



AeH₂
ASOCIACIÓN ESPAÑOLA
DEL HIDRÓGENO

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PROJECT CENSUS REPORT

Presentation: Chairman's letter

In the **energy transition** process and the path towards **climate neutrality** in which we find ourselves, the diverse range of hydrogen applications makes this technology a key element in **decarbonizing** emission-intensive economic sectors, including as electricity generation, transportation, industry, and the residential sector. Investments in this energy vector are crucial to consolidate a secure energy supply and guarantee industrial competitiveness in a scenario of intense decarbonization. In the current geopolitical context, achieving a certain degree of energy sovereignty and diversifying energy sources, while reducing dependence on politically unstable regions, becomes necessary. This is even more significant considering the increasing cost of fossil fuels, which make the use of hydrogen increasingly attractive.

In this context, **Spain** holds a privileged position in utilizing hydrogen as an energy vector, thanks to its **significant potential for renewable hydrogen generation** and the exceptionally high expectations for growth in the Spanish sector.

The Spanish Hydrogen Association (AeH2) has been working since 2002 to promote and develop the hydrogen sector and the associated industrial fabric throughout Spain. The Association currently has around 400 members representing various stakeholders across the hydrogen value chain.

In order to analyze the level of implementation of this energy vector, the focus has been placed on the hydrogen projects being developed in Spain. For this reason, AeH2, with the support of its institutional partners, is creating **an interactive map** that showcases these projects. The information is provided through the Project Census, allowing members, experts, and interested parties to access and consult it.



Within this framework, **this report has been compiled** to analyze the first data provided in the Census. It provides an overview of the current situation of hydrogen projects in Spain, thereby providing valuable insights into identifying opportunities and challenges within the sector.

The first phase of this Project Census focuses on the compilation of **Demonstration Projects (TRL 7 or higher)**. This will contribute to achieving the short to medium-term targets for green hydrogen deployment outlined in the Spanish Hydrogen Roadmap.

I would like to express my gratitude to the AeH2's partners for their support, as their contribution has made this first analysis of hydrogen projects in Spain possible. Collaboration and information exchange are essential for the development of any industry, and in the case of hydrogen, having data executed, ongoing, and short-term planned projects is crucial for devising strategies that align with the set objectives.

Executive summary

Spain's potential in the field of green or low-carbon hydrogen is attributed to three key advantages. Firstly, its privileged geographical position enables the production of renewable hydrogen in large quantities. This not only fulfills domestic needs but also allows for the export of renewable hydrogen to northern Europe. Secondly, Spain possesses a significant technological and scientific base. Lastly, the country benefits from a robust industrial sector, encompassing entities that cover every aspect of the hydrogen value chain.

The Spanish Hydrogen Roadmap¹ sets forth ambitious goals, envisioning the installation of at least 4 GW of electrolyzers in Spain by 2030, and between 300 and 600 MW by 2024. Extracting insights from the Project Census, the following observations can be made:

- The production of renewable hydrogen is experiencing a progressive increase compared to previous years. 56% of the projects registered involve the use of renewable energy sources by direct connection.
- Economy of scale is important to obtain hydrogen at a reasonable cost, favouring projects that secure largely or bring together several end-users to secure demand: Hydrogen valleys and integrated projects account for 34% of the total number of registered projects.
- The projects registered forecast a very ambitious appetite for hydrogen production which, with the right incentives and public support, could reach almost 8 GW by 2024 and 11 GW from 2026 onwards.
- Industry will start replacing grey hydrogen with renewable hydrogen, especially in oil refining and petrochemicals.
- Renewable hydrogen will start to be used for the production of synthetic fuels.
- There are significant deviations between mobility projects and hydrogen reporting stations (HRS) compared to the 2020 Hydrogen Roadmap targets.
- 56% of mobility projects are aimed at road transport.
- Both storage and residential use have not yet been established, with few such projects.
- The Census investments double the investments foreseen by the Spanish Roadmap with more than €21 billion.
- IDAE has been the national body that has financed the most projects with 53% of the funds reported in the projects, while European funding has contributed almost 20%. There is an important part of public funding coming from different regional bodies.

¹ Ministry for Ecological Transition and the Demographic Challenge (MITECO), 2020, "[Roadmap for Hydrogen in Spain](#)".

