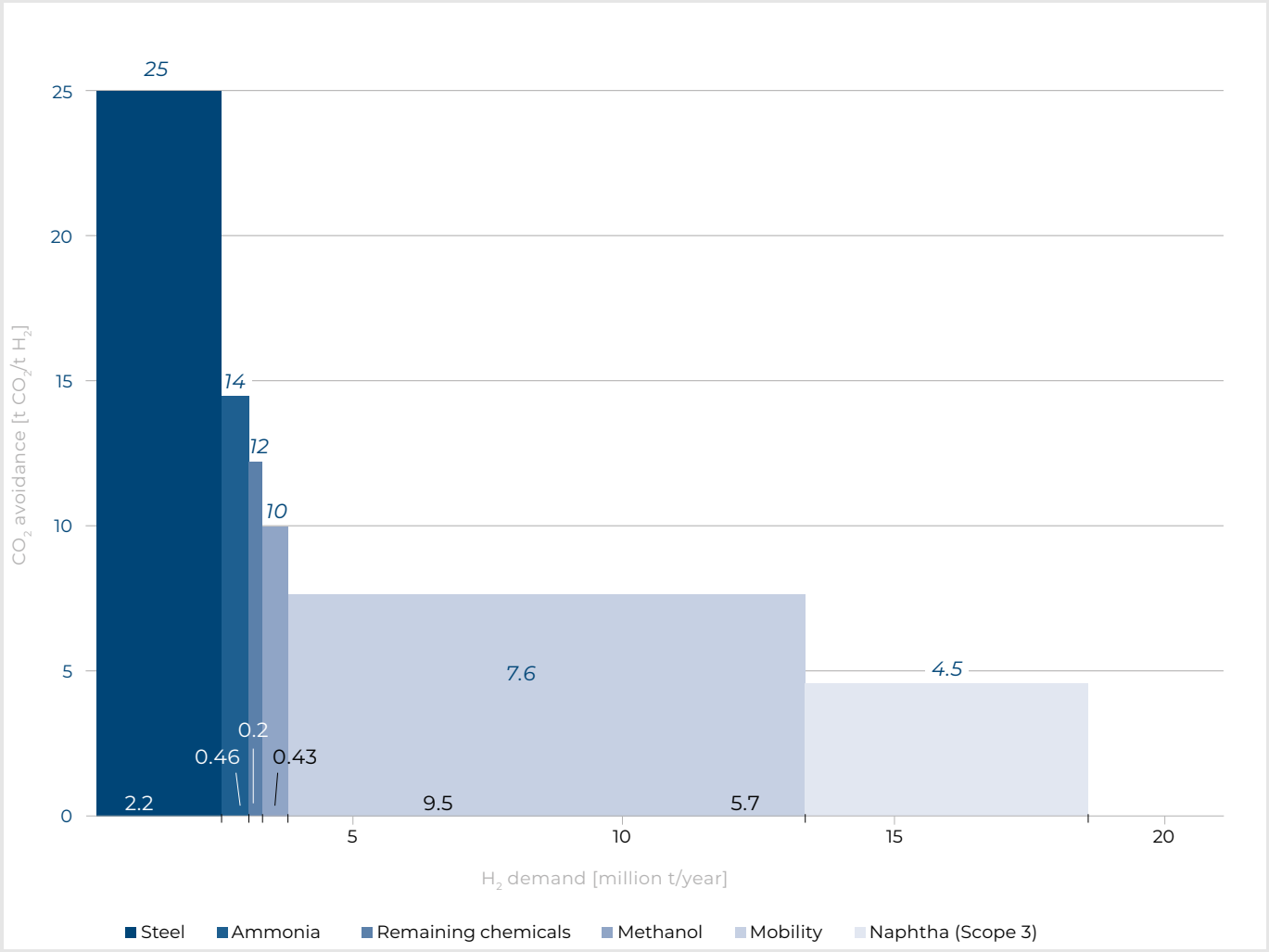


Figure 1 CO_2 avoidance levers through the conversion to H_2-based technologies in Germany (2050)

