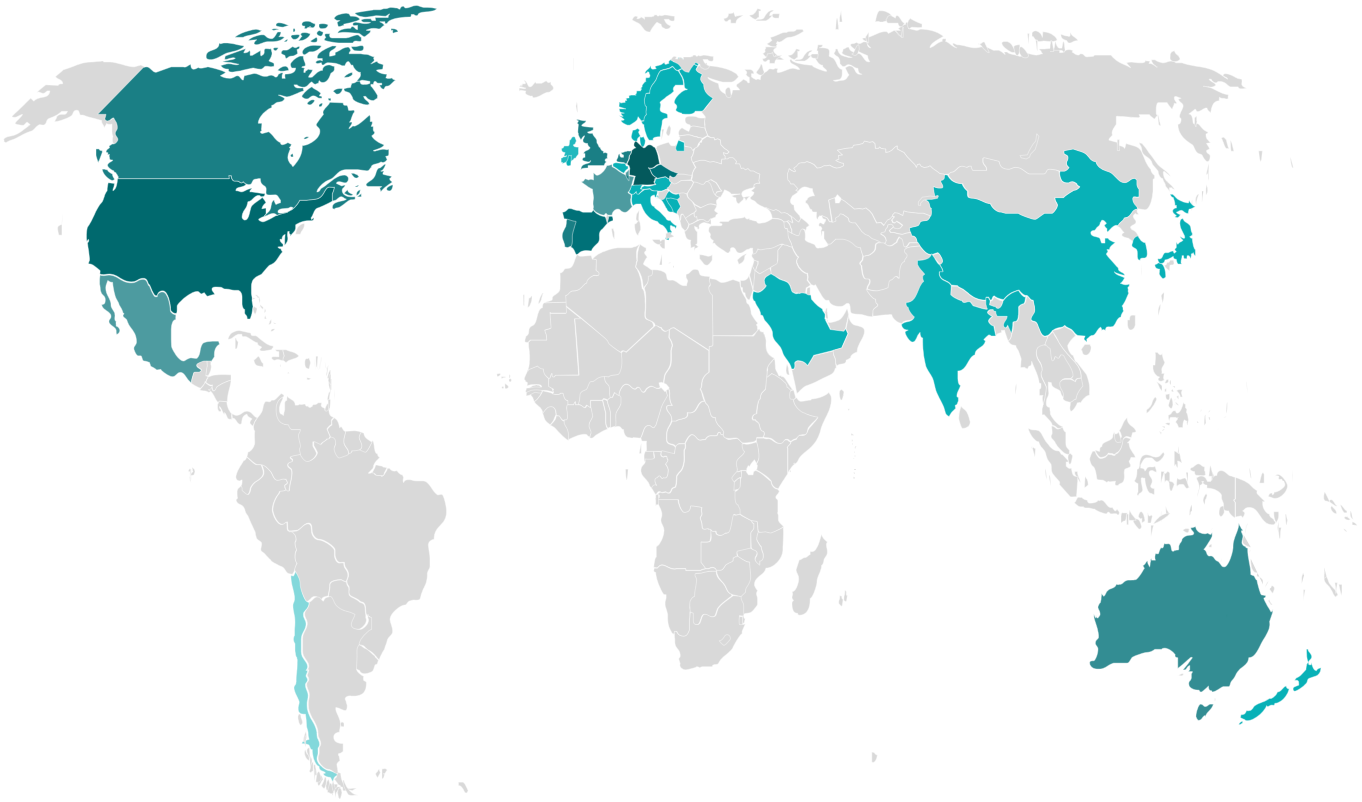
Global Alliance POWERFUELS

Public Funding for Powerfuels Projects

Closing the gap towards economic viability



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Cover Page: Colour shades indicate number of funding programmes per country

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Global overview and evaluation of public funding mechanisms

Direct government support remains essential

For the market ramp-up of powerfuels, i.e. green hydrogen and its derivatives, government support remains essential, as achieving economic viability and positive investment decisions for hydrogen projects globally still depends on public funding. There is a large and increasing number of mechanisms available. This report reviews direct incentive schemes for powerfuels[1], evaluating 116 programmes from 31 countries and the EU.