Analysis

Phase I of the AeH2's Project Census has successfully collected data on 123 projects, covering the entire hydrogen value chain². This data has been provided by 46 entities that are members of the AeH2. By analyzing this data, it has become possible to compare the current situation with the objectives set out in the Spanish Hydrogen Roadmap, which was published in 2020.



Figure 1. Map of projects registered in the Project Census classified by activity.



² Integrated: projects that focus on hydrogen production and one use.

Valley: projects focusing on hydrogen production and more than one use.

The study of each section of this roadmap has been conducted based on the project data collected by AeH2 through its consultation process.

The Hydrogen Roadmap for Spain outlines the country's objectives for 2030, focusing not only on renewable hydrogen production but also on various sectors of activity. The demand for renewable hydrogen has been identified as having the greatest potential, particularly in industry and mobility.



Figure 2. Targets for 2030 published in the Spanish Hydrogen Roadmap.

Hydrogen production

The Roadmap envisions the installation of at least 4 GW of electrolyzer capacity in Spain by 2030, with an intermediate estimate ranging between 300 and 600 MW by 2024.

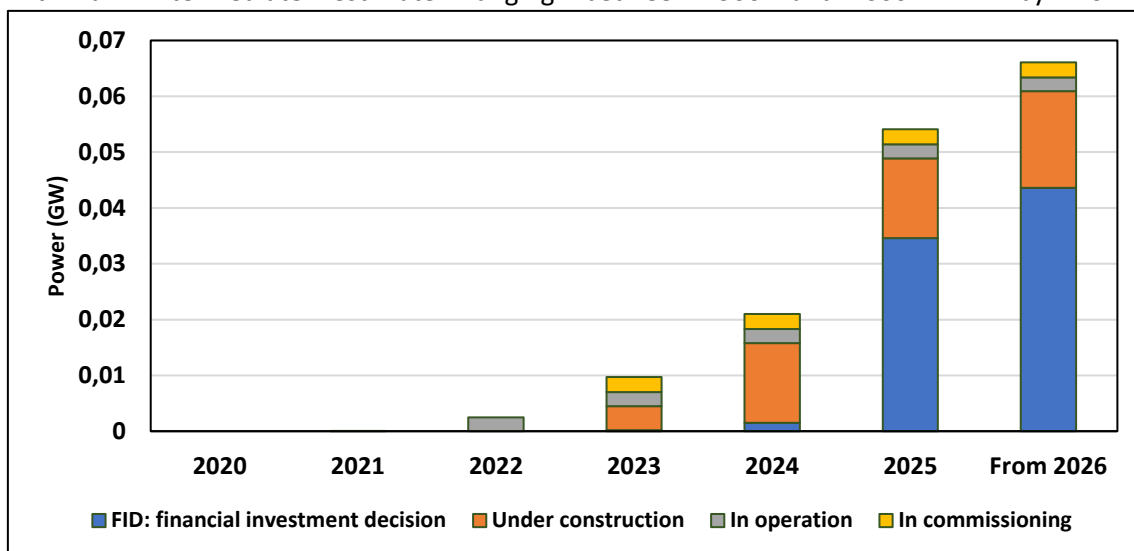


Figure 3. Cumulative power of Census projects with FID or more advanced

The projects reported in the Census show a modest deployment of installed hydrogen production capacity.