Technology	Replaced energy sources	CO_2 quantity (million t/year)
Steel	Coal	55
Ammonia	Natural gas	6.5
Methanol	Natural gas/ heavy fuel oil	2.5
Remaining chemicals	Natural gas	4.5
Mobility	Diesel/petrol	73
Naphtha (Scope 3)	Light petrol	26
Total		168

Table 2 CO_2 avoidance levers through the conversion to H_2-based technologies in Germany (2050)

All these sectors combined would avoid 168 million tons CO_2 each year in 2050 through the use of climate-neutral or virtually climate-neutral hydrogen.

The results show that the leverage for emission reduction is particularly high in steel production. By replacing coal as an energy source, up to 25 tons of CO_2 can be saved per tonne of hydrogen used. Calculated over a year, this leads to absolute savings of 55 million tonnes of CO_2 emissions in Germany. By replacing natural gas in ammonia and methanol production, 14 and 10 tonnes of CO_2 per tonne of hydrogen can be saved, respectively. The savings in the mobility sector, where the use of diesel or petrol is replaced, are significantly lower and at the same time generate a very high demand for hydrogen. As the amount of diesel and petrol currently used is high, the absolute amount of CO_2 emissions saved in the mobility sector is even higher than in the steel sector, amounting to 73 million tonnes per year. Yet, the electrification route is evidently the cheaper and more efficient path for decarbonizing the mobility sector. For intercontinental aviation and maritime shipping, there are currently no alternatives to e-fuels available for decarbonisation, which is why from a climate perspective it should also be a priority sector for hydrogen distribution.

Sector prioritization according to the German National Hydrogen Strategy 2.0

The National Hydrogen Strategy 2.0 lays a focus for sector prioritization on the industry. As a first step, fossil feedstocks shall by replaced by hydrogen. Process heat in the steel industry and chemical industry is another top priority. These priorities add up to an expected hydrogen demand in 2045 of 290–440 TWh. There are various short-term measures available for the industry sector. Actors can apply for funding under the Important Projects of Common European Interest (IPCEI) funding scheme or the Decarbonisation in Industry (DOI) funding program. Furthermore, the government is working on concepts for the creation of green lead markets in which the demand for climate-friendly products shall be stimulated.

In the traffic sector, so-called e-fuels for maritime shipping, aviation and the military are the focus. The short-term measures available are the sub-quotas for renewable fuels of non-biological origin (RFNBO) in the Renewable Energy Directive (RED) III by the EU. Furthermore, the German government aims to support promising IPCEI projects in the transport sector. Another measure is the implementation of the Hydrogen Innovation and Technology Centre (ITC).

The National Hydrogen Strategy 2.0 views hydrogen as a relevant source of electricity in the future. Therefore, H_2-readiness is a precondition for new investments in gas-fired power plants. For Combined Heat and Power (CHP), the conversion to hydrogen must be possible at low costs. The expected demand for this sector in 2045 is expected to be 80–100 TWh. The available short-term measures include tenders for 4.4 GW of so-called "Hydrogen Sprinter Power Plants" scheduled to take place between 2023 and 2026. Also 4.4 GW of tenders in the period of 2023 to 2028 will be held for so-called "Renewable Energy-Hydrogen Hybrid Power Plants".

Legal information

Publisher:
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH,
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Last updated: December 2023

This factsheet is published as part of the Sino-German Energy Transition Project (EnTrans). EnTrans is a component of the Sino-German Energy Partnership and provides advice to the Chinese government and associated energy policy think tanks.

The GIZ leads the project implementation in cooperation with the German Energy Agency (dena) and Agora Energiewende.

Initiated by
Federal Ministry for Economic Affairs and Climate Action

Implementing organisation
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

In cooperation with
dena German Energy Agency