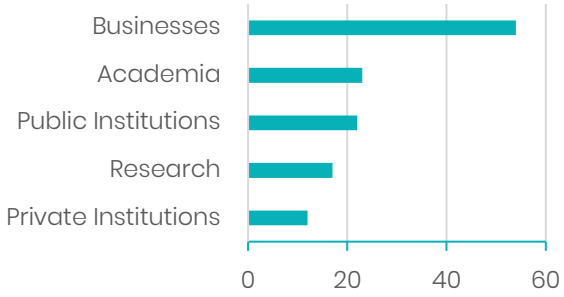

Figure 1: Types of beneficiaries[2]

Overall, the volume of these programmes amounts to a total of 200 B. €, although some funding schemes are broader than powerfuels and may hence allocate some of the available funding to other technologies. Our estimates based on an assessment of the programmes' objectives and historical data result in a total of approximately 24 B. € dedicated to powerfuels specifically. On average, a maximum of 6.6 M. € is awarded to each funded powerfuels project.

More than half of the programmes are directed at businesses or other private institutions. On average, project developers can obtain funding for a maximum of 60% of the capital expenditures (CAPEX) or cost gap[3]. A precondition for achieving economic viability with this level of funding is that costs for the contracted renewable power plants to generate electricity used to produce the renewable hydrogen/powerfuels are included in the calculation of assets/capital expenditures.

Shifting towards CfDs and offtake agreements

The vast majority of the evaluated public support schemes (90%) provide CAPEX funding (see figure 2), which allows for technology development and enables demonstration projects to be set up, but does not guarantee economic viability throughout the operation phase. Usually, CAPEX funding is provided as a grant or loan. Funding for operating expenses (OPEX), on the other hand, is more focused on market deployment and can be disbursed as offtake funding, e.g. by guaranteeing producers a fixed revenue per unit of renewable hydrogen. Germany, Portugal, France and the UK are currently planning to support longer-term offtake agreements with contracts for difference (CfD)-like funding mechanisms[4]. More public funding programmes like these will be needed to take the next step in the ramp-up of a global powerfuels economy: in order to create stable trade flows, provide investment security for further medium-and large-scale projects, and enable infrastructure development.

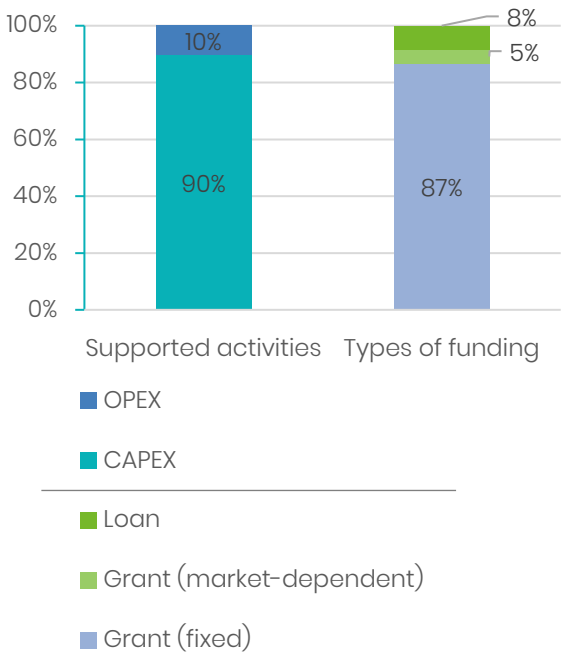

Figure 2: Types of funding and covered expenses[5]

[1] R&D activities as well as implementation of powerfuels projects. Programmes focusing only on CCU/S are not included.
[2] Public data on the types of beneficiaries was available for 71 of the evaluated programmes.
[3] If the funding amount is given relative to the project volume, the standard deviation around the mean is 20%.
[4] An example is the German H2Global programme, which is designed to bring supply and demand together through a double-auction mechanism (long-term purchase contracts on the supply side and short-term resale contracts on the demand side).
[5] Public data on types of funding and covered expenses was available for 62 of the evaluated programmes.