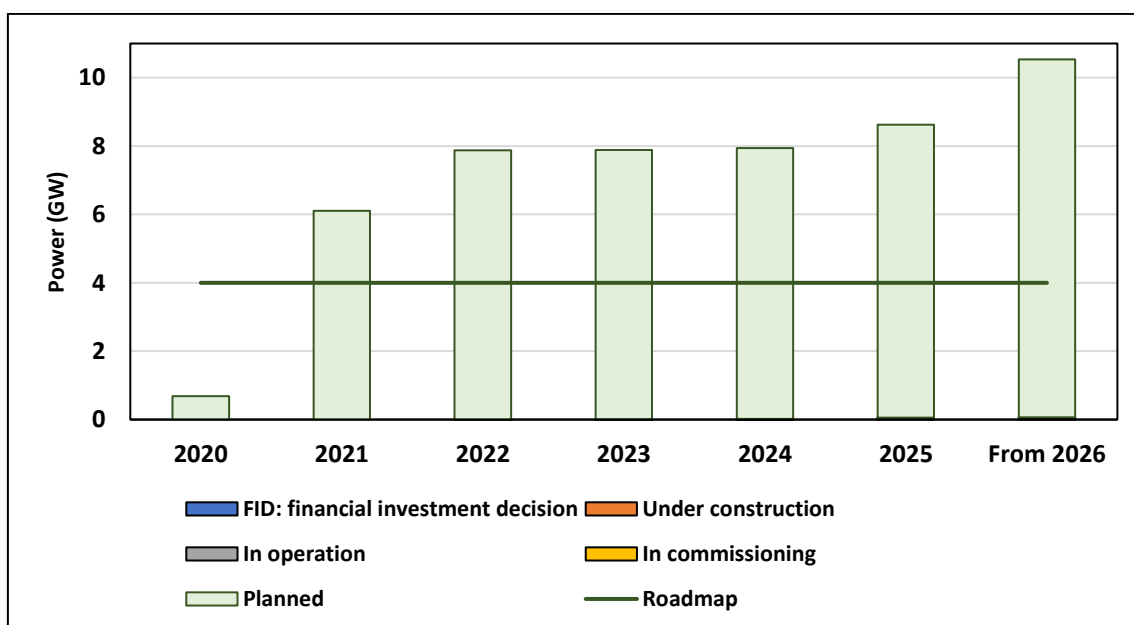


Figure 4. Cumulative power of Census projects according to their implementation status.

The reported **planned project** portfolio in the Census presents a more optimistic outlook. The projected installed capacity **in 2024** would amount to approximately **8 GW**, and **starting from 2026**, it would reach **nearly 11 GW**. If all these projects are successfully implemented, Spain could surpass the targets outlined in the roadmap for installed hydrogen production capacity.

However, the realization of this ambitious deployment plan relies heavily on the continuation and expansion of public funding and support programs at both the national and European levels.

The European hydrogen strategy³ calls for the replacement of hydrogen currently consumed in industries with green hydrogen. Initiatives to replace hydrogen production from non-renewable sources with hydrogen from renewable sources have already been launched by companies in Spain.

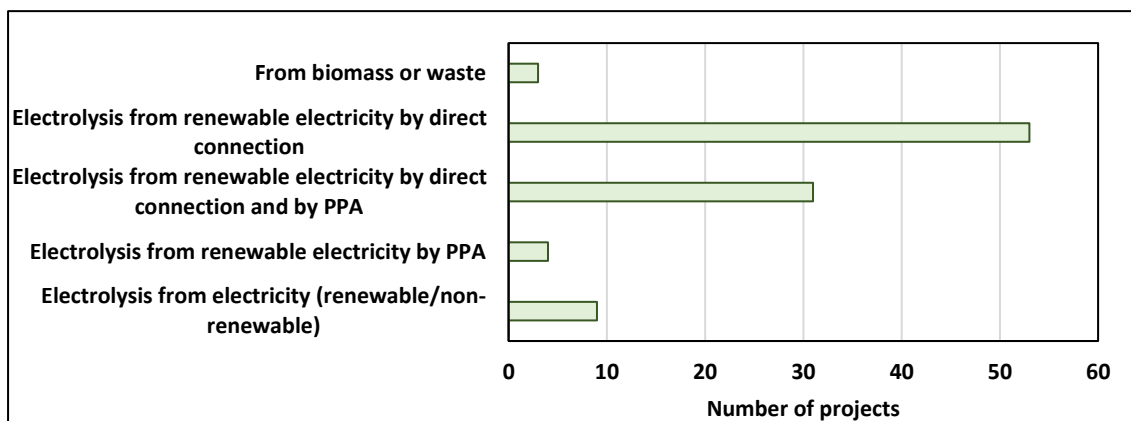


Figure 5. Sources of energy for hydrogen production

- 56% of hydrogen production projects involve the use of renewable energy sources by direct connection.
- Up to 91% of the projects expect to use clean energy, although some involve the use of Power Purchase Agreements (PPAs).
- Only 9% of the projects consider the use of non-renewable energy sources. It should be noted that these projects do not count towards the targets of the Renewables Directive or the Rodmap.