Europe leads in the number of funding measures

There is a large and increasing number of funding schemes available to powerfuels project developers worldwide. Close to 75% of all funding measures are based in Europe, with Germany having the highest number of powerfuels-related funding measures (see map on cover page). However, many of those funds have a scope much broader than powerfuels, and therefore a smaller impact than the overall volume suggests. E.g., *Horizon 2020*, the EU's past extensive research and innovation framework programme, which made €80 billion of funding available over 7 years (2014 to 2020), awarded only 0.82% of its total funding volume to powerfuels projects. In the USA and Canada, more than half of the programmes available for powerfuels projects focus exclusively on applications in mobility. Australia already focuses on market deployment through funding schemes addressing a broad range of value chain steps. This includes funds focusing on renewable hydrogen production, creation of hydrogen hubs, and industry applications including CCU/S projects that add up to a total volume of more than €1.1 billion. In South America, only Chile actively supports hydrogen through the *Green hydrogen funding round* with 50 M. USD. Except for support schemes in Japan and South Korea, we did not record any active programmes in Asian countries. Even though China invests heavily in powerfuels[6], funding structures are not publicly available. The largest programme outside of Europe is the Japanese *Green Innovation Fund* with a total volume of 15 B. €.

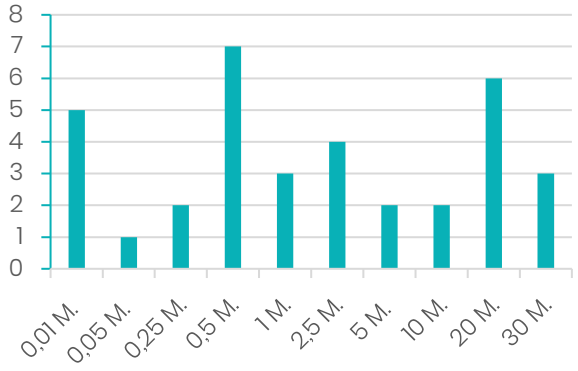

Figure 3: Number of programmes with a given maximum amount of funding per project [in Mio €][7]

From R&D and piloting towards supporting market implementation of powerfuels

Funding per project remains relatively small

Across the reviewed programmes, the absolute maximum amount of funding per project varies greatly. Funding for R&D and pilot projects usually ranges around 500,000 €, while significantly higher amounts of 20 M. € or more are often provided for the market deployment of larger-scale projects (see figure 3). Public funding for projects at an intermediate demonstration size thus appears to be scarce. More funding will also need to be provided for industrial-scale powerfuels production plants in the future, which will generally require significantly more public funding than €30 M. to achieve economic viability of their operation over a period of 10 years or longer. For example, a hypothetical programme covering a cost gap of 3€/kg of produced green hydrogen of a 100MW plant over a period of 10 years would need to provide funding of 27 M. €/year, or 270 M. € in total, for that project[8].

Several programmes are not limited to providing funding for a single value chain step, thus the total number of programmes when "stacking" the bars in figure 4 is greater than 116. Funding made available through the programmes is relatively evenly distributed over production, infrastructure, and application.

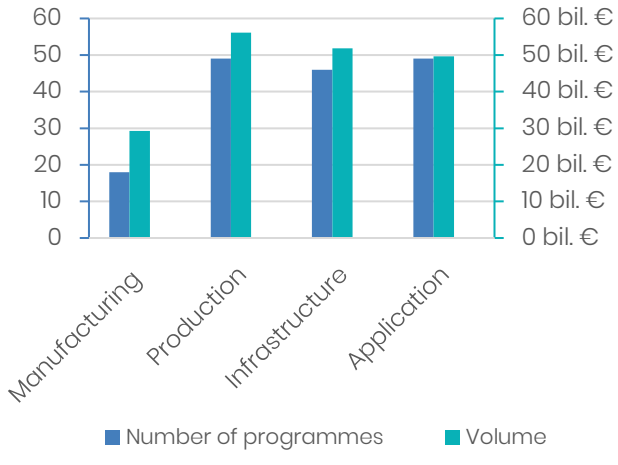

Figure 4: Number of programmes and total approximate volume per value chain step[9]

[6] https://www.bloomberg.com/news/articles/2021-12-12/china-s-solar-giants-make-a-bid-to-dominate-hydrogen-power

[7] Public data on the maximum amount of funding per project was available for 33 of the evaluated programmes.