The water electrolysis technology used in a project varies depending on the installed power and the investment considered.:

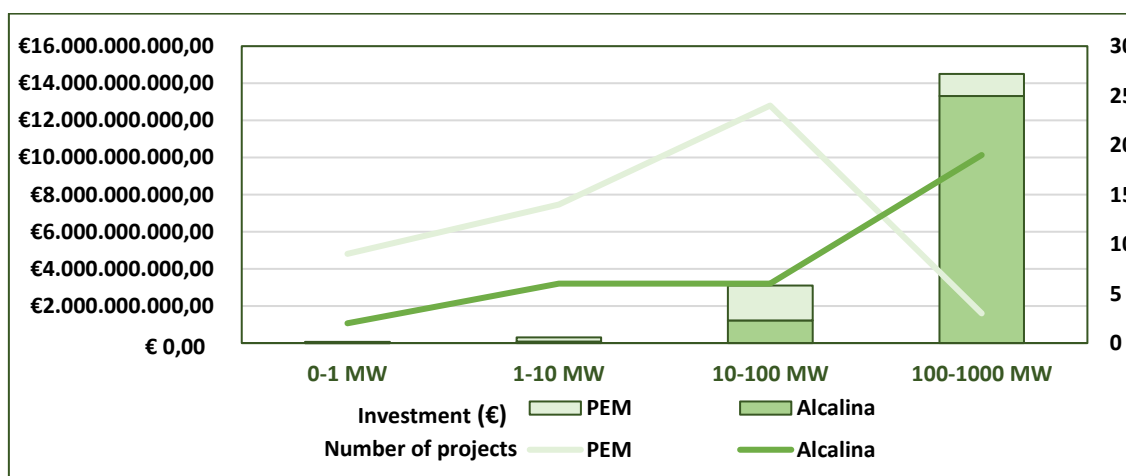


Figure 6. Investment and projects for each electrolyser technology.

³ A European Strategy for Hydrogen, European Parliament.
https://www.europarl.europa.eu/doceo/document/TA-9-2021-0241_EN.pdf

- Projects with high installed electrolyser power tend to use alkaline electrolysers, the predominant technology for power over 100MW and an investment in more than €13 billion projects.
- In small and medium-sized projects, PEM electrolyser technology predominates, with a total of 50 projects and an investment of up to €2 billion.
- AEM and SOEC electrolysers are only used in some low-power projects and their representation in the Census is low.



Industry

According to the Hydrogen, Spain consumes around 500,000 tonnes of hydrogen per year, primarily sourced from the reforming of natural gas or other hydrocarbons. However, the Census reveals that the industry has started planning the process of replacing this grey hydrogen with renewable hydrogen.

Of the 17 projects focused on the use of hydrogen in the industry, 67% are dedicated to the oil refining and petrochemical sectors, while 15% are aimed at ammonia production. The remaining projects focus on the food, glass, and ceramics industries. Notably, there is a particular application of hydrogen in the hydrocarbon sector to produce synthetic fuels.

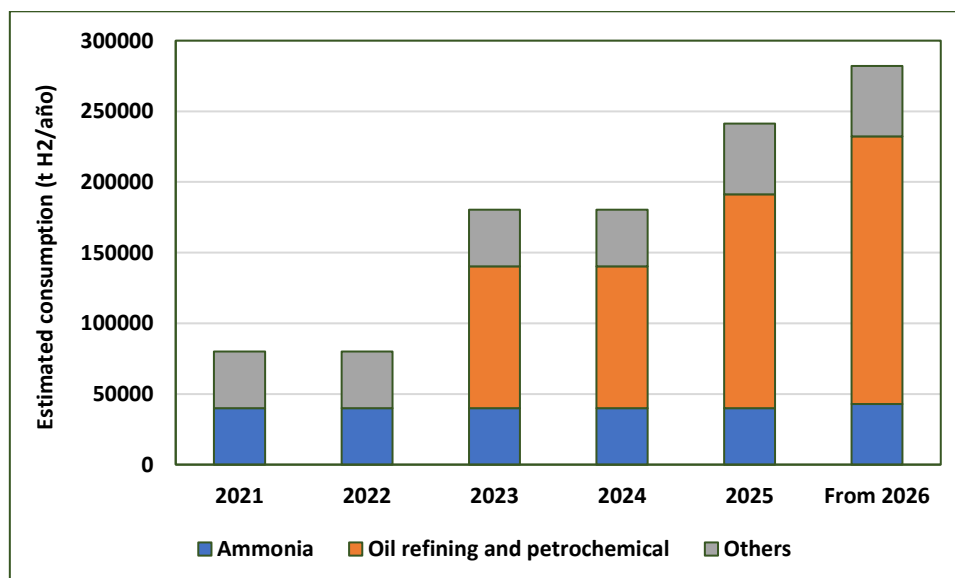


Figure 7. Estimated hydrogen consumption in the industry.

The total number of registered projects will result in annual consumption of close to 300,000 tonnes of renewable hydrogen starting in 2026. This amount accounts for approximately 60% of the current consumption of grey hydrogen, surpassing the objectives outlined in the Hydrogen Roadmap for Spain and approaching the European target of 50% set in the 'Fit for 55' plan⁴.

⁴ Fit for 55, European Council, <https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/>



Transport

➤ Hydrogen Refuelling Stations (HRS)

Hydrogen Refuelling Stations (HRS) are a key element in the implementation of the use of hydrogen as a fuel in the mobility sector. In 2020, Spain had 4 HRSs. According to the targets set out in the Hydrogen Roadmap, it is estimated that by **2030** there should be **between 100 and 150 publicly accessible HRS** in Spain.

A total of 34 planned HRS are included in the Project Census:

- 21 are for public access:
 - 95% will dispense hydrogen at 700 bar, intended for light-duty vehicles.
 - 71% Will dispense Hydrogen at 350 bar, intended for light-duty vehicles.
- 13 are for private access:
 - 55% for buses.
 - 15% are earmarked for rail transport.
 - The remaining stations are intended for trucks and/or special vehicles, such as forklifts and tractors.



Figure 8. Census public access planned HRS map.

According to the AFIR (Alternative Fuel Infrastructure Regulation), hydrogen refuelling stations (HRS) infrastructure will be required on the trans-European transport network starting from 2030. This infrastructure must be capable of supplying both cars and trucks at all urban nodes and every 200 km along the core network. As a result, the installation of 78 HRS in Spain will be necessary.⁵

⁵ European Green Deal: ambitious new law agreed to deploy sufficient alternative fuels infrastructure. https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1867



Figure 9. Map of the Atlantic corridor in Spain (TEN-T)



Figure 10. Map of the Mediterranean corridor in Spain (TEN-T)

While the HRS reflected in the Census is a step towards the target set out in the Hydrogen Roadmap, it is not sufficient for full compliance, nor does it meet the requirements of the AFIR and mobility targets.

➤ **Uses in mobility**

Closely linked to the HRS, there are several mobility projects listed:

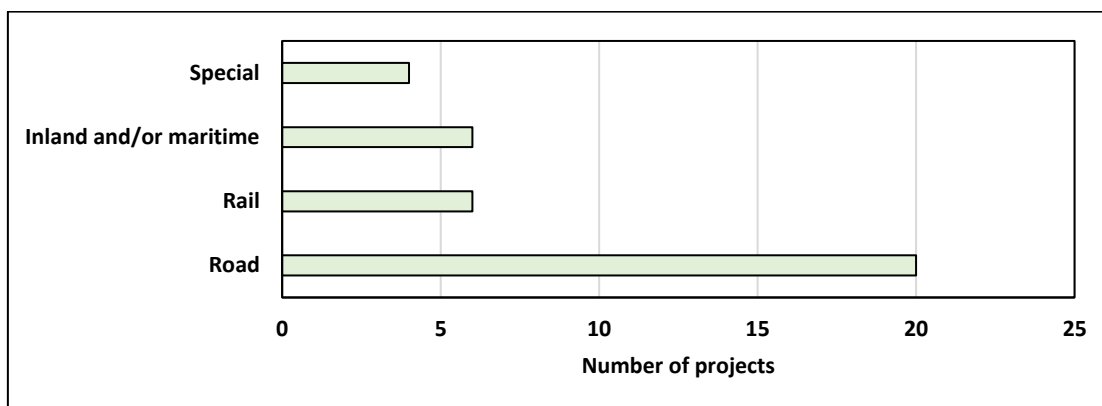


Figure 11. Means of transport used in each project.