[8] Assuming 4,000 full-load hours and electrolyser efficiency of 70%, resulting in a hydrogen production of ~0.3 TWh or 9,000 t per year.

[9] Public data was available for 72 of the evaluated programmes.

Market deployment is gaining momentum

Consistent with the focus on CAPEX funding outlined above, many programmes target R&D, piloting and demonstration. However, the volume of funding programmes addressing the investment needs for double-digit MW nameplate capacity powerfuels projects is already significant, and growing. Many smaller-sized programmes provide funding for R&D, while programmes for advancing more mature projects and market deployment are larger in size (see figure 5).

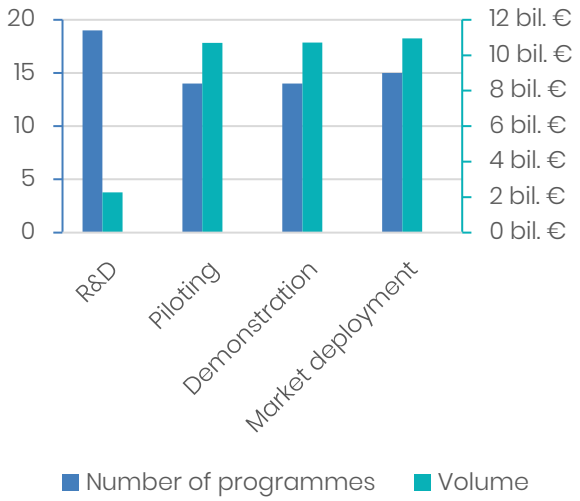

Figure 5: Number of programmes and total approximate volume per lifecycle stage [10]

[10] Public data was available for 40 of the evaluated programmes.

Recommendations to Improve Programme Quality and Effectiveness

Broadening the technology scope
In early stages of the market development, funding programmes exclusively designed for supporting the development of a specific energy carrier tend to aim at R&D and piloting projects. Out of the reviewed programmes, 91% provide funding for hydrogen, 33% for SNG and 40% for derived fuels (e.g. synthetic kerosene). In the case of 27% of the measures, all powerfuels are eligible. Future programmes should also target the integration of powerfuels production and their application in different sectors, e.g. by matching producers and potential offtakers, instead of only addressing single steps of the value chain.

Establishing international supply chains
In many countries around the world, including most Member States of the European Union, total demand for renewable hydrogen and other powerfuels will in all probability not be met by domestic production alone, making imports necessary. To establish global supply chains, funding programmes have to be more inclusive to foreign projects. Explicitly, only four of the reviewed 116 programmes allow funding for companies from another country. However, they might be eligible in more cases, as an explicit exclusion of foreign companies could only be identified in the specifications of 30 programmes. Only a few governments/ funding bodies have so far established programmes that are specifically aiming to build up projects in potential export countries.

Diversification across time
To encourage competition and professionalization of project initiatives as well as learning curves of the public authorities running or implementing the schemes, future programmes should be encouraged to run several times. More than half of the programmes for which runtime data was collected only had a single call for proposals. Larger programmes tend to run longer, typically 5 to 10 years.

Members of the Global Alliance Powerfuels have access to the full database. If you would like to add to the database or inquire about our membership options, please reach out to powerfuels@dena.de

About the Global Alliance Powerfuels

The Global Alliance Powerfuels was founded in 2018 and is backed by 16 member organisations and an international network of partner institutions. It is coordinated by the German Energy Agency (dena). All members and partners are united by the common goal of advancing the development of sustainable markets for powerfuels. Further details about the Alliance and its activities can be found at **www.powerfuels.org**