- 20 road mobility projects involving vehicles of various types have been registered. Data from these projects show that the Roadmap targets for vehicle deployment are far from being met, and measures should be taken to encourage the deployment of infrastructure and vehicles.
- There are six rail transport projects involving both local and long-distance passenger trains as well as goods trains. These projects would comfortably meet the Roadmap's objective for rail transport.
- The Roadmap does not define concrete targets in maritime transport, but with five projects in the Project Census, the sector seems to be ahead of the Roadmap.
- The special transport category encompasses material handling machinery projects, with four projects reported in the Census.



Others

Although targets for mass (or seasonal) hydrogen storage are included in the Roadmap, hydrogen storage has not yet commenced as reported in the Census. Only one storage project with low capacity for the short term has been reported.

Residential hydrogen use was also identified in the Roadmap as an application. The Census records only six projects with an installed capacity of approximately 4 MW. Only one project focuses primarily on this use.



Investment

The Roadmap foresees that, in order to achieve its objectives, it will be necessary to mobilize an estimated investment of **8,900 million euros** during the **period 2020-2030**. These estimated investments have been compared with the data obtained from the 123 projects that have participated in the Census, which foresee a total investment of close to 21 billion euros. It should be noted that, due to the confidential nature of some of the Census projects, their expected investment has not been reflected in this total, and therefore the actual investment amount would be even higher.

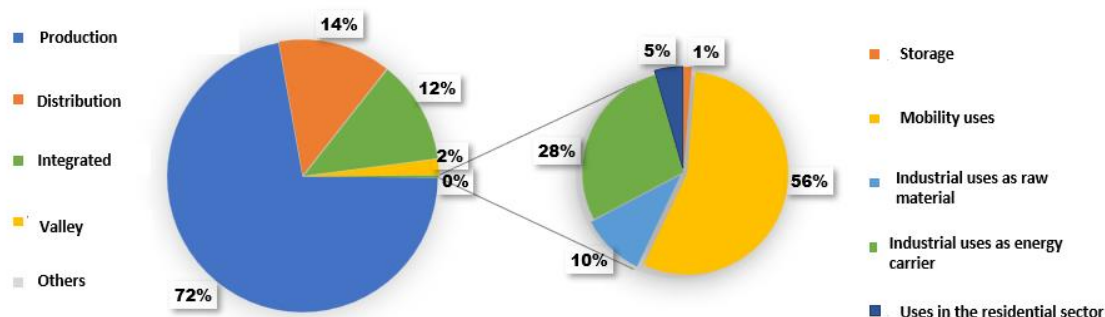


Figure 12. Total investment in each activity covered by the Census.

- 72% of the investment reflected in the Census corresponds to projects whose main activity is hydrogen production.
- Hydrogen distribution accounts for about 14% of the registered investments.⁶
- Projects with one or more uses, such as valleys and integrated, account for 14% of investments.
- Investments in other activities exclusive to storage and other uses are still incipient and do not make up a significant part of total investments. Investment in mobility stands out from the rest.
- It is worth noting the low percentage of investment in end uses. This highlights the importance of specific support programmes to facilitate the generation of hydrogen demand.

⁶ It should be noted that most of this investment is in a single project census.



Public Funding

Public funding is an important part of achieving the development of hydrogen as an energy carrier. Alongside private investment, estimated at €20 billion, it will significantly boost the growth of renewable hydrogen projects.

The projects in the Census show the distribution of public aid received, particularly from entities such as CDTI (*Centro para el Desarrollo Tecnológico y la Innovación*), IDAE (*Instituto para la Diversificación y el Ahorro de la Energía*), and the Clean Hydrogen Partnership.

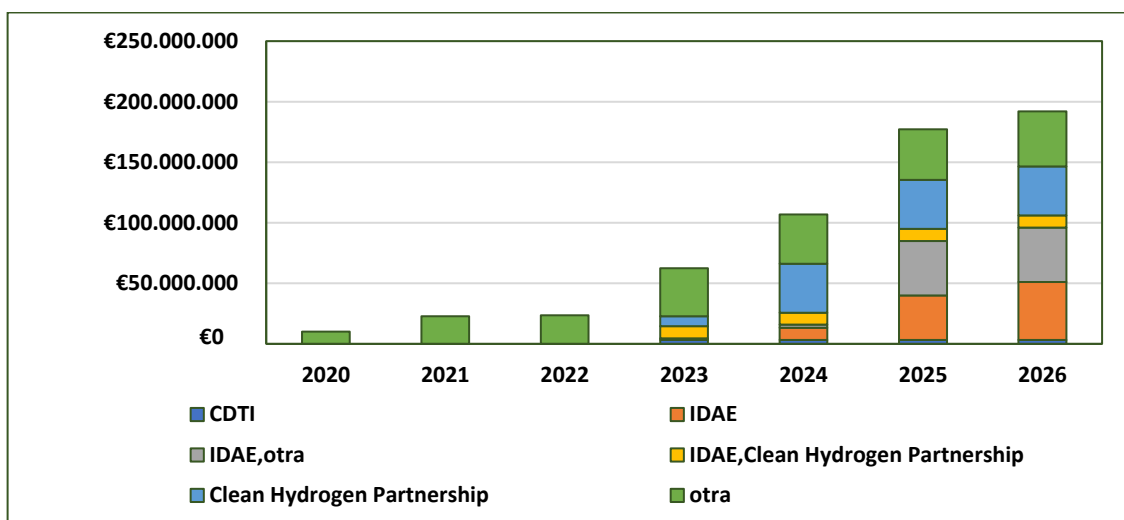


Figure 13. Cumulative public funding per year and per entity.

- CDTI's contribution, which is more focused on projects with technologies at a lower level of technological development, is close to 2%.
- IDAE is the body expected to provide most of the funding for hydrogen projects, with 53%, although a good part of this percentage is in coordination with other public funding programmes.
- Funding from programmes managed directly from the European Commission plays an important role in the deployment of these hydrogen projects with approximately 20%.
- Other grants such as those from IPCEI or regional programmes (Andalusian Energy Agency, Generalitat Catalunya, Haztek, etc.) contribute almost 25% of the total public funding.

The funding of some projects is not reflected due to the confidentiality of their budgets. However, the estimated public funding of the projects included in the Census is close to 200 million euros.



Methodology

The methodology used by AeH2 for the elaboration of the Project Census consisted of the following stages:

1. Creation of a form designed to collect comprehensive information from the entire hydrogen value chain while being user-friendly for partners. This form was made available to AeH2 partners from November 11, 2022, until February 2, 2023.
2. Dissemination of the form through various communication channels of the Association to maximize partner participation.
3. Collection and detailed follow-up of the information provided for each project.
4. Verification and validation of the gathered information through consultations and meetings with the entities responsible for each project.
5. Inclusion of verified projects in a database and confidential treatment of each project individually.
6. Preparation of a report with the data obtained from the projects included in the Project Census.

This methodology has provided AeH2 and its partners with a valuable and comprehensive tool for consulting and monitoring hydrogen projects in Spain. It also facilitates the identification of collaboration and financing opportunities in the sector. The result is a report that consolidates all this information.

Initially conceived as a comparison between the objectives outlined in the Hydrogen Roadmap in Spain and their short- to medium-term implementation, this first report corresponds to Phase I of the Project Census. A total of 123 projects across different segments of the hydrogen value chain were included in the report after the completion of the data collection period.

By completing various graphs and conducting data analysis, precise and detailed conclusions have been drawn regarding the current status and progress of many hydrogen projects in Spain. Consequently, a comprehensive report has been produced, which encapsulates all the information gathered during Phase I of the Project Census."

These changes maintain the original meaning while enhancing clarity and flow.

Annex I. Contributions made by the different entities to compile the information for the Project Census.

The Project Census, which started its consultation on 21 November 2022 and ended on 2 February 2023, aimed to publish a report compiling the main projects of all AeH2 institutional partners involved in the hydrogen value chain, as well as publishing an interactive map on the web.

The 46 entities that have sent the hydrogen projects that are being developed in different parts of the country are listed below. We would like to thank them very much for their contribution by providing information, as without them it would have been impossible to carry out this project:

