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LABOR CONTEXT GREEN HYDROGEN 2023 WRE

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- Eleanor Roosevelt

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Content

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01 INTRODUCTION

Green Hydrogen on the Rise: Exploring its Impact on Employment and the Demand for Specialized Profiles

The hydrogen business is becoming more sensible and promising.

After years of excessive expectations, the green hydrogen sector is finally taking shape and showing signs of maturity. Last year, we have witnessed significant advancements in this area. Perhaps one of the most notable milestones has been the establishment of the European Hydrogen Bank by the European Union, marking a clear commitment to investing in hydrogen production. The bank will undertake tasks such as developing price benchmarks and identifying potential buyers through expressions of interest, among other duties.

One of the first tangible achievements of this bank has been the approval of the first hydrogen auction, to be held on November 23, and will begin to distribute some 800 million euros. Hydrogen is moving from the design table to financial models and project timelines.

But it's not just the European Hydrogen Bank that represents a definitive bet on this technology by public community institutions and a boost intended to clear doubts about the future of this technology. Recently, the European Commission also presented two delegated acts that define more or less precisely what green hydrogen is for the EU and establish rules for its use within the European Union. These measures, along with announcements of incentives from other countries such as the United States, China, the United Kingdom, Germany, or Canada, are expected to boost more than 1,000 global hydrogen projects and, in parallel, accelerate the growth of the market and generate significant investments in the sector. This scenario not only promises a positive impact on the transition to a low-carbon economy but also on the labor market.

The growing interest and demand for green hydrogen are bringing new employment opportunities and an increasing need for specialized profiles. As the hydrogen sector expands into areas such as production, distribution, storage, and applications, the search for talent with specific knowledge will become a priority. The first projects are becoming a reality, and there will be an increasing demand for profiles focused on the construction, operation, and maintenance of H2 generation, storage, and transport plants. The energy transformation aims not only for sustainability but also represents an opportunity and drives the creation of jobs and the training of a highly qualified workforce.

Amid a changing landscape, the study we approach for the second consecutive year from Worldwide Recruitment Energy on the green hydrogen sector and its impact on employment and the demand for specialized profiles plays a fundamental role. It provides a deep insight into the intersection of technological innovation, government regulations, and emerging labor needs. For investors, legislators, and professionals interested in this rapidly growing field, this study offers an essential guide to navigating the opportunities and challenges presented by the green hydrogen revolution.

02 METHODOLOGY

Due to the still relative scarcity of professionals and profiles trained in the field of hydrogen and low-carbon hydrogen, a multidisciplinary survey and analysis approach has been adopted. Initially, in 2022, a search was conducted on social networks and databases (LinkedIn, Twitter, Associations, candidate databases, etc.) for profiles that offer some experience or training in this sector. Subsequently, in the second edition of 2023, the number of potential respondents increased fourfold within a year.

In this search, we admitted as potential respondents those who claim to have work experience or academic training in the hydrogen sector in general or in green hydrogen in particular. This category includes graduates but also professionals with intermediate diplomas, vocational training, or simple workers with experience.

While in 2022 a total of 1,089 profiles were identified to whom a questionnaire consisting of 14 questions was sent, in 2023 we quadrupled the sending of these questions to **4,150.** Initially, **406** complete responses were obtained, equivalent to 10% of the total interviewed. Based on various sectoral[1] sources, we consider this cohort of respondents in the external survey sufficient to obtain relevant results. We estimate a margin of error of +-5% in the responses. There is also a percentage of around 5% of "Don't know, don't answer" responses or those who simply did not respond.

In selecting the profiles, we opted to search within the countries where a larger number of hydrogen projects have been identified: the European Union, the United States, Latin America, and the Middle East, along with others such as China, Japan, or India. The reason for choosing these countries is that the vast majority of the detected profiles come from these countries.

In total, people from 41 countries were surveyed, although the majority of the responses came from Spain 33%, Chile 9.9%, Brazil 6.4%, Italy 5.2%, Mexico 5.7%, France 3.4%, and the United Kingdom 2.2%. However, responses also came from countries outside this sphere. We have respondents from South Africa, Kenya, Ukraine, India, China, Australia, and Thailand, to name a few examples.

For Spanish-speaking countries, the questionnaire was sent in Spanish. In the rest of the countries where Spanish is not the main language, the questionnaire was sent in English.

Regarding the methodology of the questionnaire, a mixed approach was chosen. This method of research and survey alternating qualitative and quantitative questions is known as a "mixed approach" or "mixed research" with the goal of providing a more complete and deeper understanding of the phenomenon studied. Mixed research allows collecting quantitative data to measure variables numerically and also qualitative data to explore perspectives, experiences, and underlying contexts.[2] By combining both types of data, researchers can obtain a more holistic and rich view of the research problem. This approach is used in a variety of fields, such as social sciences, psychology, education, and health, among others.

1 Source: [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2384218/#:~:text=Response%20rates%20approximating%2060%25%20for,of%20≥%2080%25%20is%20expected.]
2 Source: [https://economipedia.com/definiciones/investigacion-mixta.html]

03

CURRENT H2 MARKET CONTEXT

3.1

HYDROGEN SECTOR INCENTIVES AND REGULATORY FRAMEWORK: UPDATES IN 2022-23

Over the past year, there have been notable advances in the regulatory environment and the provision of aid aimed at the development of the green hydrogen sector. This form of energy has emerged as a crucial element in the global decarbonization strategy, especially in sectors where reducing emissions is complex and viable alternatives are limited. In particular, heavy industry and long-distance transport have been identified as areas where hydrogen and its derived fuels play an essential role in achieving sustainability goals.

The International Energy Agency (IEA) has stated that hydrogen and its derivatives can significantly contribute to decarbonization, especially in sectors where emission reduction is particularly challenging. These sectors include heavy industry and long-distance transport, where alternative solutions are limited. The IEA has also highlighted the importance of investing in the development and implementation of hydrogen technologies to achieve a cleaner transition in these areas.

Key advancements by countries include:

1. CHINA:[3]

The country added about 220 MW of electrolyzer capacity in 2022, with plans for an additional 750 MW under construction in 2023.
The country added about 220 MW of electrolyzer capacity in 2022, with plans for an additional 750 MW under construction in 2023.
China's National Hydrogen Development Plan marks a significant stage for the rapid expansion of the hydrogen industry in the country.

The plan sets two concrete goals for 2025: reaching 50,000 hydrogen fuel cell vehicles and a renewable hydrogen production capacity of between 100,000 and 200,000 tonnes per year. The focus is on green hydrogen production and its application in mobility. It establishes a strategy based on hydrogen production from industrial byproducts and renewable hydrogen. The plan seeks a balanced development of the hydrogen industry in China, avoiding excessive investments and safety risks. Although the national targets are conservative, local investment and demand are expected to continue driving the development of green hydrogen in the country.

3 https://www.iea.org/policies/16977-hydrogen-industry-development-plan-2021-2035

2. EUROPEAN UNION (EU):

Recent Measures: The EU has implemented various actions to promote the development of green hydrogen, including:

1. Definition and Regulations:

- Definition of renewable hydrogen and the establishment of key regulations.
- Delegated acts providing clear rules for definition, infrastructure investments, and state aid norms.

2. IPCEI Hy2Use Project:

- Supported to boost research, innovation, and infrastructure building across the hydrogen value chain.
- Participation of 29 companies in 35 projects to develop technologies in challenging industrial sectors.

3. EUROPEAN HYDROGEN BANK AUCTIONS (PLANNED FOR NOVEMBER 2023):

Characteristics of the auction include:

- An increase in the offer ceiling to €4.5/kg. Priority for large, cost-effective projects with a lower fixed grant premium.
- Required guarantee of 4% of the maximum grant amount. "Pay-as-bid" auction structure ranked by price.
- Budget limit of €800 million.
- Grant limit per project of €266.7 million. Exclusion of small projects (less than 5MW of electrolysis capacity).
- Semi-annual payments only for projects that produce verified green hydrogen according to the EU's strict definition of non-biological origin renewable fuels (RFNBO).

4. GERMANY'S H2 GLOBAL:[4]

Germany's H2 Global project aims to acquire green hydrogen from outside the EU. The project offers 10-year purchase agreements, followed by competitive auctions. Auctions of €900 million have already been conducted to acquire imported green hydrogen. Last year, it was announced that it would expand to EU member countries and receive an additional €1 billion. It is also planned to merge this initiative into the EU's €3 billion Hydrogen Bank. Germany will allocate more than €5 billion to buy external hydrogen, increasing the original budget by €1 billion. The EU will conduct an €800 million auction in December for renewable hydrogen projects, with yet-to-be-defined requirements. The focus is to promote the production and use of clean hydrogen in the energy transition.

5. CANADA:[5]

- Last year, the federal government announced a refundable tax credit for investment in clean hydrogen production. The Clean Hydrogen Investment Tax Credit offers tax incentives of 15-40% depending on the carbon intensity of the hydrogen. The maximum credits are:
- 40% for emissions < 0.75 kg CO2e/kg of hydrogen.
- 25% for emissions between 0.75 - 2 kg CO2e/kg.
- 15% for emissions between 2 - 4 kg CO2e/kg.
- Production > 4 kg CO2e/kg does not qualify.

6. PORTUGAL:[6]

In January 2023, Portugal announced its first national green hydrogen auction, offering ten-year contracts to renewable H2 producers. Gas suppliers must mix at least 1% of their natural gas with green H2 or biomethane, which will also be auctioned. A maximum price of €127/MWh for hydrogen and €62/MWh for biomethane was established. The auction includes 120 GWh/year of hydrogen and 150 GWh/year of biomethane, based on calorific power. The auction date is not yet set, but procedures must be submitted to the government before May 30 and published before June 30.

4 *https://www.h2-global.de*
5 *https://www.mltaikins.com/energy/new-tax-credit-for-investments-in-clean-hydrogen-production/*
6 *Source: https://elperiodicodelaenergia.com/portugal-duplica-solar-hidrogeno-plan-energetico-2030/*

7. INDIA: [7]

Approved the National Green Hydrogen Mission, aiming to produce 5 Mt of renewable hydrogen by 2030 and become a leader in electrolyzer manufacturing. It seeks to reduce fossil fuel imports worth €23 billion and lower CO2 emissions by 50 MMT per year by 2030. Approved in January 2023, the mission aims to make India a global leader in the production, use, and export of Green Hydrogen and its derivatives.

8. UNITED KINGDOM:[8]

Established a Low Carbon Hydrogen Standard and launched an Electrochemical Allocation Round to support hydrogen production through electrolysis. The "Hydrogen Investor Roadmap" aims to attract investments for the sector. The lowcarbon hydrogen production target was doubled to 10GW by 2030. The government offers financial support through the "Net Zero Hydrogen Fund," with up to GBP 240 million for low-carbon hydrogen projects. Additionally, the "Industrial Hydrogen Accelerator Programme" was established for innovation projects and creating a low-carbon hydrogen emission standard.

9. UNITED STATES:[9]

Introduced significant incentives under the Inflation Reduction Act (IRA) for clean hydrogen production, promoting environmentally friendly technologies. $9.5 billion will be allocated to finance the Clean Hydrogen Regional Hubs Program, the Clean Hydrogen Electrolysis Program, and the Clean Hydrogen Manufacturing and Recycling Programs.

INFLATION REDUCTION ACT (IRA) USA SUMMARY

The 2022 Inflation Reduction Act, with a budget of $433 billion, establishes a tax credit for clean hydrogen producers in the United States. This credit can reach up to $3 per kilogram of hydrogen, adjusted for inflation. The available credits depend on two main factors: the greenhouse gas (GHG) emissions in the project's lifecycle and the staff's wages.

The base rate of the credit is $0.60 per kilogram of qualified clean hydrogen. However, this rate varies according to lifecycle emissions, measured in carbon dioxide equivalents (CO2e) per kilogram of hydrogen produced. If emissions are less than 0.45 kg of CO2e per kg of H2, 100% of the credit is awarded. Then, there are decreasing percentages of credit for different emission ranges: 33.4% for 0.45-1.5 kg CO2e/kg H2, 25% for 1.5-2.5 kg, and 20% for 2.5-4 kg. Verification of lifecycle emissions must be conducted by an unrelated third party. Moreover, only projects that begin construction before 2033 will be eligible for these credits. A crucial aspect of this law is the wage requirement. The tax credit size can increase up to five times if producers ensure that the workers and mechanics hired for construction receive wages not lower than the local rates for similar jobs.

It is relevant to note that these lifecycle emissions include the entire process, from hydrogen production to delivery, even considering methane emissions in the production of blue hydrogen, which comes from natural gas with partial carbon capture and storage. On the other hand, the law stipulates that blue hydrogen projects will not be eligible for these tax credits if they already receive federal tax benefits for carbon capture and storage. However, green hydrogen projects could receive additional renewable energy tax credits, valued at $30 per megawatt-hour (MWh), in addition to hydrogen credits.

7 *https://www.pv-magazine.com/2023/07/04/india-unveils-incentives-for-green-hydrogen-electrolyzerproduction/*
8 *https://www.gov.uk/government/publications/uk-hydrogen-strategy*
9 *https://www.hydrogen.energy.gov/clean-hydrogen-strategy-roadmap.html*

3.2

CURRENT STATUS OF THE SECTOR: EXECUTED AND UNDER-CONSTRUCTION PROJECTS

To date, over 1,000[10] renewable and low-carbon hydrogen projects have been announced globally, requiring an investment of at least $320 billion by the end of 2030. However, it is estimated that less than 10% have reached the final investment decision, according to a report by the Hydrogen Council lobby group.

Of these projects, 112 are large-scale production, 91 of which are green hydrogen and 21 are "low carbon" (a term not clearly defined here but generally refers to blue H2), and will need around $150 billion in investment by 2030, according to the Hydrogen Insights[11] 2023 report, conducted in collaboration with consulting firm McKinsey.

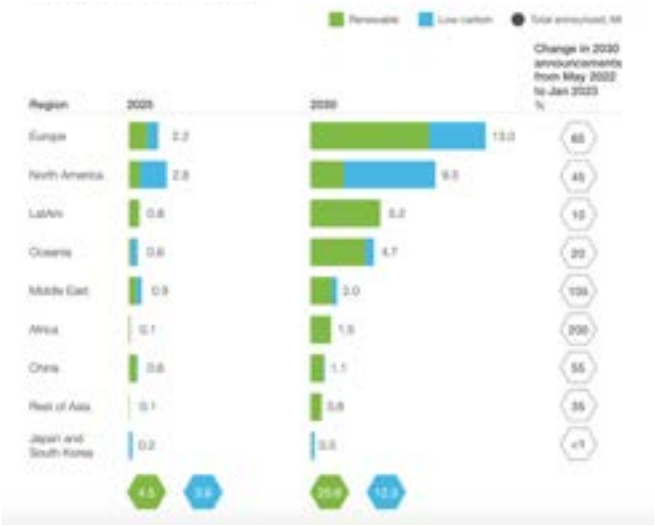
Approximately two-thirds of the 1,046 projects identified by the Hydrogen Council[12] focus on the supply of clean hydrogen, representing about 25 million tonnes annually of green H2 and approximately 13 million tonnes of "low carbon" H2, with around 20% intended for end-use and the majority related to infrastructure. Nearly half of the announced projects have not yet entered the planning stage or received government funding.

Currently, only about 60,000 tonnes of green hydrogen are produced annually from 700MW of electrolyzers, along with 740,000 tonnes of "low-carbon" hydrogen.

According to the IEA,[13] although new projects for the production of low-emission hydrogen are constantly being announced, only **5% of the final projects** (about 50) have made firm investment decisions due to uncertainties surrounding the future evolution of demand, the lack of clarity in certification and regulation, and the lack of infrastructure available to deliver hydrogen to end users.

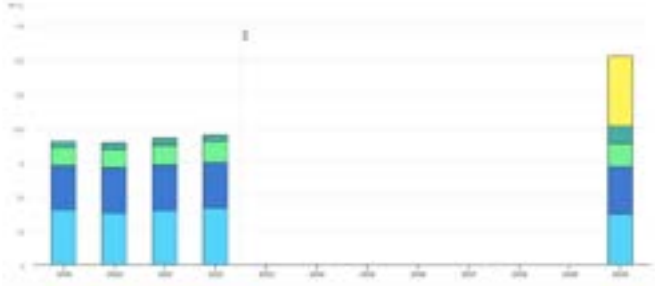
Regarding **demand**, it continues to rise but is primarily concentrated in traditional applications. Innovative applications in heavy industry and long-distance transport account for less than 0.1% of hydrogen demand, even though they are expected to represent a third of global hydrogen demand by 2030 in the Net Zero Emissions by 2050 Scenario.

Figure 1. Clean hydrogen volumes announced



Source: Hydrogen Council, Mckinsey [14]

Figure 2. Global hydrogen demand by sector in the Net Zero Scenario, 2020-2030



Source: IEA[15]

10 *https://hydrogencouncil.com/en/hydrogen-insights-global-project-funnel-gains-momentum-across-valuechain-and-geographies/*
11 *https://hydrogencouncil.com/wp-content/uploads/2023/05/Hydrogen-Insights-2023.pdf*
12 *https://hydrogencouncil.com/en/hydrogen-insights-2023/* 13 *https://www.iea.org/energy-system/low-emission-fuels/hydrogen*
13 *https://www.iea.org/energy-system/low-emission-fuels/hydrogen*
14 *https://hydrogencouncil.com/en/hydrogen-insights-2023/ Source: IEA*
15 *https://www.iea.org/energy-system/low-emission-fuels/hydrogen*

3.3

GLOBAL INVESTMENT FORECASTS 2023-24.

Figure 3. Direct hydrogen investments until 2030, $B

Source: IEA[16]

According to the Hydrogen Council:

29.000 millions

belonging to green hydrogen projects have reached a final investment decision

North America
10,000 billion

Europe
7,000 billion

China
5 billion

Middle East
5 billion

According to the Hydrogen Council, only **$29 billion belonging to green hydrogen projects have reached a final investment decision, (most of which were carried out "in the last few months," led by North America ($10 billion), followed by Europe ($7 billion), China ($5 billion), and the Middle East ($5 billion).**

Of these initiatives, Europe leads in investment with $117 billion (35% of global investments), followed by Latin America and North America, each accounting for about 15%. Proposals for large-scale projects (more than 1 GW of electrolysis or more than 200,000 kt p.a. of low-carbon hydrogen) total 112 projects requiring an investment of $150 billion until 2030, almost double that of eight months ago. However, according to the Hydrogen Council, more than double the investments are needed by 2030 and their maturation to achieve net-zero emissions by 2050.

16 *https://hydrogencouncil.com/en/hydrogen-insights-2023/*

Here are some of the most important points from the Hydrogen Council and McKinsey's report on new investments in the last year:

- **Interest in hydrogen projects is increasing in all phases**, although mainly in the part of new announcements. Projects have not yet consolidated or only a very small percentage have.

- Announced investments by 2030 **have increased by 35% in eight months**, from $240 billion to $320 billion.

- All stages of project maturity **have grown between 30% and 40%,** but the majority remain in early stages. Committed investments have accelerated, **growing by 30% since May 2022, led by North America with $10 billion USD.**

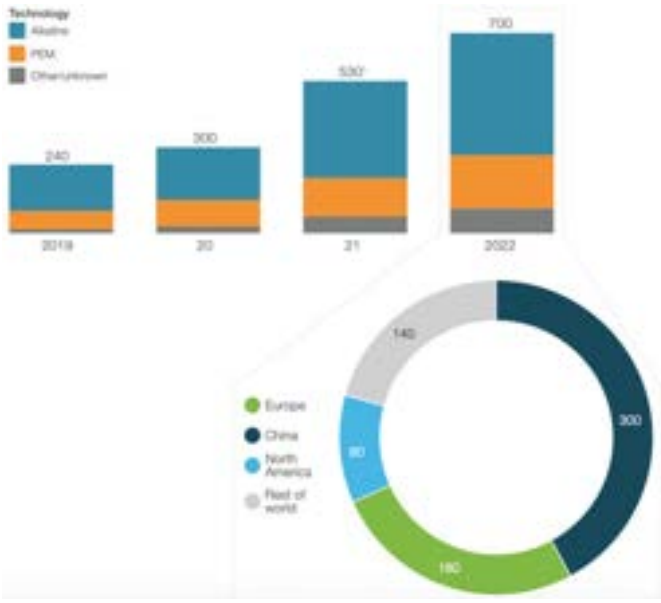
- Europe has the **largest total investment ($117 billion USD, 35% of global investments) and the highest absolute growth ($40 billion).**

- Although new electrolysis capacity has been deployed, with 170 MW in 2022 and a total of 700 MW, the pace is insufficient to achieve net-zero emissions targets by 2050. **More than 200 GW of electrolysis capacity would be needed by 2030, over 200 times the current capacity.**

- The share of alkaline and PEM electrolysis technologies is stable, **with alkaline around 60% and PEM approximately 30%.**

- China leads in deployed accumulated capacity **(about 300 MW),** followed by Europe (**about 180 MW).**

Figura 4. Global Hydrogen Council



Source: Global Hydrogen Council, Mckinsey.[17]

17 *https://hydrogencouncil.com/en/hydrogen-insights-2023/*

3.4

UPDATE ON HYDROGEN GENERATION PRICE/COST PERSPECTIVES

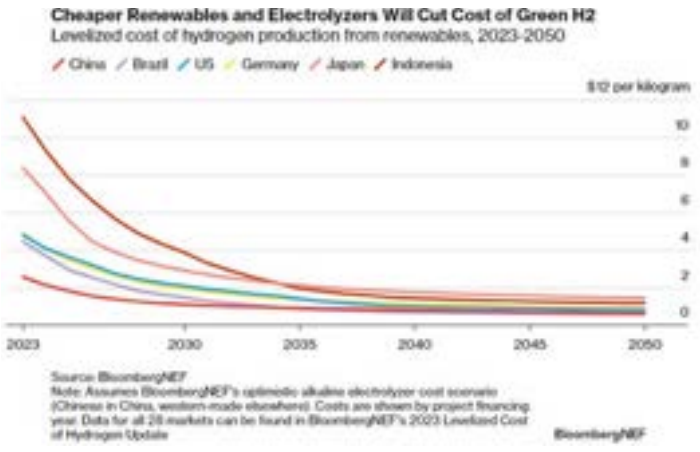
The levelized cost of hydrogen (LCOH2)[18] has slightly increased in 2023 due to inflation and higher financing costs. However, according to BNEF, green hydrogen (H2) is expected to be competitive with existing grey hydrogen plants operating at marginal costs in five markets by 2030.

Figure 5. By the numbers

$1.47/kg	Lowest LCOH2 of all modeled markets in 2030 using Brazilian onshore wind and western alkaline electrolyzers
2030	Year in which a new renewable H2 project is cheaper than running an existing grey H2 asset at marginal cost in Brazil, China, Sweden, Spain and India
46-49%	Increase in India's 2023 renewable H2 cost due to higher cost of capital assumptions versus 2H 2022

Source: BloombergNEF

Figure 6. Levelized cost of hydrogen production from renewable electricity, 2023-2050



Source: BloombergNEF

In BNEF's view:

- The **LCOH2 forecast increased slightly in 2023** compared to the second half of 2022 due to inflation, higher financing costs in some markets, and longer construction times.
- The **average levelized cost of blue hydrogen is 59%** cheaper than green for projects financed in 2023 due to falling future gas prices since our second-half 2022 update.
- **Green H2 is now more economical than blue H2 by 1 to 3 years** in the modeled markets. Green is cheaper than new blue H2 in 2028 using Chinese alkaline electrolyzers, and in 2033 using Western alkaline electrolyzers.
- Green H2 will be more economical than new grey H2 in over 90% of the markets by 2035. By 2030, building a new green H2 plant will already be cheaper than continuing to operate an existing grey hydrogen plant in **Brazil, China, Sweden, Spain, and India.**
- By **2050**, the levelized cost of newly built green H2 will be more economical than the marginal cost of grey H2 from existing plants in all modeled markets.

18 *https://about.bnef.com/blog/2023-hydrogen-levelized-cost-update-green-beats-gray/*

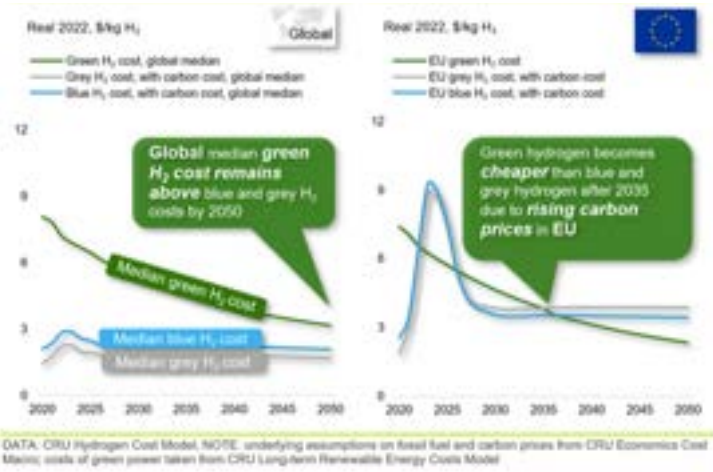
According to the **Hydrogen Council**, despite regulatory momentum, the production of clean hydrogen is more expensive today than two years ago in the **United States**, possibly due to an increase in the national average prices of Power Purchase Agreements (PPAs) from **USD 27 per MWh in 2020 to USD 45 per MWh in 2022, a shortage of construction capacity, and a rise of up to 20% in labor costs, as well as a two to fourfold increase in gas prices**. To reduce costs in the coming years and develop a clean, competitive ecosystem, it is necessary to expand the value chain.

On the other hand, according to a **report this year by the consultancy PWC**[19]**:**

- Hydrogen production **costs are expected to decrease by about 50% by 2030** and then continue to fall steadily, albeit at a slightly slower pace, until 2050.
- By **2050**, the production costs of green hydrogen in parts of the **Middle East, Africa, Russia, China, the United States**, and **Australia** are expected to be **around €1 per kilogram.**
- In the same timeframe, production **costs in regions with limited renewable resources**, such as certain areas of Europe, Japan, and Korea, **will exceed €2 per kilogram**, likely leading these markets to import green hydrogen from other regions.
- Even in densely populated regions with good renewable resources, hydrogen **will be imported as space constraints limit the production of green electricity and its conversion to hydrogen.**

Finally, as a counterpoint, we note a report from **CRU Group**[20]that indicates green **hydrogen is essential to decarbonize hard-to-abate sectors.** While some suggest it will be available for **~€0.5/kg (unfeasible), CRU does not believe it will be available for <$3/kg (2022 real) in 2050**. This cost implies higher energy prices and economic challenges for the transition. According to CRU, projections of **~€0.5/kg do not withstand rigorous techno-economic analysis.** By 2050, **the costs of green hydrogen are expected to be around €2/kg, with reductions of 50-70%.**

Figure 7. Globally, green H2 costs remain above grey and blue H2 production costs by 2050 but green H2 in the EU will gain cost-competitiveness over blue and grey H2 in late-2030s



Source: CRU [21]

19 *https://www.pwc.com/gx/en/issues/esg/the-energy-transition/analysing-future-cost-of-greenhydrogen.html*
20 *https://sustainability.crugroup.com/article/energy-from-green-hydrogen-will-be-expensive-even-in-2050*
21 *https://sustainability.crugroup.com/article/energy-from-green-hydrogen-will-be-expensive-even-in-2050*

3.5

OFFICIAL PERSPECTIVES ON LABOR DEMAND. STAFF SHORTAGE? UPDATES 2022-23.

The industry is maturing, and supply chains are tightening. There is evidence of increasing personnel demand and parallel labor shortages (e.g., engineering, procurement, and construction). On the other hand, rising inflation and interest rates, and the lack of public support in many markets, point to the existence of barriers and brakes that could slow down the sector's growth.

According to the **Hydrogen Council, labor costs have increased by 20% in the last year**. Also, in their opinion, to enable the sector in the coming years, it will be necessary to have:

1) **A skilled workforce[22] for the manufacturing and installation of electrolyzers, renewable energies, and low-carbon hydrogen production equipment.** Workforce development could be accelerated through specific training programs and facilitating labor transition from adjacent industries (e.g., fossil fuel-based sectors).

2) **Standardization and acceleration of permitting processes, for example, for renewable energies, electrolyzers, class VI wells for CO2 injections, facility remodeling/modifications, and pipelines.** Currently, permitting processes can take several years. Having adequately dedicated staff to manage permit applications and guide the permitting processes, as well as standardizing processes among agencies and jurisdictions, could help reduce the timeline of processes.

3) **A financial plan for investors that could reduce risk and accelerate implementation.** This could include education for investors and lenders about the economics of hydrogen projects, risks, regulations, and purchase dynamics, as well as financial models for hydrogen projects, ideally backed by assumptions and proof points from implemented hydrogen projects. There is a need for specialists in this specific area.

The United Kingdom also faces a significant labor shortage in its hydrogen sector, according to a **report by Cogent Skills.**[23] The current staff represents only **5% of what is required for 2030**. Although more than 12,000 jobs are projected for 2030 and 100,000 for 2050 in the sector, the lack of skilled workers could delay hydrogen production and affect Net Zero goals.

The report highlights the need for collaboration between industry, government, and educational institutions to overcome this shortage and ensure a successful transition to a cleaner economy.

Finally, according to Judith Kirton-Darling,[24] general secretary of IndustriALL, the European union representing energy workers, "from our point of view, this is the Achilles' heel of the just transition."

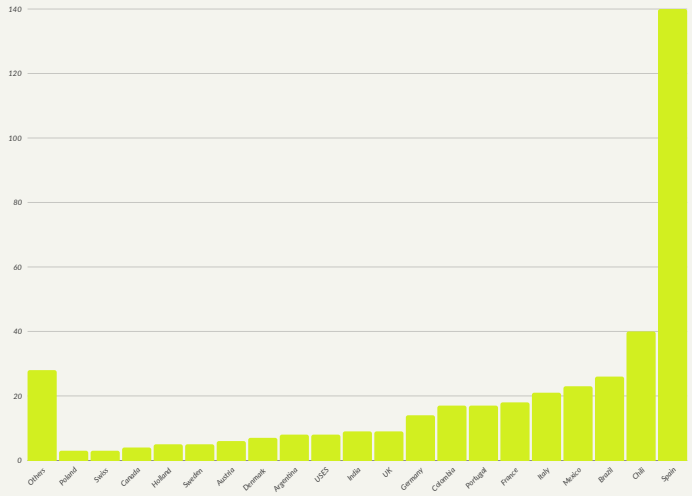
IndustriALL oversees retraining programs in areas where fossil fuel jobs are disappearing, such as eastern Germany and some coal regions of Spain, which are now looking to develop green hydrogen industries. Although many of these initiatives have been successful, there is often a skills mismatch. Specifically, in Spain, IndustriALL's concern was that the skills needed for green hydrogen projects are much higher than the skills of workers who have left the old industries.

22 *https://hydrogencouncil.com/wp-content/uploads/2023/05/Hydrogen-Insights-2023.pdf*
23 *https://cogentskills.com/news/first-national-occupational-standards-for-hydrogen-set-to-shape-skills-requiredfor-green-jobs/*
24 *https://www.spglobal.com/marketintelligence/en/news-insights/videos/streamline-corporate-workflow-spcapital-iq-pro*

04 STUDY RESULTS

4.1 LABOR CONTEXT GREEN HYDROGEN 2023 WRE

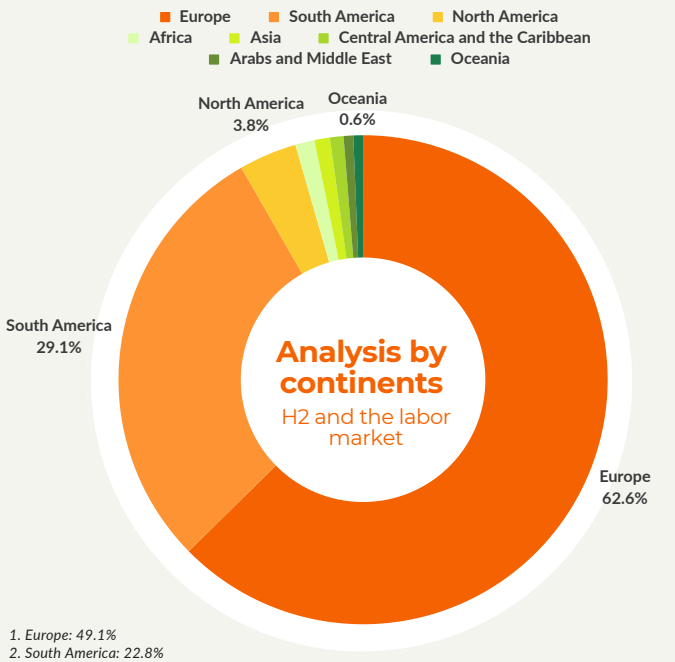
Figure 8. Geographic origin of respondents in the H2 survey



Source: Worldwide Recruitment Energy

To analyze the data on the geographical origin of the respondents in the H2 survey and the labor market, we can classify countries into regions and continents to get a more comprehensive view. Below, we break down the analysis by continents.

Figure 9. Analysis by continent H2 and the labor market



1. *Europe: 49.1%*
2. *South America: 22.8%*
3. *North America: 3.0%*
4. *Africa: 1.0%*
5. *Asia: 0.8%*
6. *Central America and the Caribbean: 0.7%*
7. *Arabs and Middle East: 0.5%*
8. *Oceania: 0.5%*

Source: Worldwide Recruitment Energy

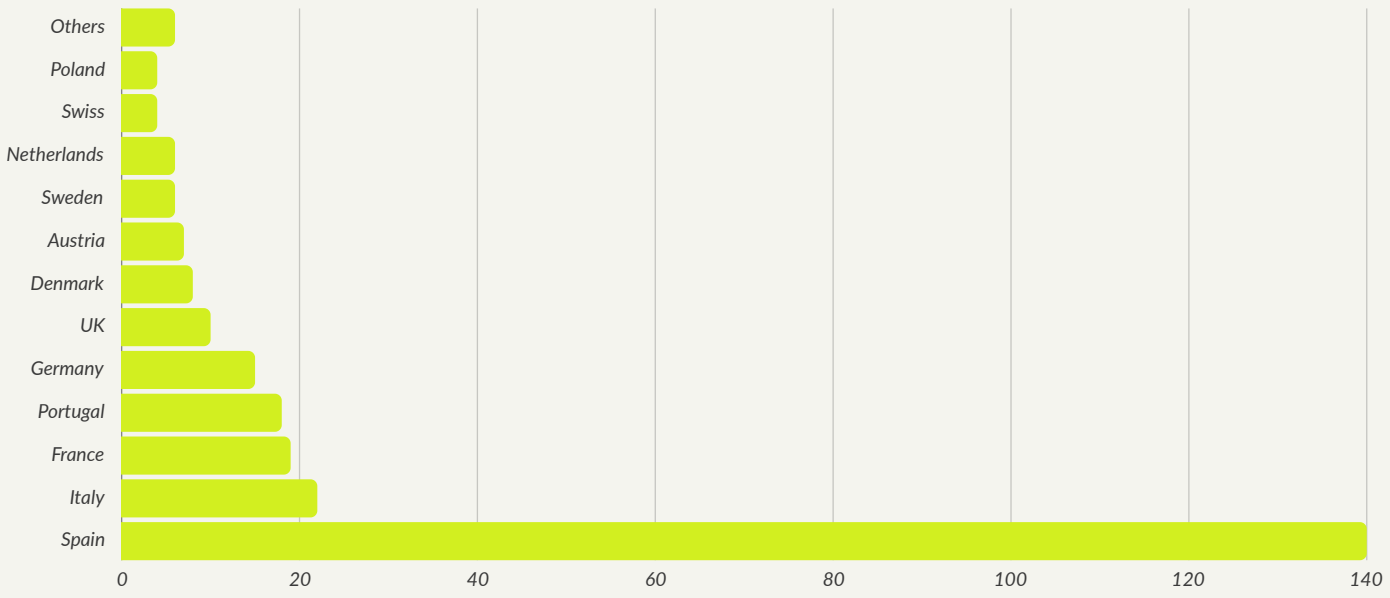
The data analysis reveals that the majority of respondents come from Europe, accounting for nearly half of the responses (49.1%). We believe this is due to several factors, such as the location of the company or institution conducting the survey, the dissemination of the survey through specific media and networks, or the greater availability and access to the internet in the region. In general, the main reason is due to the area of influence and contacts of the company that conducted the study, Worldwide Recruitment Energy, which focuses on the markets of Spain, Europe, Mexico, Chile, and Brazil.

South America, on the other hand, represents the second continent with the highest number of responses (22.8%). This figure is also significant and shows considerable interest in the survey from this region. The presence of the company with headquarters and extensive contacts in Chile, Mexico, and Brazil is reflected in the survey results.

In contrast, other regions such as North America (3.0%), Africa (1.0%), Asia (0.8%), Central America and the Caribbean (0.7%), Arab and Middle East (0.5%), and Oceania (0.5%) have a smaller representation in the survey. The main reason has been that the vast majority of respondents come from the first two continents. Although significant efforts have been made to expand the presence, especially in Asia, North America, and the Middle East, the volume of responses is relatively lower. In subsequent editions of this study, the presence of these continents will be increased.

Most Represented European Countries.

Figure 10. Main Responses Europe



Fuente: Worldwide Recruitment Energy

After a first edition where there was a relatively low presence of these regions, the research team of WWR Energy has made a significant effort to improve presence in key markets, mainly: Germany, France, the United Kingdom, the United States, and Italy. Of all these markets, however, we have perceived a lower receptivity to respond in markets such as Germany and France and the United States, and conversely a wider response rate in markets such as Italy. The countries with the highest number of responses in Europe have been Spain, Italy, and France.

The reasons can be various. We have noticed in Germany a very low response rate based on the surveys we have conducted - 18 responses to more than 400 shipments. We can point to cultural reasons or a certain caution on the part of respondents living in Germany, although there is a lack of precise data to justify this disproportion.

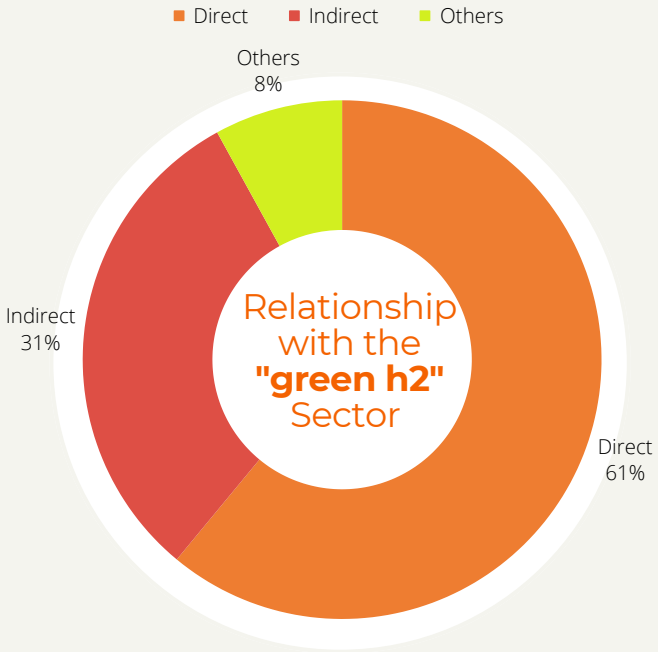
In subsequent editions of this study, efforts will be increased in regions with less presence and that have an important weight in the Green Hydrogen sector. We have identified as possible areas for improvement: Central Europe, the United States and Canada, Japan, China, South Korea, and Australia.

4.2

WHAT IS YOUR RELATIONSHIP WITH THE LOW-EMISSION HYDROGEN ENVIRONMENT?

The graph shows the respondents' relationship with the **"green h2"** (green hydrogen) sector and is divided into **three main categories:**

Figure 11. Relationship with the "green H2" Sector



Fuente: Worldwide Recruitment Energy

1) **Direct:** Those who work in a company in the green hydrogen sector, representing *60.6% of the responses (246 respondents).*

2) **Indirect:** Respondents who work in a company that is considering entering the green hydrogen sector or have business relations with companies in the same, constituting *31.0% of the responses (126 respondents).*

3) **No direct relation, only interest in the sector:** This group represents *8.4% of the responses (34 respondents).*

At first glance, we can observe that the majority of the respondents have a direct relationship with the green hydrogen sector, either working in companies that operate directly in this field or are involved in related activities.

This result indicates a high level of participation and/or interest in the development of the green hydrogen sector by the respondents. The fact that 60.6% of the respondents work directly in companies of the sector points to a booming sector or in a period of significant growth. A direct link with the sector implies personnel who dedicate a good part of their labor resource to this activity. Likewise, this percentage of response is also possibly due to the greater interest of a professional who is "inside" the sector than a professional with simple interest.

Asimismo este porcentaje de respuesta también es posiblemente debido al mayor interés que tiene un profesional que está "dentro" del sector que no un profesional con simple interés "dentro" del sector que no un profesional con simple interés.

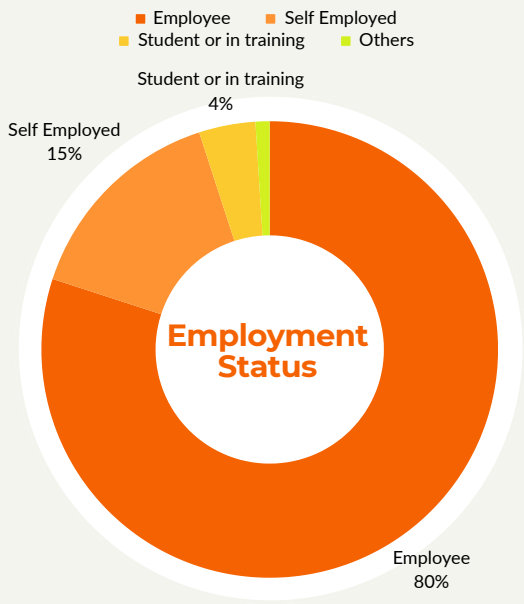
The group of respondents in the "Indirect" category also represents a considerable proportion (31.0%). This could indicate that there is a significant number of companies or professionals who are considering entering the green hydrogen market or establishing business relations with companies that already operate in this sector.

The group of respondents in the "Indirect" category also represents a considerable proportion (31.0%). This could indicate that there is a significant number of companies or professionals who are considering entering the green hydrogen market or establishing business relations with companies that already operate in this sector.

4.3

WHAT IS YOUR EMPLOYMENT STATUS AS A WORKER IN THE HYDROGEN SECTOR?

Figure 12. Employment Status



Source: Worldwide Recruitment Energy

The analysis of the results provides valuable information about the labor c**omposition of the respondents and their participation in the hydrogen market.** We break down the main sections:

1) Employed by Others:
A high percentage of 79.80% is observed.

- The majority work for established companies or organizations. This could indicate a solid and attractive labor market for professionals with solvent companies that have the capacity to hire staff.

2) Self-Employed:
Percentage: 15.02%

- There is a considerable presence of entrepreneurs and business owners. This section could include those responsible for entrepreneurship and innovation and growth in projects related to green hydrogen. This data coincides with the figure of self-employed individuals offered by Eurostat, which focuses on 15% of the total labor mass of the EU.

3) Student or in Training:
Percentage: 1.23%

- Reveals interest in the sector by students and people in training. In principle, it is a minor percentage, indicating that the majority of respondents are active, and few of them are dedicated exclusively to study.

4) Others:
Percentage: 3.94%

- Includes various non-specific employment situations in the survey. A more detailed analysis would be necessary to understand the diversity of this category but may include researchers, interns, or unemployed individuals.

PRELIMINARY CONCLUSIONS:

Stable Employment: The high proportion of employees working for others suggests opportunities in established and solid companies with the potential to continue hiring.

Entrepreneurial Growth: The presence of entrepreneurs at a percentage of 15% shows an attractive sector for investment and innovation. This data validates the information offered by the public sector.

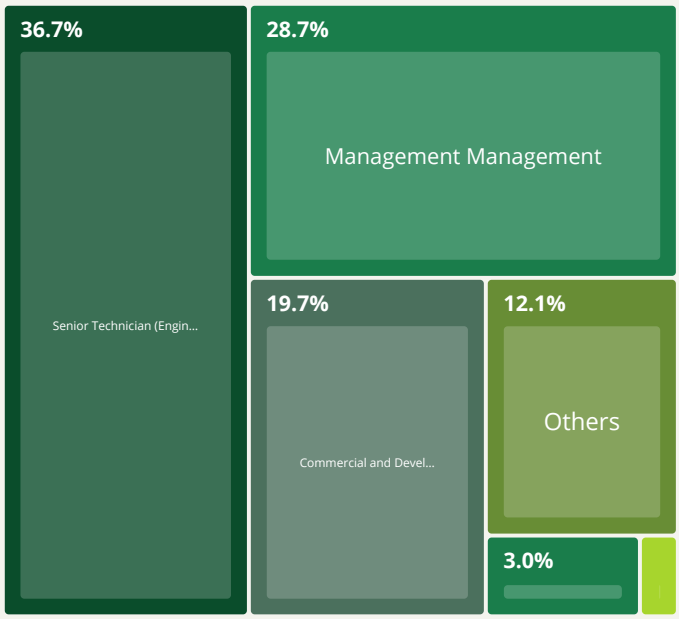
In short, the sector mainly attracts employees working for others, but with a significant presence of entrepreneurs and self-employed individuals, demonstrating that it is an attractive sector for both capital and employees.

4.4

WHAT IS YOUR JOB POSITION AS A WORKER IN THE HYDROGEN SECTOR?

The results of the question about the job **position of workers in the hydrogen sector reveal a diverse distribution of roles and responsibilities.** Let's analyze these results:

Figure 13. Labor Position as a worker in the sector



1. Senior Technician (Engineer or Technical Engineer) - 36.7%
2. Management and Executive - 27.8%
3. Commercial and Development - 19.7%
4. Others - 12.1%
5. Technical (Professional Training or similar) - 3.0%
6. Administration, Accounting - 0.7%

Source: Worldwide Recruitment Energy

Senior Technician (Engineer or Technical Engineer) - 36.7%

The highest percentage corresponds to higher technical workers, including engineers and technicians with advanced training. This highlights the importance of technical and engineering experience in the hydrogen sector, which is essential for the development and implementation of related technologies. This percentage is similar to the one obtained by the Worldwide Recruitment report from 2022.

Management and Executive (27.8%):

The high percentage of workers in management and executive roles points to a need for strong leadership and strategic decision-making in the hydrogen sector. This is crucial for coordinating various activities and ensuring that set goals are achieved. This proportion seems relatively high compared to the rest of the options, which may also indicate the growing need for entrepreneurship, direction, and business development in a moment of growth and business development of the sector.

Commercial and Development (19.7%):

The fact that nearly a fifth of respondents are involved in commercial and development roles points to the growing importance of marketing and industry growth of hydrogen. Companies are looking to expand their operations and establish new business opportunities in the sector. Finding customers, buyers, investors, and companies willing to establish purchase and sale agreements for Hydrogen or HPA are proving key.

Others (12.1%):

The "Others" group includes non-specific responses. This may indicate a variety of less common roles or a lack of categories that precisely fit the respondents' responsibilities. We have appreciated a high percentage of respondents who do not identify with these functions, such as students, teachers, consultants, etc.

Technician (Vocational Training or similar) (3.0%):

The presence of technical workers with vocational training in the hydrogen sector suggests a need for practical and execution skills in areas such as the installation, maintenance, and operation of hydrogen-related equipment. While subsequent responses highlight the high demand expected of these professionals, the responses obtained are relatively small. The search profile used on LinkedIn has a clear bias towards higher education graduates, and there are not as many technical profiles and vocational training. According to the Pew Research Center's 2021 Social Media Use study, LinkedIn continues to be popular among college students. A deeper investigation of these LinkedIn statistics[25] has revealed that over 50% of adults with a bachelor's degree or an advanced degree in the U.S. are LinkedIn users, while the site only attracts 10% of people whose education does not exceed high school.

Administration, Accounting (0.7%):

This relatively low percentage indicates that a small group of respondents occupies roles in administration and accounting areas within the sector.

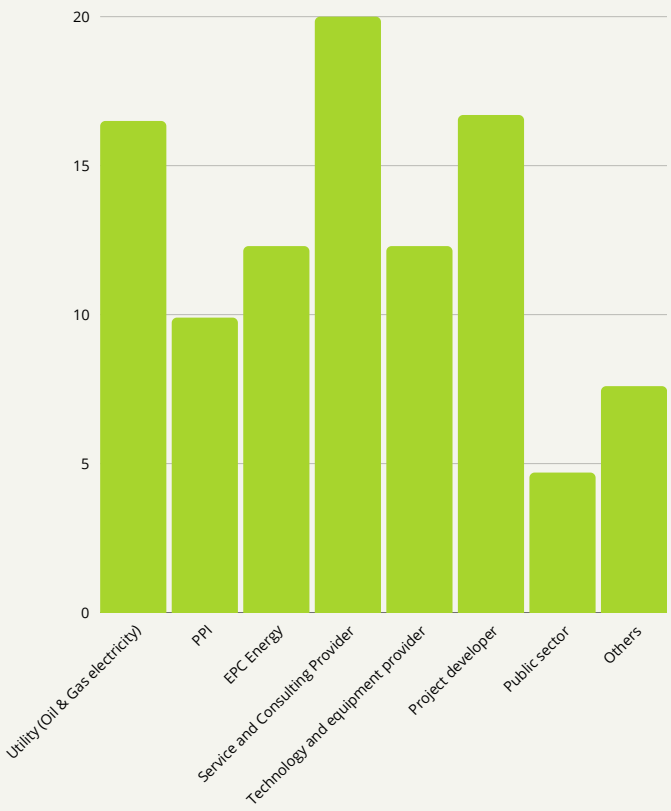
In general, there is a high proportion of management and executive roles, which suggests the need for solid leadership to guide strategic development and decision-making in the sector. It also somehow reflects the profile of the respondents contacted through social networks, mostly graduates, and mid-level professionals and executives. On the other hand, the scarce presence of vocational training profiles contrasts with the following results, where a high demand for these profiles is appreciated. Undoubtedly, these professionals exist, but it is very likely that the methodology used by this study has not managed to get the questionnaire to a sufficient number of respondents with this profile. There is also the possibility that those respondents with this profile have been more passive when responding to the survey. In any case, we have detected more than 400 professionals with this profile, and the response has been scarce.

25 *https://www.pewresearch.org/internet/2021/04/07/social-media-use-in-2021/*

4.5 WHAT IS THE ACTIVITY PROFILE OF YOUR COMPANY?

Next, a detailed analysis will be presented, including possible relationships between sectors:

Figure 14. Activity profile of your company



Fuente: Worldwide Recruitment Energy

Utility Electric Power Generators (Oil & Gas and Electricity) - 16.5%
This category represents 16.5% of the responses, indicating that a significant portion of the respondents come from utility companies, energy suppliers, or water supply companies operating in the oil and gas sectors, as well as in the electric industry. This relationship suggests that traditional utility companies are showing interest in green hydrogen and considering their transition to this low-emission sector. This conclusion, while relatively evident, confirms the existing synergies between both sectors.

IPP (Independent Power Producer)[26] - 9.9%
Independent power producers (IPPs) make up 9.9% of the responses. The presence of IPPs in the green hydrogen sector indicates a high percentage of independent producers interested in the production and distribution of energy from hydrogen. The specific profile of these IPPs is not broken down, but we can find both established companies diversifying into this business and new companies born with the aim of being exclusively hydrogen IPPs. Generally, in our contacts with the sector, we have found a high percentage of these companies that have a presence in more sectors and are taking a step to address the hydrogen sector.

Energy EPC - 12.3%
Energy EPCs (Engineering, Procurement, and Construction) represent 12.3% of the responses. Their presence could indicate the maturity of certain projects or proximity to their construction and commissioning phase. This was corroborated with interviewees at the end of the study who point to a maturity phase and the start of construction of many projects.

Service Provider and Consultancy - 20.0%
This category represents 20.0% of the responses and suggests that there is a significant amount of service providers and consulting firms interested in the green hydrogen sector. Their involvement may be related to technical advising, technology implementation, and the identification of investment and business opportunities in the green hydrogen sector. Interestingly, the high presence of consultants compared to the number of self-employed workers (15%) suggests many consultants working in organizations or companies as employees.

26 *https://energydigital.com/articles/top-10-hydrogen-companies*

Technological Equipment Supplier - 12.3%

With 12.3% of the responses, this category indicates the presence of companies that specialize in manufacturing and supplying equipment and technologies related to the production, storage, transport, or applications of green hydrogen. Their presence could indicate the maturity of certain projects or proximity to their construction and commissioning phase since equipment supply and purchase usually fall in the advanced phases of projects.

Energy Project Developer - 16.7%

Energy project developers represent 16.7% of the responses. This category denotes a very high percentage of professionals who provide auxiliary services. Their participation may indicate a growing interest in investing in projects that leverage the potential of hydrogen as a clean energy source.

Public Sector - 4.7%

This category represents 4.7% of the responses. There is a relatively low participation of the public sector in the green hydrogen sector. However, its presence is significant as it may imply the interest of governments and public institutions in developing and promoting policies and projects related to green hydrogen.

Others - 7.6%

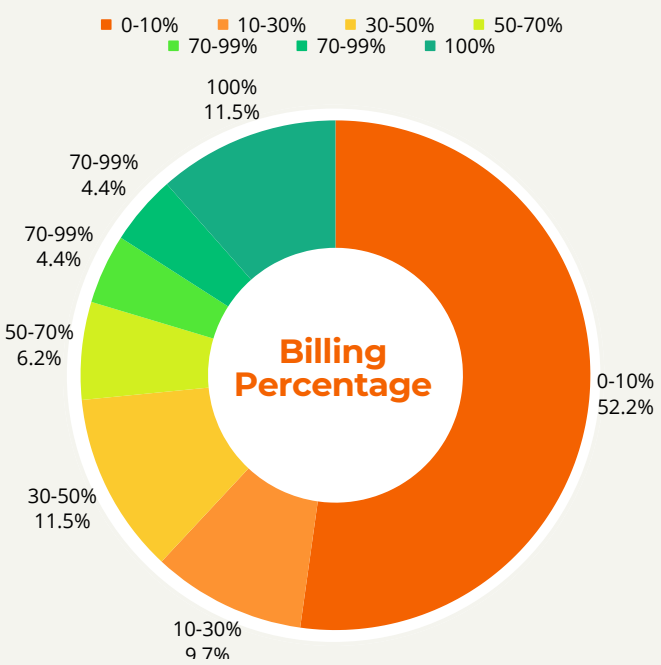
The "others" category represents 7.6% of the responses and includes responses that do not directly fit into the previous categories. This probably includes students, teachers, researchers, or specialists in R&D.

The data from question 4.4 show that the **green hydrogen sector attracts a variety of players in a fairly balanced distribution.** This confirms the multidisciplinary nature of the sector and the wide need for company profiles and professionals necessary to execute green hydrogen projects. **The importance of technical profiles is noted, but there is also a reinforcement of the need for commercial, legal, and management professionals in the execution and development of projects.** This was something that was noted in the 2022 edition and is reinforced by the current survey.

4.6

WITHIN YOUR BUSINESS/COMPANY, WHAT PERCENTAGE OF TURNOVER COMES EXCLUSIVELY FROM THE HYDROGEN/AMMONIA SECTOR?

Figure 15. Billing Percentage



Source: Worldwide Recruitment Energy

Economic Dependence in the Hydrogen Sector: The data reveal that 59% of the companies and professionals surveyed have a low degree of economic dependence on the hydrogen sector. This suggests that, despite high expectations, many derive vital revenue from other sectors, considering hydrogen as just another line of business. We extract some suggestions:

1) Total Dependence:
Percentage *13.1%*.

- We note a significant group of companies (at least 50) that report 100% of their income comes from the hydrogen/ammonia sector, indicating a strong commitment and specialization.

2) Total dependencia:
Percentage: 11%.

- A tenth of the total number of companies declare a dependency of between 50 and 99% of their total income. It is a smaller percentage, but added to the companies 100% dedicated, we find that a quarter of the total or 24.2% of the companies predominantly depend on this sector (more than 100 respondents). This highlights a pronounced specialization.

3) Companies in Transition or in Need of Investment:
Companies with low (0-10%) and medium (10-50%) dependencies add up to 76%.

- This points to potential growth but suggests a need for investment in infrastructure, research and development, and supportive policies.

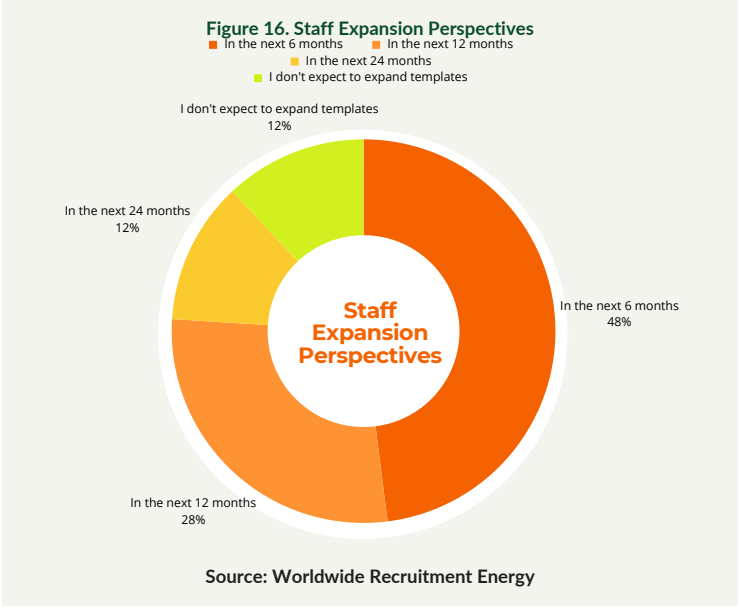
EVOLVING LANDSCAPE:

Overall, the data paint a changing picture. **As companies innovate and adapt, the green hydrogen sector becomes more crucial in the economy, generating an increase in the number of companies with greater dependence on this sector.** However, it is crucial that these companies achieve stable revenues over time and that the technology reaches maturity and economic viability to maintain it.

4.7

GROWTH PERSPECTIVES. DO YOU THINK YOUR COMPANY EXPECTS TO EXPAND THE WORKFORCE FOR THE GREEN HYDROGEN SECTOR?

Growth Perspectives:



Source: Worldwide Recruitment Energy

Initial Analysis:

The results of this question, in general, show that a **large majority of the surveyed individuals expect an expansion of the workforce in their organizations in the next year (88%)**, a percentage almost identical to that of 2022.

Short-Term Growth:

A significant number of p**rofessionals (41.14%) anticipate an imminent expansion of their workforce within the next 6 months.** This percentage is even higher than in 2022, which was 36.4%.

Medium and Long-Term Growth:

Responses **indicating growth in the next 12 and 24 months (28% and 12%, respectively) also suggest that there is an expectation of continuous development in the medium term.** The percentage of those expecting to expand in 12 months has increased slightly compared to the previous year's edition, and the percentage of those expecting to hire in **24 months has decreased from 18% to 12%.** This could signify a more significant short-term presence of actual projects and their execution and the need to hire staff in tighter periods. It could offer signs of certain market maturity.

Stability or Disinterest

A small group of professionals **(10.35%) do not expect to expand their workforce.** This could be due to various reasons, such as stability in their current operations or a focus on optimization and efficiency rather than expansion. This figure has remained stable since 2022.

Relationship of Workers with the Company and Growth Prospects

In this case, we have linked the data from question 4.2 (relationship with the sector) with the respondent's prospects:

- It is observed that those who have a direct relationship with the sector expect to hire in the next 6 months (50.41%). This percentage is higher than the one obtained in the general survey of this section (48%). Also, those with a direct relationship expect to hire in the next 12 months (26%), which is slightly lower than the general expectation.
- It is observed that those who have a direct relationship with the sector expect to hire in the next 6 months (50.41%). This percentage is higher than the one obtained in the general survey of this section (48%). Also, those with a direct relationship expect to hire in the next 12 months (26%), which is slightly lower than the general expectation.

PRELIMINARY CONCLUSIONS:

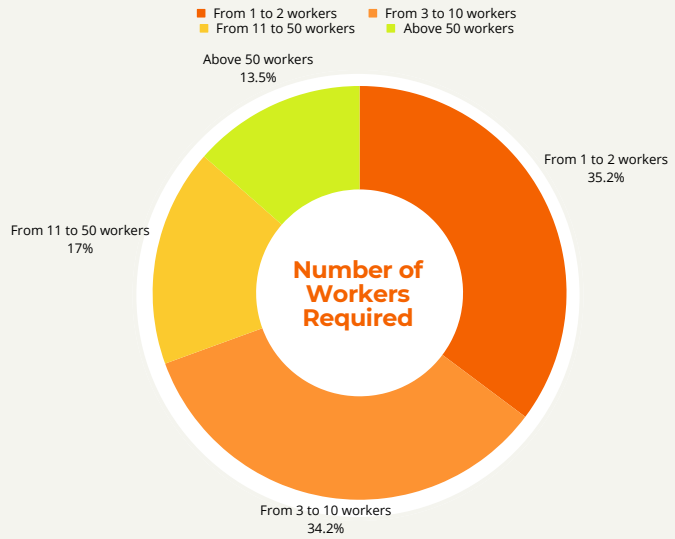
- Overall, there is an expectation of growth in the green hydrogen sector, as the vast majority of responses indicate that there will be an expansion of the workforce at different time horizons.
- Most professionals are optimistic about the future of the sector, both in the short and medium to long term. 76% expect workforce expansion in 12 months, 88% in 24 months.
- The combination of responses expecting growth over different timeframes suggests a diversified and long-term perspective in hiring decisions.
- There is also a greater willingness to hire among companies with a direct link to the sector. This does not prevent neophyte companies from also being interested in hiring but over more extended periods. These results are very similar to those obtained in the 2022 study.

4.8 IF AFFIRMATIVE, HOW MANY WORKERS DO YOU THINK WILL BE NECESSARY?

Number of Workers Required:

- From 1 to 2 workers:
  143 responses (35.24%)
- From 1 to 2 workers:
  139 responses (34.24%)
- From 1 to 2 workers:
  69 responses (17.03%)
- From 1 to 2 workers:
  55 responses (13.54%)

Figura 17. Number of Workers Required



Source: Worldwide Recruitment Energy

Number of Workers Required:

Comparing this data with the previous responses about growth expectations, we can make some interesting connections:

- There seems to be a relative direct correlation between the estimated size of the workforce expansion and the growth expectations previously mentioned in question 4.6. That is, those who expect faster growth (in the next 6 months) might be projecting the need to hire 1 to 2 workers, while those who anticipate more gradual growth (in the next 12 to 24 months or beyond) might be considering an expansion of 3 to 50 workers.

Number of Workers and Growth Horizon:

- Responses indicating the need to hire 1 to 2 workers may align with short-term growth expectations (in the next 6 months). This suggests an initial expansion, perhaps for specific projects or to fill key roles that will drive the early growth of these companies.
- Responses indicating the need to hire 3 to 10 workers suggest a relation to medium-term growth expectations (in the next 12 to 24 months). These hires could address a broader phase of development and sector expansion.
- Responses that suggest the need to hire 11 to 50 workers could be connected with medium to long-term growth expectations and could indicate a more consolidated and sustained growth phase in the sector.
- Responses pointing to the need to hire more than 50 workers could be related to longterm growth expectations. This could represent a more massive and stable expansion phase in the sector.

Relationship of Workers with the Company and Hiring Prospects:

We have also linked the data from question 4.2 (relationship with the sector) with the respondent's perspectives regarding the number of hires:

- We notice that those workers with a **Direct relationship** with the sector expect to hire mostly 3-10 people (37.4%), followed by 1-2 people (26.4%). This contrasts with the general response and points to an interest in larger volumes of hiring by those with a direct relationship.
- On the other hand, those with an **Indirect relationship** and who affirm the will to hire, 44.44% expect to hire 1-2 employees, followed by 33.33% who expect to hire 3-10 employees. This suggests a lower hiring capacity by these companies as well as more conservative spending prospects under current circumstances.
- As a relevant fact, those with a **Direct relationship** with the sector are the ones with a higher willingness to hire more than 50 workers, 16.26%, and a total of 40 companies. In the case of Indirect relationships, this figure drops to 8.73%, which is still significant.
- Finally, a surprising fact is that those who declare **NO relationship** with the sector still expect to hire between 1 and 2 employees in 64.7% of cases.

COMPARISON TO 2022:

Compared to the previous 2022 edition, there is a growth in the percentage of the range of 1-2 workers from 22% to 35%. In some way, companies may be lowering their expectations of professional demand or adjusting their initial forecasts and making tactical hires in the short term. The reason could be a delay in generating revenue from the sector or a perspective of receiving it over a more extended period.

In the range of 3-10 workers, there is also an interannual contraction from 37 to 34% in demand for this profile. The range of 11-50 workers does not change, which points to similar medium-term needs regarding the larger range of over 50, the percentage increases from 11 to 14% in the interannual rate.

Analysis by Profiles

Demanded Profiles in the Hydrogen Sector:

1) **General Engineers (24.0%):**
   - They represent the largest group of demanded profiles.
   - There is a marked contrast between the need (47.8%) and declared activity (36%) indicating a possible deficit of these types of profiles.
   - Also, an interannual increase in demand is observed compared to the 2022 edition.

2) **Medium Technicians and Operators (15.6%):**
   - Demand for technical personnel for installation and maintenance.
   - The contrast between needs (15.6%) and dedicated professionals (3%) indicates a possible and marked deficit.
   - The difference could be due to the lack of presence of these profiles in the survey.

3) **Commercial and Business Development (13.7%):**
   - Indicates the growing need for commercial skills and business development.
   - Contrast the higher number of people dedicated to this area (19%) compared with the perception of need.
   - Increase in demand from the previous year (12% to 13.7%)

4) **Chemical Engineers (8.0%):**
   - Significant presence in the sector, reflecting the chemical nature of production and multidisciplinary.
   - A decrease to half the interest compared with the previous edition (16%). The reasons are not clear

5) **Project Managers (5.4%):**
   - The demand for these profiles suggests a need for coordination in emerging projects or in the final design and construction phase.
   - There is a decrease in demand from 2022 (8%).

6) **Electrical Engineers (4.9%) and Process Engineers (4.2%):**
   - Importance in electronics and process management in hydrogen production.
   - May be a reflection of the hybrid nature of these profiles that combine experience in electrical and industrial engineering.

7) **IT (1.0%):**
   - Importance in electronics and process management in hydrogen production.
   - May be a reflection of the hybrid nature of these profiles that combine experience in electrical and industrial engineering.
   - Other categories have less representation: Although less mentioned, categories such as marketing, external consulting, ports/desalination/marine technologies, among others, also play a role in the development and application of clean hydrogen and ammonia.

General Analysis of the Responses Obtained:

1) **A marked interdisciplinarity in the demand for professionals is detected:**
The variety of demanded profiles reflects the multifaceted nature of the clean hydrogen and ammonia sector. The need for engineers, technicians, commercial, financial, and other professionals shows that innovation in this area is not limited to technology but also to management, marketing, and sustainability.

2) **Singular importance of chemistry:**
Chemical Engineers (8.0%) play a crucial role in the production and processing of clean hydrogen and ammonia. This data suggests that a deep understanding of chemical and catalytic processes is essential for the sector's development. However, this profile has lost presence compared to 2022.

3) **Innovation and management in focus:**
The presence of project managers (5.4%) along with R&D professionals (2.9%) indicates a focus on planned innovation and efficient project management. This points out that companies are looking to implement new solutions in an organized and effective manner.

4) **Convergence of technology and energy:**
The demand for electrical engineers (4.9%) and electronic engineers (0.7%) and even electrochemical engineers in the sector suggests a significant intersection between electrical technology and the production and use of clean hydrogen and ammonia. There is a certain growth in the demand for these specialists.

5) **External collaboration:**
The presence of External Consulting (2.4%) and Legal (1.7%) indicates the importance of collaboration with external experts and regulatory compliance in a highly regulated field.

6) **Emerging roles:**
The inclusion of less common categories, such as IT (1.0%), trading (0.7%), or marine technologies (0.3%), suggests that there are emerging areas of importance in the clean hydrogen and ammonia sector, such as technological control and emerging technologies.

These results reveal a complex and bubbling ecosystem. The diverse profiles required indicate that energy and technology are interconnected with management, marketing, and sustainability, and require close collaboration among experts from various fields to reach their full potential. The need for specialization in multiple areas, from engineering to marketing and project management, indicates that the sector's growth is not limited to production but encompasses a wide range of roles and skills.

GEOGRAPHIC ORIGIN OF RESPONSES.

In terms of respondents who believe that the first category **(General Engineer)** is the most demanded, there are significant differences in responses by geographic area. **While in France (66%) and Spain (53%)**, the majority consider this profile the most important, others such as **Germany (26.7%) or Chile (23.3%)** assign relatively less importance to these profiles.

In **Germany,** there is a greater relative importance given to **technical vocational profiles (13.3%)** and **Commercial profiles (13.3%)**. This contrasts with the general trend.

However, specifically in **Germany,** there is a notable need for **process engineers with 20% interest**, making it the second most demanded profile.

In **Chile**, the **Chemical Engineer profile is especially in demand (16.7%)**.

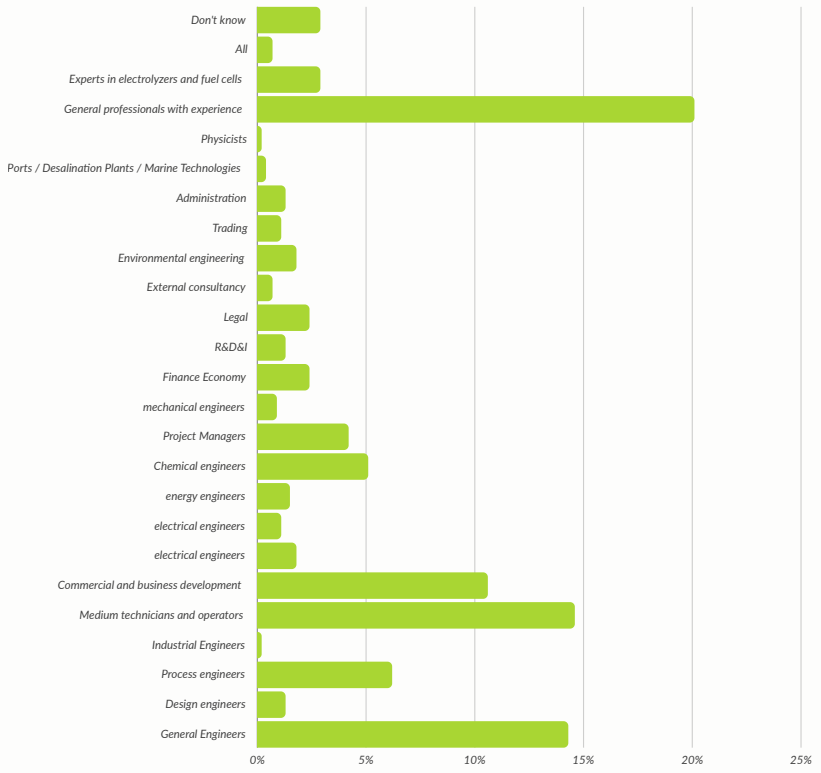
In **Mexico**, the second most demanded profile is **Legal with 18.8%.**

Some profiles have an unusual demand in certain countries, such as **Mechanical Engineer,** which has a **21.4% demand in Italy.**

4.10

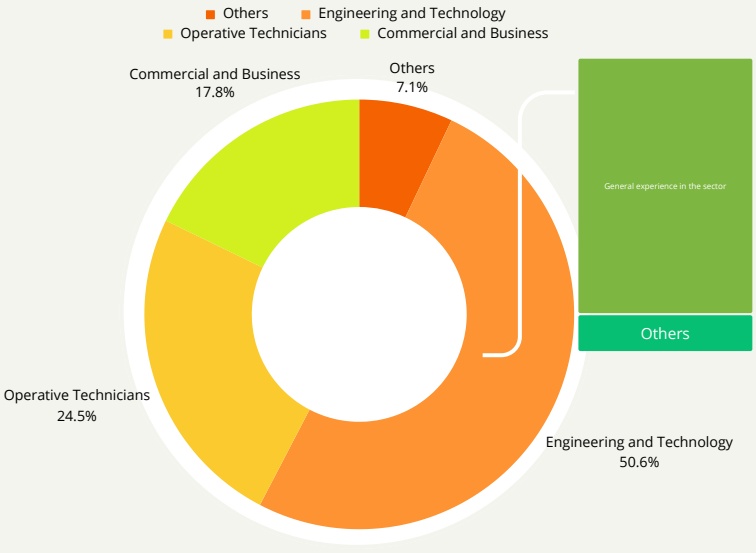
WHAT DO YOU CONSIDER TO BE THE KEY PROFILES MOST DIFFICULT TO HIRE FOR THE CLEAN HYDROGEN AND AMMONIA SECTOR?

Figure 18. More difficult profiles



Source: Worldwide Recruitment Energy

Figure 19. Most difficult profiles by % groups



Source: Worldwide Recruitment Energy

RESPONSES OBTAINED

Affiliated Groups (%):

1) Engineering and Technology (30.1%):
- General Engineers (14.3%)
- Design Engineers (1.3%)
- Process Engineers (6.2%)
- Industrial Engineers (0.2%)
- Electrical Engineers (1.8%)
- Electronics Engineers (1.1%)
- Energy Engineers (1.5%)
- Chemical Engineers (5.1%)
- Mechanical Engineers (0.9%)

2) Technicians and Operators (14.6%):
- Middle Technicians and Operators (14.6%)

3) Sales and Business (10.6%):
- Sales and Business Development (10.6%)

4) Management and Administration (14.3%):
- Project Managers (4.2%)
- Finance and Economics (2.4%)
- R&D+I (1.3%)
- Legal (2.4%)
- External Consulting (0.7%)
- Administration (1.3%)

5) Specific Expertise (2.9%):
- Experts in Electrolyzers and Fuel Cells) (2.9%)

6) General and Professional Experience (20.1%):
- Professionals in General with Experience (20.1%)

7) Others (4.2%):
- Ports/Desalination/Marine Technologies (0.4%)
- Physicists (0.2%)
- All (0.7%)
- I don't know (2.9%)

Analysis:
Firstly, we have grouped similar specialist profiles into related activity groups:

- The high percentage of **Professionals in General with Experience (20.1%)** is noteworthy. This suggests that industry experience is highly valued, regardless of an individual's previous training or education. The scarcity of profiles in this sector makes experience in the field a highly sought-after asset. This could reflect the lack of an already established and experienced workforce in the clean hydrogen sector, highlighting the need for specific education and training programs to fill this gap.
- The presence of **technical and operator profiles (14.6%)** suggests the complexity and need for practical skills in the implementation and maintenance of technologies, as well as a high demand for this profile. This data continues to contrast with the low response of people who claim to work in this segment.
- **Connection between Innovation and Business:** The presence of s**ales and business development profiles (10.6%) along with R&D+I (1.3%)** indicates a relationship between technological innovation and its commercialization.
- **Demand for Specific Expertise: Experts in electrolyzers and fuel cells (2.9%)** are a prominent profile. This data reflects the need for specialization in key technologies for the production and use of clean hydrogen and hints at the shortage of certain specialized knowledge in key technologies for hydrogen production, which could be limiting the availability of these profiles in the job market and thus slowing down the growth in this sector.
- **Combination of Technical and Business Skills:** The need for **technical, sales, and business development profiles (10.6%)** shows the complexity of finding professionals who can combine technical skills with a solid understanding of market and business strategies. This could be a challenge in talent acquisition.
- **Strategic Management and Projects:** The demand for **project managers and profiles related to strategic management (4.2% and 6.2%, respectively)** indicates that the successful implementation and scalability of clean hydrogen technologies depend on effective management and strategic planning.
- **Difficulties in Identifying Needs:** EThe percentage of **"I don't know" responses (2.9%)** regarding the most difficult profiles to hire could reveal a challenge in accurately identifying labor needs. This could indicate a disconnect between what is required and what is sought in hiring.

In general, the difficulty in obtaining certain profiles in the clean hydrogen and ammonia sector appears to be multifaceted and reflects the complexities and rapid developments in this emerging industry. This underscores the importance of comprehensive education, training, and talent attraction strategies by both the sector and public authorities to address these gaps and strengthen the sector as a whole.

Geographic Origin of Profiles.

Regarding the most difficult profile to find, it is worth noting that Senior Engineers are the most demanded, although it varies greatly by region. For example, in France, 30% of respondents believe this is the most difficult profile to obtain, while in Germany, only 6.6% of respondents share the same opinion. Spain (13.8%), Chile (11.5%), and Italy (9.5%) fall in between.

As for Middle Technicians and Operators, they are considered even more difficult to find than General Engineers in some countries. For example, in France (20%), Spain (17.6%), and Chile (17.3%), respondents believe this profile is the most challenging to locate. However, in countries like Germany and Colombia, this profile received 0% as the most challenging to find.

Furthermore, there is a significant percentage of respondents who believe that "people with experience in the sector" are the most challenging to find. This response, given by 91 people, accounts for 20.1% of the total and is relatively evenly distributed geographically in Germany (20%), Colombia (21%), Italy (23%), Brazil (23%), and Spain (20.7%). This suggests a need for this profile regardless of its origin.

Another profile with a fairly homogeneous response geographically and high demand is that of Process Engineers, with 13% in Germany, 15.7% in Portugal, and 7.5% in Spain.

COMPARISON WITH THE PREVIOUS EDITION

In comparison to the previous edition, the most significant contrast is the shift from a majority demand for engineers (50%) in 2022 to the current 30%. On the other hand, the demand for sales (10.6%) and technical profiles (14.6%) is higher in this edition compared to 2022 (8% and 13%, respectively).

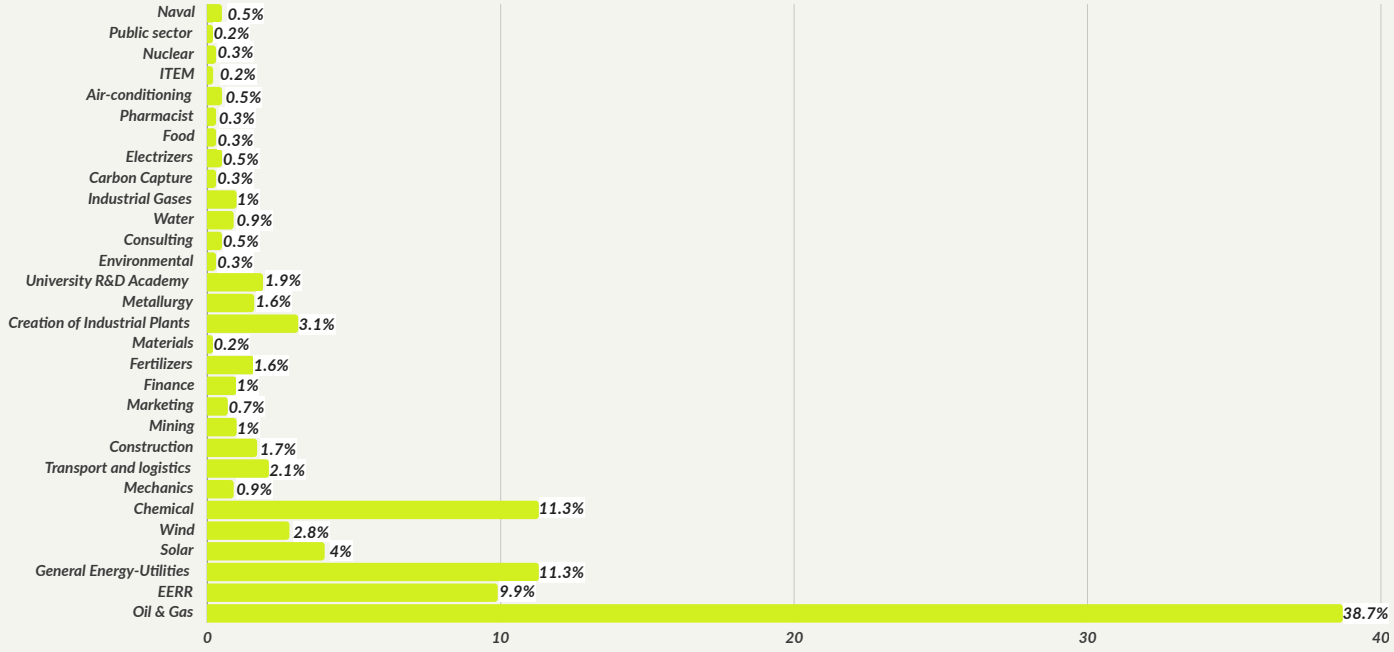
Another noteworthy point is the doubling of demand for management positions, from 7% to 14%. Finally, a category that was not identified in 2022, which is "general experience," is now one of the most demanded profiles at 20.1%. It's possible that in the previous edition, this category fell under "others," which received 14% of responses compared to the current 4.2%. However, this increase in profiles with professional experience seems significant as it surpasses the possible 14% from the previous year, reaching 20%.

In some ways, the differences between last year and this year suggest a maturation in projects, a reduced dependence on engineering profiles, and a greater appreciation of pure work experience as a value in itself.

4.11

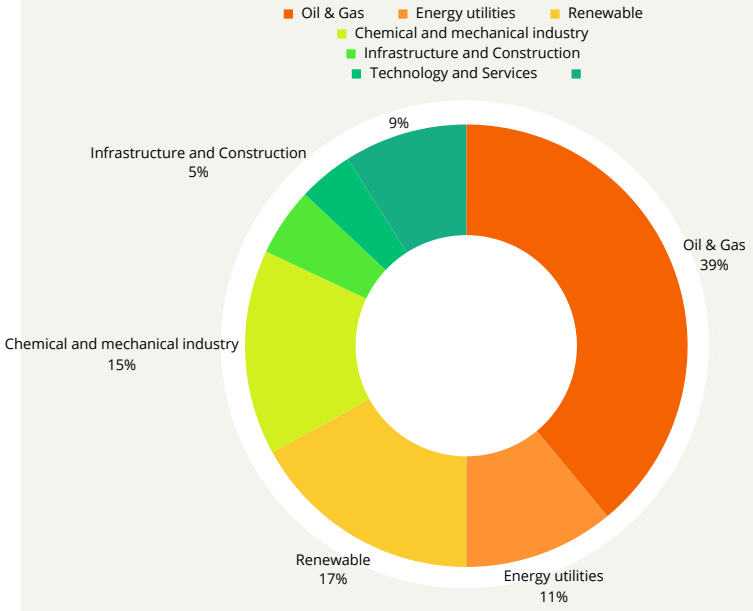
FROM WHICH OTHER SECTORS WITHIN THE ENERGY SECTOR WOULD YOU CONVERT THE NECESSARY PROFILES FOR THE CLEAN HYDROGEN AND AMMONIA SECTOR?

Figure 20. Sectors from which the necessary profiles would come



Source: Worldwide Recruitment Energy

Figure 21. Grouping by related macro sectors:



Source: Worldwide Recruitment Energy

Based on the provided data, the sectors with the highest number of responses are:

1) OIL&GAS:
With 236 responses. 38.7%

2) RENEWABLE ENERGY (Energías Renovables y Recuperación de Energía)
With 9,9%

3) GENERAL ENERGY-UTILITIES:
With 40 responses. 11.3%

4) CHEMICAL:
With 51 responses. 15,5%

There is a predominance of professionals from the Oil & Gas sector at 39%, followed by Renewable Energy at 17%, and the chemical industry at 15%. Infrastructure and construction account for 5%, and Technology and services for 4%.

The Oil&Gas sector remains the majority as a potential source of labor profiles at 38.7%. However, if we add professionals from the electrical sector (Renewables and Utilities), they make up 21%. The Oil&Gas sector is closely related to the production, distribution, and commercialization of hydrocarbons and energy. Professionals in this field have solid experience in extraction, processing, and distribution technologies for energy resources, making them highly relevant to the transition to a partially hydrogen and green ammoniabased economy.

Additionally, the chemical sector, with 11.3% of responses, shows its importance in the demand for chemical engineers, experts in electrolysis, and industrial and electrochemical chemical processes.

In addition to these sectors, we can also identify more specific sectors with profiles needed to work in the hydrogen and green ammonia industry:

SOLAR and WIND:
Professionals in these sectors have experience in renewable energy generation technologies, which can be applicable to the production of green hydrogen through water electrolysis using renewable energy sources. Both technologies account for 6.8%.

TRANSPORTATION AND LOGISTICS:
Since hydrogen can be used as fuel in vehicles and as a means of energy storage and transportation, experts in transportation and logistics play a crucial role in developing the infrastructure and supply chain related to hydrogen and green ammonia. This category seems to have a growing presence in responses compared to the previous 2022 edition.

This category seems to have a growing presence in responses compared to the previous 2022 edition.

MARKETING and FINANCE:
The hydrogen and green ammonia industry will require marketing professionals to promote and market its products, as well as finance experts to manage project investment and financing. Their growing presence indicates an increasing need for commercial development.

FERTILIZERS and AGRICULTURE:
Since green ammonia can be used in fertilizer production, professionals in this sector have potentially relevant experience. There are obvious technical and business synergies between the two sectors.

CONSULTING:
Experts in various types of consulting undoubtedly play a key role in providing advice and technological solutions for the implementation of hydrogen and green ammonia-related projects.

Other minority sectors that may play a growing role include:

MINING *(5 responses)*:
The entry of mining professionals could be due to their experience in handling materials and extractive processes. Mining can provide knowledge in obtaining raw materials necessary for the production of hydrogen and green ammonia, such as lithium (for electrolyzer batteries) or metals for catalysts. Additionally, some mines may have renewable energies, such as solar or wind, which could be relevant for hydrogen production.

MATERIALS *(2 responses):*
Although it is a minority sector, the knowledge of materials professionals could be useful for the improvement and development of technologies related to hydrogen storage and transportation. Research and development of advanced materials for tanks, pipes, or storage systems could be applicable in the field of green hydrogen.

CARBON CAPTURE *(2 responses):*
Carbon capture and storage (CCS) is a technology that can have synergies with the hydrogen and green ammonia industry. Hydrogen production from methane reforming (SMR) emits CO2, but if captured and stored, the resulting hydrogen is considered green. Therefore, CCS professionals may be involved in green hydrogen projects with emission reduction technology integration. While this sector is in an early stage, its presence in this study is relevant and deserves further attention.

ELECTROLYZERS *(3 responses):*
Although the number of responses is low, the electrolyzer sector is relevant because these devices are essential in hydrogen production through water electrolysis. Professionals specialized in the manufacturing, design, and optimization of electrolyzers will play a key role in the development of this key technology for green hydrogen. Their appearance indicates a more advanced phase in projects where a possible purchase of electrolyzers is being negotiated.

COMPARISON TO 2022:

In conclusion, the analysis points to the predominance of the Oil & Gas sector as the main provider of workers, followed by the energy and electrical sectors in general. It also suggests that some of the minority sectors can provide useful knowledge to the hydrogen and green ammonia industry.

However, it is important to note that the number of responses from these minority sectors is significantly low compared to larger and directly related sectors such as OIL&GAS or renewable energies. The lack of representation of some minority sectors may be due to a lack of awareness or knowledge about the opportunities and specific applications of their skills in this new industry. It could also indicate that there is still a need for greater integration and interconnection between sectors to promote the transfer of knowledge and experiences among them. Some of these sectors may have occasional or occasional presence.

Geographical Analysis

Regarding the regions with the greatest variation in professionals from the Oil & Gas sector. In this regard, the countries that tend to adopt this sector as the origin of their employees are **Portugal with 68.2%, Spain with 43.9%, and Italy with 40%.**

On the other hand, those who are less in agreement come from **Brazil, 24.3%, Germany with 28.6%, and France with 34.6%.**

Regarding profiles from the general energy and utilities sector, the most inclined countries are **Mexico with 16.1%, Italy with 16%,** and **France with 15.4%.** The least inclined are **Portugal, Spain, and Germany with 4.5, 9.1**, and **9.5%**, respectively.

For those who opt for profiles from the chemical sector, **Chile** stands out with **16.9%, Colombia with 15.4%, and Germany with 14.3%**. Regarding those coming from renewables, **Mexico** stands out with **16.1%, Colombia** with **15.4%**, and **Germany** with **14.3%.**

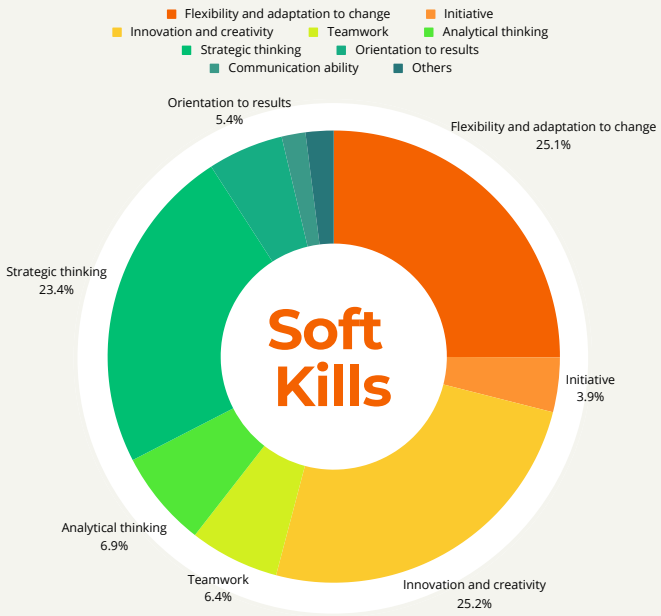
Regarding profiles from the Solar sector, **Spain** stands out with **5.9%**, followed by **Chile** with **5.1%**.

Finally, it is worth noting the significant percentage of responses from profiles with experience in industrial plant creation, with **Germany at 9.5%, Chile at 5.1%, and Spain at 3.2%** (although with 6 positive responses). This could suggest the imminent deployment of certain plants in these markets.

4.12

WHAT KIND OF SKILLS AND SOFT SKILLS WILL THE GREEN HYDROGEN SECTOR DEMAND?

Figure 21. Soft Kills



Source: Worldwide Recruitment Energy

In this case, as in the 2022 edition, we have opted to include a closed-ended questionnaire. In the current edition, we have chosen to provide a smaller number of defined responses.

The aim has been to contrast the quantitative scenario with the qualitative one.
In this case, as in the 2022 edition, we have opted to include a closed-ended questionnaire.

In the current edition, we have chosen to provide a smaller number of defined responses. The aim has been to contrast the quantitative scenario with the qualitative one.

- Three essential skills stand out, accounting for more than **70%** of the responses: Innovation and creativity, Flexibility and adaptability, and Strategic thinking.

- **Flexibility and adaptability** to change point to a volatile and ever-evolving environment where rapid adaptation is crucial to respond quickly and stay competitive. This skill is common to many other profiles, but specifically, the hydrogen sector requires a high level of flexibility.

Importance of innovation and creativity:

- The prevalence of **innovation and creativity** suggests the technical and economic challenge of creating a virtually new sector, developing new technical and economic solutions to reduce costs and make this technology competitive compared to other similar sources. Undoubtedly, there is a connection with the need to find more efficient and competitive ways to produce and use green hydrogen.

- Finally, **strategic thinking** emphasizes the complexity of processes, the extended timelines in which projects will be developed, and the need to have a medium and long-term vision. Considering that it is a growing sector, having this vision for management and administration positions, as well as in designs, is a clear advantage.

- **Need for leadership and teamwork:** Although leadership and teamwork skills are not the most highlighted in this study, they remain important. The green hydrogen industry will likely need leaders who can efficiently coordinate projects and teams. This suggests that at this moment, the focus may be more on process and technological development than on business leadership.

In relation to the previous questions in the study, it can be concluded that while technical and scientific skills are fundamental for success in the green hydrogen industry, soft skills play a crucial role in adaptation and continuous innovation. The ability to think strategically, be flexible, and foster creativity can make a difference in a constantly changing market like this. Additionally, it is important to recognize that the balance between technical and soft skills may vary depending on the specific role in the green hydrogen industry, but both are valuable overall.

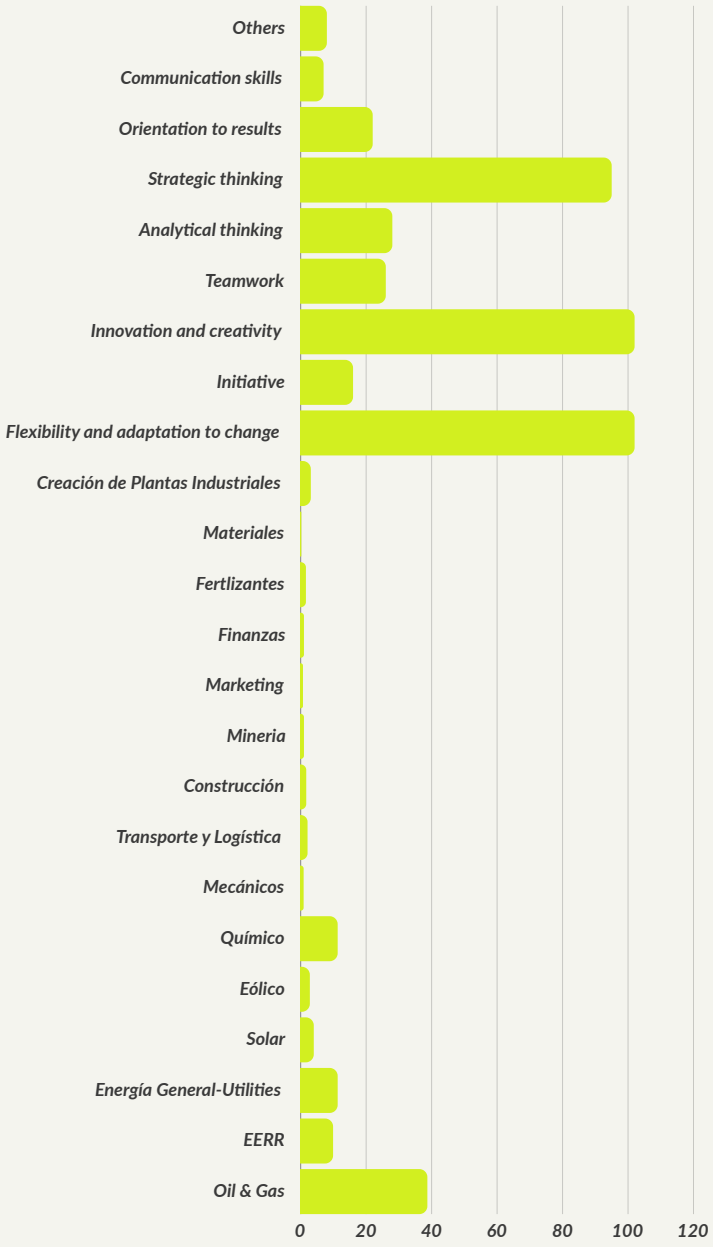
REGARDING THE PREVIOUS YEAR'S EDITION IN 2022

we can identify some interesting conclusions:

- **Stability in essential soft skills:** Despite differences in percentages, some soft skills continue to be consistently valued in both editions. "Flexibility and adaptability to change," as well as "Innovation and creativity," remain critical skills. This suggests that these skills are fundamental in the long term in the green hydrogen industry and are not just a passing trend.
- **Initiative and communication in change:** While "Initiative" decreased significantly from 9% in 2022 to 3.9% in 2023, "Communication skills" also experienced a decrease from 4% to 1.7%. This seems to reflect a shift in the perception of the importance of these skills. It is possible that in 2023, the ability to adapt and think strategically is more highly valued than individual initiative or direct communication, although it may be related to the fourfold increase in responses obtained in this edition.
- **Differences in the perception of strategic skills:** "Strategic thinking" increased significantly in importance, from 6% to 23.4%, respectively. This could indicate a shift in the need for professionals who can analyze data and make strategic decisions in a constantly evolving market. Long-term strategy seems to have become crucial.
- **Constant evolution of required soft skills: These changes in the perception of soft skills reflect a continuous evolution in the green hydrogen industry. As technology and demands change, the necessary skills also adapt. This highlights the importance of staying updated and prepared to develop new skills throughout a career in this industry.**

In summary, while some soft skills such as flexibility and innovation remain essential in the green hydrogen industry, we have observed notable changes in the perceived importance of other skills over time. This reflects the dynamic nature of the industry and the need to constantly adapt to succeed in this evolving market.

Figure 22. Soft Kills

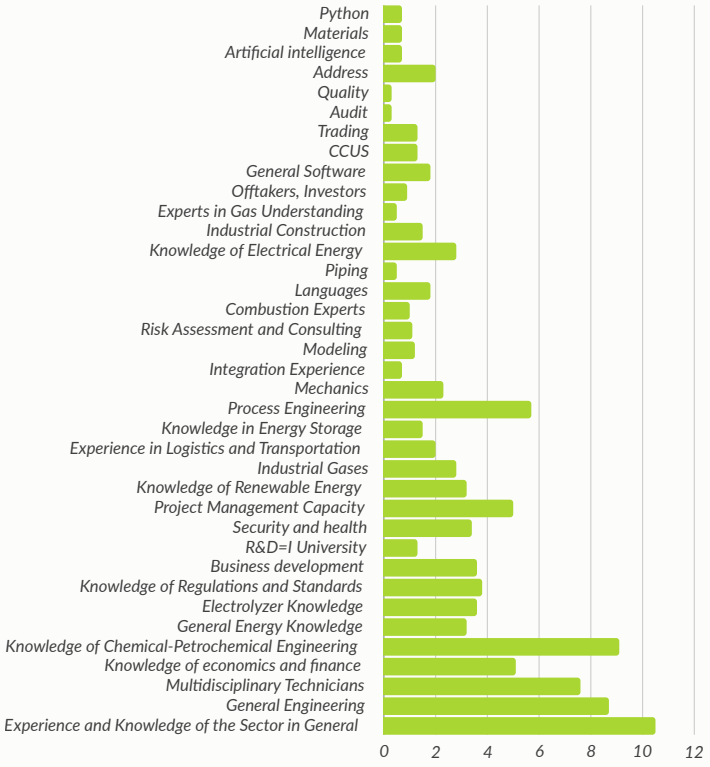


Source: Worldwide Recruitment Energy

4.14

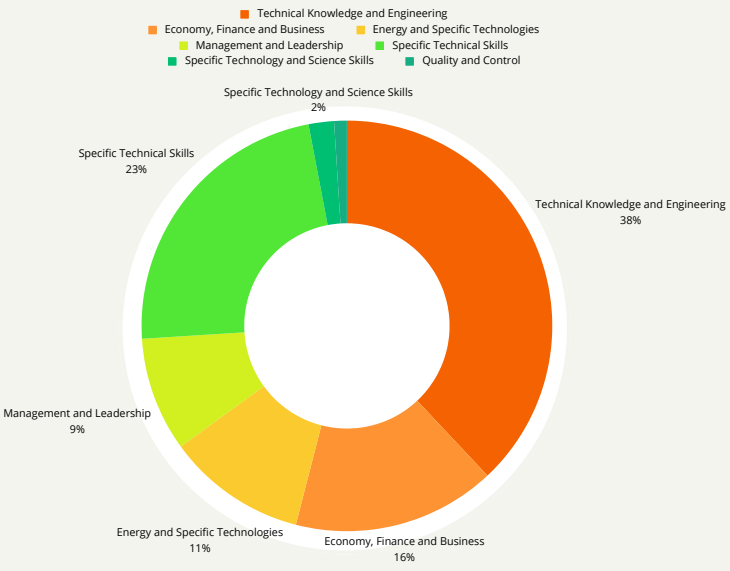
WHAT TYPE OF PROFESSIONAL SKILLS AND COMPETENCIES (HARD SKILLS) WILL THE GREEN HYDROGEN SECTOR DEMAND?

Figure 23. Hard Kills



Source: Worldwide Recruitment Energy

Figure 24. Groups of the Main Hard Skills



Source: Worldwide Recruitment Energy

General Observations:

knowledge to more general skills related to the industry and management. The most prominent category in terms of percentage is "Experience and General Sector Knowledge" with 10.5%, followed by "General Engineering" with 8.7%, and "Multidisciplinary Technicians" with 7.6%.

General Hard Skills:

1) **Technical Knowledge in Engineering and Energy:** The importance of technical skills in engineering, especially related to chemistry, energy, and processes, highlights the highly specialized nature of roles in this industry. Professionals with prior knowledge in these fields will be essential.

2) **Sector Knowledge and Experience:** The emphasis on experience and sector knowledge indicates that companies are looking for professionals who already have a deep understanding of the industry and its challenges. This competency suggests that companies value the ability to apply contextualized knowledge in a work environment. It also points to a possible shortage of profiles of this type and the importance of training and talent development in a virtually new sector.

3) **Financial and Business Skills:** The presence of competencies such as business development, investors, trading, and risk assessment highlights the importance of economic and financial viability in the green H2 sector. Professionals with the ability to understand and address business and financial aspects will be crucial for the success of initiatives in this area.

4) **Advanced Technological Skills:** The inclusion of skills in artificial intelligence, programming (Python), modeling, artificial intelligence, or materials experience reflects the growing integration of digital technologies and data analysis in the green H2 industry.

5) **Regulatory and Safety Skills:** The presence of knowledge in regulations, standards, and safety reflects the importance of complying with specific regulations and ensuring safety at all stages of green H2 projects. It also seems to indicate an approach to the execution and maintenance phases of projects.

6) **Renewable Energy Skills:** This section on knowledge of renewable energy and energy storage highlights the importance of understanding the technical and business dynamics of the energy sector applied to green H2. While the renewables sector is growing and has a strong demand for various profiles, many respondents have expressed interest in transitioning from the wind and solar sector to a sector that presents a greater challenge, such as hydrogen.

Technical-FP:

It is important to note that in the analysis of the survey on the labor market and green H2, there is a significant presence of technical and specialized competencies, many of which are traditionally associated with university profiles. However, some observations can also be made regarding non-university profiles or those with lower-medium professional qualifications.

This section accounts for approximately 25% of the responses. This data continues to contrast with the data from question 4.3, in which only 3% of the responses correspond to this segment. Undoubtedly, this is the segment in which the largest difference (GAP) between supply and demand is observed.

1) **Multidisciplinary Technicians:** The category of "Multidisciplinary Technicians" in the survey highlights the importance of more specialized technical skills that do not necessarily require a complete university education. They account for 7% of the total responses.

2) **Experience in Logistics and Transportation:** Although not exclusive to non-university profiles, experience in logistics and transportation is a skill that can be acquired through training and work experience. This type of skill is crucial in the supply chain and distribution in the green H2 industry.

3) **Experience in Integration, Industrial Construction, (pipes or Piping):** These competencies may be related to roles that require practical experience in project execution and management in the field. In a way, this demand suggests that certain projects are entering the final phase of execution and implementation. It also shows new synergies with the Oil & Gas sector.

4) **Languages:** Although not technical skills in themselves, the ability to communicate in multiple languages remains a valuable asset in an increasingly globalized environment.

4) **General Software:** While the survey does not specify what type of software is referred to in this category, it is likely that these are tools that do not require formal university training to learn to use, yet they are still relevant for specific tasks. (Python, AutoCAD, Scada)

In general, while many of the competencies mentioned in the survey are associated with university or highly specialized profiles, there are areas within the green H2 sector that offer opportunities for non-university or lower-medium professional qualification profiles. Practical experience, training in specific competencies, and adaptability can be key factors for these profiles in this evolving field. There is a high demand for these profiles and an uncertain supply in the market.

Overall, according to this data, the green H2 sector demands professionals with strong technical skills, a focus on sustainability, innovation ability, and skills to generate business opportunities. It tends to combine technical knowledge with a deep understanding of economic and business dynamics. The type of profile that emerges from this survey is highly technical and specialized. Most participants value experience and knowledge in the sector, suggesting that the job market is looking for professionals who already have a solid foundation in the industry. Additionally, the presence of engineers, multidisciplinary technicians, and experts in specific areas highlights the need for specialization in fields such as chemical engineering, electronics, renewable energies, and electrolysis technologies.

Geographical Analysis

On a geographical scale, there are substantial differences by regions.

1) General engineering competence is more appreciated in **Portugal at 23.5% and Chile at 11.9% than in Italy at 5.6% or Germany at 5%.**

2) On the other hand, knowledge of chemical and petrochemical engineering is more valued in **Portugal at 23.5%, Brazil at 11.5%, Italy at 11.1%, and Spain at 10.5%, while in Germany or Colombia**, they barely reach **5% and 4.3%**, respectively.

3) Multidisciplinary technicians are particularly valued in **Italy at 22.2%** and **France at 14.3%,** while in **Spain or Portugal, they barely reach 5.9%.**

4) Regarding Process Engineers, their demand stands out in **Portugal at 11.8% and Spain at 7.2%.**

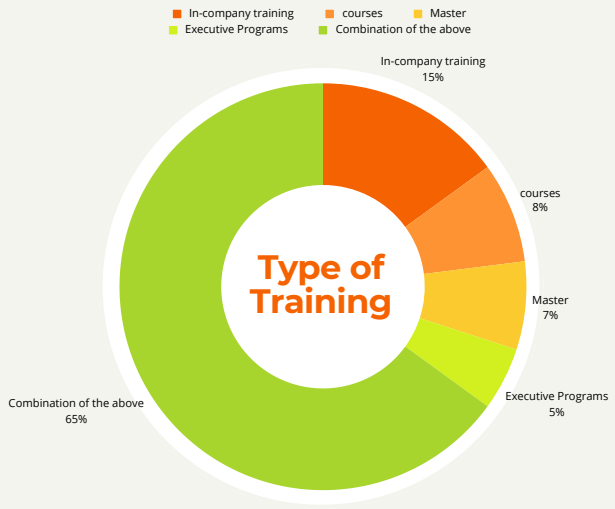
5) Finally, the most demanded category is experience in the general sector, where **Colombia at 21.7%, Italy at 16.7%, Spain at 16.3%, and France at 14.3%** stand out. Comparison with the Previous Edition

4.14

HOW CAN A PROFESSIONAL TRANSITION TO THE HYDROGEN SECTOR MOST EFFICIENTLY?

In the 2022 edition, this question was disaggregated based on the type of form (English or Spanish). In this case, we have chosen to merge data and obtain global responses.

Figure 24. Type of Training



Source: Worldwide Recruitment Energy

Emphasis on Combination of Options:

The combination of multiple options is the most cited, with 65% of responses. This suggests that professionals are considering more holistic and varied approaches to their retraining in the green hydrogen sector, possibly recognizing the complexity of the transition and the need for diversified skills.

Preference for Self-Training or In-Company Training:

The option of "Self-training or incompany training" is individually mentioned the most, with 15% of responses. This could indicate that individuals looking to enter the green hydrogen sector are willing to seek and acquire knowledge on their own or through in-house training programs at their current companies. This is likely one of the most offered options by companies themselves due to the shortage of formal training.

Courses and Master's as a Foundational Basis

The high number of responses for Courses (8%) and Master's (7%) indicates that many professionals consider these programs as a foundational basis to enter the green hydrogen sector. However, the option of a master's degree is still a minority, albeit growing, and new options are added each year.[27]

Interest in Executive Programs:

Although in smaller numbers, the option "Executive Programs" (5%) shows that some professionals are looking for shorter-duration training programs compared to a master's degree. In Spain, there is a specific executive program at the Escuela de Organización Industrial, an option that may not exist in other markets.

Incremental Adoption and Flexibility:

The presence of several options with significant numbers of responses indicates that there is no single approach to transitioning to green hydrogen. Professionals are willing to adopt gradual and flexible approaches to acquire the necessary skills.

The presence of several options with significant numbers of responses indicates that there is no single approach to transitioning to green hydrogen. Professionals are willing to adopt gradual and flexible approaches to acquire the necessary skills.

Year-on-Year Comparison (Not Applicable, the questionnaire is different).

27 In Spain we have identified the following masters:Mondragón University: *https://www.mondragon.edu/cursos/es/master-interuniversitario-tecnologiashidrogeno*
1. UPC Catalunya *https://www.talent.upc.edu/esp/estudis/formacio/curs/205900/master-formacionpermanente-tecnologias-hidrogeno/*
2. *https://www.ubu.es/master-de-formacion-permanente-en-tecnologias-del-hidrogeno-online*
3. *https://www.ehu.eus/es/web/graduondokoak/master-tecnologias-de-hidrogeno*
4. Universidad de Loyola *https://www.uloyola.es/masteres/energias-tecnologias-hidrogeno*

4.15

IS YOUR ORGANIZATION OFFERING TRAINING TO RECYCLE ITS EMPLOYEES IN THIS REGARD?

In this section, there is a significant appreciation for training by users.

1) **Interest and Awareness:** The number of "Yes" responses (224) suggests that a significant number of organizations are willing to provide training to recycle their employees in the green hydrogen sector. This could indicate a growing level of interest and awareness among companies about the importance of adapting to new sustainable trends and technologies.

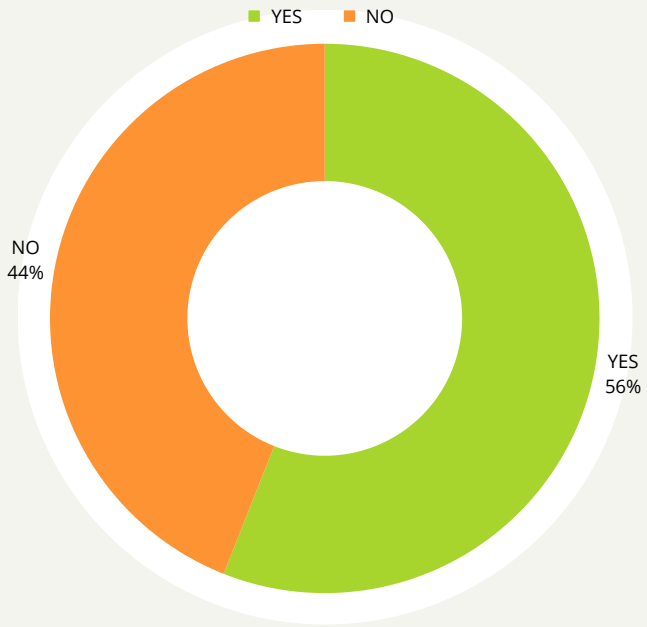
2) **Need for Organizational Change:** Organizations that answered "Yes" may recognize the need to make internal changes to adapt to the green hydrogen sector. This could include reviewing organizational structures, identifying new business opportunities, and preparing for a workforce with updated skills.

3) **Skills Gap:** The fact that some organizations responded "No" could reflect a gap in understanding or the perceived importance of green hydrogen in their current operations. This could also indicate a lack of resources or a limited vision of how this transition could affect their industry.

4) **Collaboration between Organizations and Professionals:** There is an opportunity for collaboration between organizations that are offering training and professionals interested in transitioning to the green hydrogen sector. Organizations could consider designing customized training programs in collaboration with the needs and experience of professionals.

In summary, these results show a mix of willingness on the part of organizations to provide training in the green hydrogen sector. The proportions are similar to those of the 2022 edition.

Figure 25. Does your organization offer training in the area of green H2?

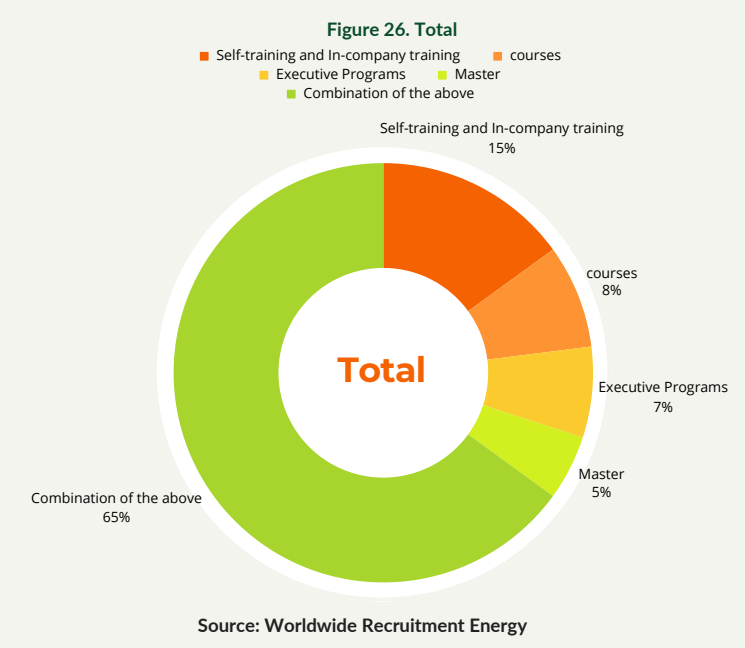


- "Yes" responses: 219
- "No" responses: 178

Source: Worldwide Recruitment Energy

4.16

IF AFFIRMATIVE, WHICH KIND OF FORMATION?



Source: Worldwide Recruitment Energy

Initially, we observe three major blocks (combination, self-training in-company, and courses). The following conclusions can be drawn:

- **Diversification of Training and Previous Response:** The response *"Combination of the above (37%)* regarding the type of training offered by organizations willing to train in the green hydrogen sector reflects a correlation with the trend of *"Combination of the above"* in question 4.13. This suggests that organizations willing to provide training recognize the need for a comprehensive approach that encompasses multiple educational methods.

- **Emphasis on Courses and Masters:** The response *"Courses (27%)" and "Masters (5%)"* in the second question shows that, although in smaller numbers, organizations also consider more formal training, such as courses and master's programs, as valid options. This reinforces the correlation observed in question 4.13 where "Courses" and "Master" were popular responses.

- In general, there is a fundamental difference between this question and question 4.13. While the first aims to describe or approach the ideal training approach desired by professionals, the second (4.15) is a closer snapshot of reality. In the first question, the preferred option is to combine various types of training. In the second, the most offered options are a combination of various (37%), followed by self-training and in-company training, and courses, both with 27%. Master's and executive programs account for 5% and 4%, respectively, and are the least common options.

- It is important to note that the responses to this second form represent 56% of the responses that claim to have access to training through their company, which corresponds to 228 respondents. The rest of the responses do not count as they do not offer training through their organization. This is an important point in this overall consideration.

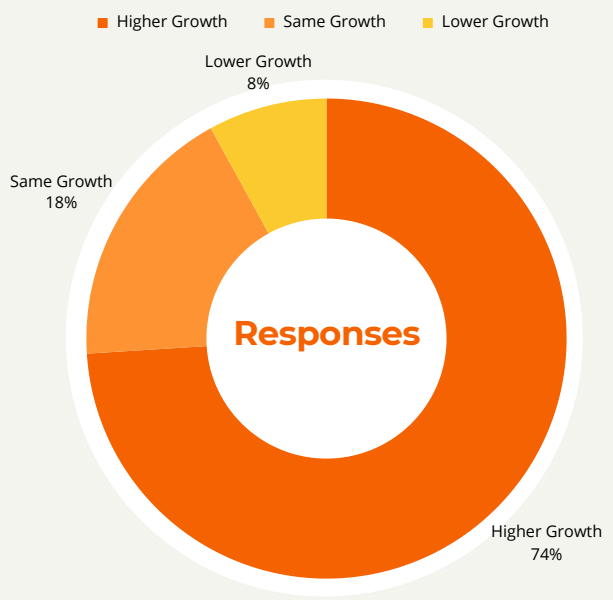
It is important to note that the responses to this second form represent 56% of the responses that claim to have access to training through their company, which corresponds to 228 respondents. The rest of the responses do not count as they do not offer training through their organization. This is an important point in this overall consideration.

4.15

HOW DO YOU BELIEVE THE CURRENT ECONOMIC AND POLITICAL SITUATION HAS IMPACTED AND WILL IMPACT IN THE NEAR FUTURE THE DEMAND FOR PROFILES IN THE HYDROGEN SECTOR (COVID, INFLATION, WAR IN UKRAINE)?

We will analyze these responses in relation to the previous questions, considering the geopolitical context.

Figure 27. Responses



Fuente: Worldwide Recruitment Energy

Greater Growth in Profile Demand:
The response **"Greater Growth 74%"** suggests that the majority of respondents anticipate an increase in the demand for profiles in the green hydrogen sector in the near future. This could indicate a positive perception that the green hydrogen sector will become an essential part of the economy and sustainability. Additionally, the global geopolitical situation seems to somehow push, incentivize, or at least accelerate the transition to a hydrogen economy.

Adaptation and Strategies of Organizations:
The fact that many organizations are willing to offer training in the green hydrogen sector **("Yes" in the training question)** may align with the perception of greater growth in profile demand. Organizations may be preparing to meet future talent needs in this growing sector.

Relationship with Current Geopolitics:
Mentioning geopolitical factors like the War in Ukraine in the question about economic and political impact could indicate that respondents consider geopolitical stability as a factor that will influence profile demand in the green hydrogen sector. Geopolitical stability can be crucial for investment and growth in this sector, especially as an alternative energy supply source to traditional suppliers in the East and as a substitute for Russian-origin gas and oil.

Possible Implications of Inflation and COVID:
Although it is not specified how the effects of inflation and COVID are perceived on profile demand, it can be speculated that inflation could affect budgets allocated to sustainable energy investments and projects, while the COVID pandemic and its subsequent recovery, especially in China where it occurred later, could impact energy demand and investments. It's worth noting that China is the primary supplier of electrolyzers currently.

Trend Towards Sustainability and Diversification:

The anticipated increase in profile demand for the green hydrogen sector could indicate that organizations and governments are actively considering the transition to cleaner and more sustainable energy sources. This reinforces the correlation between the willingness to offer training in the sector and the perception of greater growth in demand.

Year-on-year Variation

It's worth noting that in 2022, 84.2% of respondents stated that the current geopolitical situation had provided a boost to the sector's growth. However, in 2023, this perception partially deflates, with 74% believing that situations like the conflict in Ukraine indirectly boost this sector. On the other hand, those who remain neutral increase from 7.9% to 18%, and those who perceive negative impacts remain at the same percentage (8%). In some way, this suggests a cooling of expectations where many operators were expecting a short-term resurgence.

Reality is showing that hydrogen projects have lengthy timelines, and political circumstances do not always align with economic timelines.

GENERAL CONCLUSIONS

In 2022,

when the first edition of this study was undertaken, there were many uncertainties and doubts regarding the green hydrogen sector.

Is it a passing trend?
Will it deflate?
Is it not competitive in terms of pricing?
Does the market not demand the product?
How can costs be reduced?
Will there be enough professionals?

All these questions still lack a definitive answer. There are no strong price signals, real projects are scarce, and the "chicken or the egg" dilemma remains unsolved. However, something we have been able to confirm in this study is the growing interest among professionals in this sector. Not only has the volume of professionals we could interview increased substantially compared to the previous edition (it has multiplied by four), but there is also a greater number of job specializations in the hydrogen chain and an increased offering of training in this field.

One of the trends that this second edition seems to confirm is a gradual transition from **"on paper"** projects to **"on-site"** projects. The increasing demand and interest in "hard" profiles related to project execution, installation, or maintenance point in this direction. There is also a need for professionals who will only be required in these advanced project phases, such as specialists in electrolyzers, procurement and logistics, pipelines, electromechanics, safety, maintenance, transportation, software, or simply project managers who can manage these phases.

Another point worth highlighting is the increasing importance of what are known as hybrid profiles that include technical knowledge along with business, financial modeling, or even technical sales knowledge. This trend, which undoubtedly exists in other sectors, is particularly intense in this one, where major technological blocks such as energy, chemistry, industrial production, and logistics intersect.

Finally, in this study, we have detected for the first time the demand for **"future"** professionals, which is already the present. Experts in artificial intelligence, maritime energy and technologies, carbon capture and storage, combustion experts, materials, or automation are some of the professions that the future demands and outline the main lines of the green hydrogen job sector. The need for increasingly complex profiles, specialized but also with generalist knowledge, suggests that this will be a sector that requires highly qualified and multifaceted professionals. **As the Irish writer George Bernard Shaw once said, "Progress is impossible without change, and those who cannot change their minds cannot change anything."**

INTERVIEWS WITH PROMINENT PROFESSIONALS IN THE FIELD

Senior Manager of Regulatory Affairs at Hydrogenious LOHC (Germany)

Maryna Hritsyshyna is a Senior Manager of Regulatory Affairs at Hydrogenious LOHC (Germany). She has over 11 years of experience in the energy sector and specializes in hydrogen regulations, renewable energy projects, and energy markets. Maryna has experience in drafting laws for implementing EU regulations in Ukraine's energy sector, including the hydrogen sector bill. In 2023, she was nominated by Women in Hydrogen 50 by Hydrogen Economist in the "Policy and Regulation" category, and in 2022, she was recognized as one of the leading individuals in Ukraine's energy field by Legal 500. In previous years, Maryna was also part of the expert group of the Energy Community.

Hydrogenious LOHC Technologies is developing a solution for hydrogen transport based on Liquid Organic Hydrogen Carrier (LOHC) technology. It provides the missing link in highperformance hydrogen value chains worldwide. Based on its proven LOHC technology with benzyl toluene as a carrier medium, Hydrogenious LOHC enables superior, flexible, and safe hydrogen supply to consumers in industry and mobility worldwide, using conventional liquid fuel infrastructure.

WWR: How would you describe the current state of the global and European job market in relation to renewable hydrogen and ammonia?

The green transition, including the hydrogen sector, is one of the major drivers of changes in the job market in Europe and globally. The World Economic Forum expects the creation of 30 million jobs in the clean energy sector by 2030, and a significant portion of these jobs will be related to the hydrogen sector. The growth of renewable hydrogen projects is expected to align with the goals of the REPowerEU plan. This trend will lead to an increased demand for skilled workers not only in the European Union but also in hydrogen-exporting countries.

WWR: Regarding the most in-demand professional profiles, are they specific technical or scientific specializations where you see a bottleneck?

The hydrogen sector is in its early stages of development, and most professional profiles are still being defined. Some clarifications regarding the most sought-after professionals may be possible, in my opinion, when the hydrogen sector matures by 2030. However, it is essential to note that the hydrogen market's growth depends on the development of new technologies where scientific specializations may be required.

WWR: From your personal experience, what skills do you consider essential to work in this industry?

Based on my experience, the following skills play a significant role in the hydrogen industry:

- Openness to new technologies such as LOHC, which can be used in hydrogen projects.
- Collaboration: the development of the hydrogen economy relies on collaboration between countries through partnerships, various business alliances, and, of course, cooperation among individuals.
- Continuous learning: there are no definitive answers to all practical problems in the hydrogen sector, and even experienced professionals need to study new rules and acquire new knowledge about the hydrogen industry.

WWR: In your opinion, are there enough viable hydrogen projects in the short term? Will we achieve the EU's objectives?

It is too early to assess the fulfillment of the EU's objectives. The requirements for renewable hydrogen production in the EU, as set out in the Delegated Acts, came into force in June 2023. Other significant EU regulations for the hydrogen sector, such as the Hydrogen Package, are still in the process of adoption. Without clear and predictable conditions, it is challenging to expect the immediate realization of hydrogen projects. It is also important to consider that in the early stages of development, the hydrogen sector will depend on available incentives, in my opinion. Initiatives like the Hydrogen Bank and H2Global will have a significant impact on the development of the hydrogen sector in the EU.

WWR: If there were a significant change in the EU regulatory framework regarding the promotion (or hindrance) of hydrogen, how do you think it would affect workers already employed in this professional field?

Any significant change in the EU regulatory framework is driven by policy documents. According to the REPowerEU plan, the EU has clear objectives for the hydrogen sector by 2030, and these objectives cannot be changed overnight. Having worked in the energy sector for over 10 years, I have seen some policy changes, such as the shift from fossil fuels to renewable energy. However, in any case, such changes are possible in the long term, and employees have enough time to plan their careers in the energy sector considering such changes.

WWR: Is there a hydrogen bubble? Are there many promotions but very few projects?

The current situation cannot be considered a hydrogen bubble. Project realization in the EU is a long-term process due to permitting procedures, lack of clarity in regulations, and support schemes. At the same time, some hydrogen projects are in the process of realization. For example, the Hector Project, the world's largest plant for storing green hydrogen in LOHC on an industrial scale, is being constructed in North Rhine-Westphalia, Germany, in CHEMPARK Dormagen, and it will be operational in 2024 by Hydrogenious LOHC Technologies' Krefeld-based subsidiary, LOHC Industrial Solutions NRW GmbH.

WWR: Internationally, which countries are currently prominent in actively promoting renewable hydrogen and ammonia projects and initiatives?

Among other countries, Germany is actively committed to promoting hydrogen projects. This activity is based on Germany's development of energy and water partnerships with other countries. For 15 years, Germany has established various energy partnerships with 23 countries worldwide. Through hydrogen partnerships, Germany not only ensures the diversification of hydrogen import options but also supports the implementation of different joint hydrogen projects with third countries.

WWR: Regarding the required training to enter these jobs, do you think there is a significant gap between what is offered academically and what is needed in practice?

In the energy sector, as well as in the information technology sector and other sectors, there is always a gap between what is offered academically and what is needed in practice. However, there are also many solutions, such as various training courses and programs. Hydrogenious LOHC Technologies, like other companies in the energy sector, also has its programs to share knowledge with new employees and ensure a successful integration process.

WWR: Considering the current geopolitical conflicts between Russia and Ukraine, do you think this can have any direct or indirect impact on the development of the hydrogen sector? What role do you think Ukraine can play in this global context? Any other perspective on the war in Ukraine from your point of view?

The REPowerEU Plan confirmed that Russia's military aggression against Ukraine led to the disruption of the global energy system. To reduce the EU's dependence on Russian fossil fuels, the EU decided to accelerate the clean transition and the development of the hydrogen sector. This means that this geopolitical situation became an additional boost to the growth of the hydrogen economy. Ukraine was mentioned in the REPowerEU Plan as one of the main corridors for hydrogen import. Additionally, in February 2023, the EU and Ukraine signed a memorandum of understanding on a strategic partnership in biomethane, hydrogen, and other synthetic gases. These facts confirm, in my opinion, that Ukraine can become one of the exporters of renewable hydrogen once the country recovers.

WWR: As a woman, have you encountered difficulties in thriving in this sector? Are there equal opportunities? Is there enough female representation in the industry?

Based on my experience in the energy sector, I see many opportunities for women. We also have many associations that support women in the hydrogen sector through mentoring programs, such as Women in Green Hydrogen or Global Women's Network for the Energy Transition. Hydrogenious LOHC Technologies also offers many opportunities for women to start careers in the hydrogen sector, confirming the existence of equal opportunities.

WWR: Finally, if someone wanted to specifically train to work in the renewable hydrogen and ammonia energy sector in Ukraine, what advice would you give them or where could they look for relevant information?

To work in Ukraine's hydrogen and renewable energy sectors, I believe it may be helpful to complete training or gain practical experience in the EU. According to the EU-Ukraine Association Agreement, Ukraine will need to implement key regulations in the energy sector. Additionally, to export hydrogen and renewable electricity from Ukraine to EU countries, it is essential to understand not only the key requirements but also the specifics of EU energy markets. For this reason, knowledge of the EU energy sector can be beneficial for working in Ukraine.

Founder and President of the Mexican Association of Hydrogen, Storage, and Sustainable Mobility

Interview with Israel Hurtado on the current hydrogen market in Mexico Israel Hurtado is a renowned expert in energy, hydrogen, sustainability, and technological innovation in Mexico. Israel is the Founder and President of the Mexican Association of Hydrogen, Storage, and Sustainable Mobility, as well as the author of the book "The Last Reality" and the host of the podcast "Mr.H". With his extensive experience in these fields, Israel will share his insights into the current hydrogen market in Mexico.

WWR: Israel, what is the current situation of the job market in the hydrogen and green currency industry in Mexico?

Israel Hurtado: In Mexico, the hydrogen industry is still in the early stages of development, so there is no consolidated job market in this regard. However, it is important to note that there are already industries related to hydrogen and green ammonia in the country. This means that people working in these industries could transfer their knowledge and experience to the hydrogen and green ammonia sector. Currently, we are focused on building human capital to prepare for the upcoming strong phase of the hydrogen industry.

WWR: What are the main sectors and areas of opportunity in the Mexican hydrogen industry?

Israel Hurtado: We have identified three major areas of opportunity in Mexico. The first is the replacement of gray hydrogen with green hydrogen in the petrochemical industry, where non-renewable hydrogen is already used. The second area is the use of hydrogengas mixtures in electricity generation, especially in industries such as steel, mining, and cement production. Finally, we have the incorporation of hydrogen technologies as substitutes for diesel and gasoline in various sectors. I could share our roadmap with you, which details these industries and their respective impacts and opportunities.

WWR: How does the Mexican job market in this industry compare to that of other countries?

Israel Hurtado: In general terms, the Mexican job market in the hydrogen industry is similar to that of other countries. However, it is important to consider that Mexico has one of the strongest economies in Latin America, which can influence the comparison due to the size of the economy. Despite that, in terms of opportunities and challenges we face, the situation is quite comparable internationally.

WWR: What professional profiles are in high demand in the green hydrogen industry?

Israel Hurtado: The most in-demand profiles in this industry include chemical engineers, industrial engineers, electrical engineers, as well as professionals specialized in renewable energies and those involved in the mentioned areas. Profiles in accounting, economics, law, and others are also required. There is a diversity of professions and skills that will be in demand in this growing green hydrogen industry.

WWR: What are the most valued skills and technical knowledge in this field?

Israel Hurtado: Skills and technical knowledge related to engineering will be highly valued in the green hydrogen industry. It is important to have a solid understanding of areas such as chemistry, industrial engineering, and electrical engineering. Furthermore, a deep understanding of renewable energies and hydrogen technologies will be necessary.

WWR: What role does the government play in developing the hydrogen job market in Mexico?

Israel Hurtado: The government is planning to present a document in the coming months outlining government policies and support programs to promote green hydrogen in Mexico. This will provide greater clarity on the job market and the opportunities that will arise. It is important to stay tuned for these measures and policies that will drive the development of the hydrogen industry.

WWR: How do decarbonization and sustainability goals impact the hydrogen industry and the job market?

Israel Hurtado: Decarbonization and sustainability goals play a crucial role in the hydrogen industry and, consequently, in the job market. Many companies are adopting Corporate Social Responsibility (CSR) practices and are seeking to meet carbon emission reduction targets. This generates a growing demand for skilled employees in the green hydrogen sector. Decarbonization and sustainability will be driving factors for the growth of the industry and job creation.

WWR: What are the main challenges facing the green hydrogen industry in Mexico?

Israel Hurtado: One of the main challenges is that green hydrogen is an emerging industry, so university programs and the industry, in general, have not sufficiently included these topics in their curricula. There is a need to gather and strengthen knowledge about green hydrogen in specialized educational programs, such as master's degrees or specializations at renowned universities. We have initiated discussions with educational institutions, such as Tec de Monterrey and other universities, to work on the preparation of specialized educational programs in green hydrogen and ammonia. This will allow us to be prepared when the job market for these industries develops.

WWR: Is there collaboration between foreign companies and the emerging market of the green hydrogen industry in Mexico?

Israel Hurtado: Yes, there has been significant collaboration between foreign companies and the emerging market of the green hydrogen industry in Mexico. The Mexican member companies, the majority of which are foreign. Additionally, the association has established strategic alliances with leading organizations in the field of hydrogen worldwide. We are adopting international best practices in human capital development and the job market in this industry.

Thank you very much, Israel, for sharing your knowledge and insights into the green hydrogen job market in Mexico. It has been a pleasure talking to you, and I appreciate your time.

Ph.D. in Inorganic Chemistry,

Emilio Nieto is a prominent scientist and expert in the field of inorganic chemistry. He completed his studies in Chemical Sciences and earned his Ph.D. in Inorganic Chemistry, conducting his research at the prestigious CSIC (Spanish National Research Council). Throughout his career, Emilio has worked in various companies and research centers, with notable roles in a British multinational specializing in ceramic products and as a director at the National Hydrogen Center. His career has been closely tied to research and development of sustainable technologies, especially in the field of hydrogen and its applications in various industrial sectors.

WWR: Emilio, could you tell us about your experience in the last 6-7 years regarding hydrogen?

E.N.: It has been an interesting but also challenging period. I have encountered difficulties in dealing with administration, which has been somewhat frustrating. It is essential to understand that hydrogen is not a one-size-fits-all solution for all sectors. We need a balanced approach to electrification, using both hydrogen and batteries, depending on the It has been

an interesting but also challenging period. I have encountered difficulties in dealing with administration, which has been somewhat frustrating. It is essential to understand that hydrogen is not a one-size-fits-all solution for all sectors. We need a balanced approach to electrification, using both hydrogen and batteries, depending on the

WWR: What will be the most prominent hydrogen technologies in the future?

E.N.: Mobility will be one of the most important sectors for hydrogen. In Spain, we are already seeing significant progress, such as the implementation of hydrogen buses, like the 10 that are in operation in Madrid. This is an effective way to show people that hydrogen is a viable and safe option. Additionally, the oil and gas sector is one of the largest consumers of hydrogen in the country. Other sectors, like metallurgy, are also looking to replace coke with hydrogen and exploring how to make this transition efficiently. Furthermore, applications like blue hydrogen and its use in industries such as ceramics or cement to reduce carbon footprint are gaining importance. Once we have a hydrogen refueling infrastructure, we will see more industries adopting hydrogen in their production chains.

WWR: What are the most in-demand profiles in the field of hydrogen?

E.N.: The demand for technical and professional profiles in the field of hydrogen is very high. While many people focus on university education, I want to emphasize the importance of Vocational Training (FP in Spanish). FP is managed by the Ministry of Education, and we currently need more support and recognition for this area of education. There is a shortage of electrical and electronic engineers specialized in power electronics, design, and integration. Additionally, there is a growing need for experts in energy and thermal management. In my experience, many of the professionally trained individuals at the research center where I work are attracted by job offers in private sector companies.

WWR: What advice would you give to those interested in working in the field of hydrogen?

E.N.: My advice is to be patient and consider that hydrogen will have a very promising future. It is essential for professionals to have a flexible profile and broad training, as hydrogen will span various areas. Additionally, staying informed about government calls for proposals and financial support is key to the development of sustainable projects. It is also vital for educational institutions, universities, and the Ministry of Education to collaborate in offering proper education in the field of hydrogen, both at the university level and in Vocational Training.

WWR: How do you see the future of hydrogen in Spain?

E.N.: I believe Spain has significant strategic potential in the field of hydrogen and has been recognized as one of the European powers in this field. The recent approval of pioneering projects and the injection of financial support for the development of renewable hydrogen are important steps in the right direction. I am confident that in the coming years, we will see a significant increase in both small and large-scale projects. As the hydrogen value chain develops, numerous job opportunities will be generated in the sector, making it a powerful strategic industry for Spain.

Hydrogen Expert at Engie in Chile.

Asunción Borrás is a prominent professional in the energy and hydrogen industry. Currently, Asunción is the Head of Hydrogen Business Development at Engie and Vice President of H2 Chile. Additionally, she is an Ambassador for Women in Energy (WEC Chile) and plays a significant role as a Strategic Advisor and Investor at SAVIA Ventures. In this interview, we will learn more about her extensive career and her vision for the industry.

WWR: Asunción, please share your opinion on the labor market in the hydrogen sector. What profiles are in demand, and what are the challenges in finding them?

Asunción Borrás: In general, the market is forming or strengthening teams in the hydrogen sector. Profiles related to construction are primarily sought, which was not common in this field before. We need personnel with experience in the construction, execution, and maintenance of projects. Project development profiles are also in demand, but they don't necessarily need specific knowledge of hydrogen.

It's important that they understand critical paths and pathways for project development. However, the supply of technical profiles in hydrogen is limited, and there is high demand, especially in the field of photovoltaic energy (PV).

WWR: What is the difficulty in finding technical profiles in the hydrogen sector?

Asunción Borrás: When it comes to technical profiles, it is particularly challenging to find experts in the field of wind energy. At a higher level, there are very few professionals available. Additionally, many people with experience in oil and gas tend to stay within that industry, and it's necessary to open up to new industries to compete in terms of salaries.

WWR: What is the current situation of demand and infrastructure for hydrogen in Chile?

Asunción Borrás: In northern Chile, there is a challenge regarding demand and infrastructure. There is not enough evacuation capacity for all renewable generations that occur simultaneously. However, hydrogen demand may be different because it is produced at different times and in different regions of the area. This prevents excessive impact on the infrastructure of a single region. Therefore, we don't believe the same situation that has been experienced with renewable generation in the north will repeat itself.

WWR: What is the expected duration of this excess demand in the hydrogen sector?

Asunción Borrás: Hydrogen is a long-term project with an estimated duration of 25 years. The matching capacity of a generation profile to a 24-hour supply profile depends on consumption patterns. You can't simply match a solar profile, for example. Additionally, the duration of "curtailment" (generation reduction) is also a factor to consider.

WWR: What is Chile's strategy regarding the hydrogen market?

Asunción Borrás: In Chile, we are not aiming to be the cheapest in the world in the hydrogen market. We want to be competitive but not at the cost of reducing prices. Moreover, it's important to understand the technology and know how to develop projects in this field. Electrical profiles are essential, and academic education is valuable. Many people undergo training while working on projects.

WWR: How do you see the presence of women in the hydrogen sector?

Asunción Borrás: There is a profile of women who are more inclined toward the long term than the environment. Personally, I come from the renewable energy field. Eight years ago, I transitioned to the hydrogen sector after completing a wind farm in Calama. In the hydrogen sector, there is a constant challenge due to the novelty of this industry, whereas in renewable energies, projects tend to repeat.

Is there hype or over-expectation surrounding hydrogen?

Asunción Borrás: There are two types of developers: those who believe in the projects and those who don't. Personally, I believe in the projects I trust and believe will progress. However, there are many projects where doubts and lack of knowledge arise. Some may overvalue the project's readiness. Regarding "curtailment," we cannot base our long-term strategy on a generation reduction that may occur in 20 or 25 years; we cannot rely on curtailment for the development of the hydrogen sector. We need firm 24-hour energy.

Hydrogen Expert at Repsol

Maribel Rodríguez is one of the most experienced individuals in the hydrogen sector in Spain. With 16 years of experience in the hydrogen sector, she is a seasoned professional.

Currently, she works as the Hydrogen Business Development Manager at Repsol. Throughout her career, Maribel has led hydrogen business development in various companies and has been involved in over 35 innovation projects.

She has also held key roles in international organizations, such as the International Energy Agency (IEA). With a deep conviction in the potential of hydrogen to decarbonize the economy, Maribel remains committed to developing capabilities, establishing collaborations, and promoting projects in this exciting low-carbon energy sector.

WWR: Maribel, please tell us about your professional journey in the hydrogen sector.

Maribel Rodríguez: My case is a bit unusual. I entered the sector in 2007 and worked for a company whose primary goal was to develop renewable hydrogen production equipment and hybridize these technologies with other low-carbon options to promote the transition to a sustainable energy economy. I stayed with this company until 2020, and at that time, renewable hydrogen didn't have a market yet and was in a pre-commercial stage. The company couldn't sustain itself solely by selling hydrogen, so we supplemented market development with various activities related to renewable hydrogen, including training, consulting, equipment optimization projects, and managing support organizations for renewable hydrogen development (technology platforms and associations).
I must say that keeping this company afloat for so long in that situation was quite a challenge, but it was an enriching experience for me. After working for another renewable energy company with an innovative vision for using hydrogen to maximize the potential of renewable energy parks, I joined Repsol in 2021 to lead hydrogen business development. At that time, there were still very few of us with experience in renewable hydrogen. My background is in Forestry Engineering, and I later pursued an MBA. I entered the hydrogen sector without specific training in the field, but I chose to work in this hydrogen-focused company because the woman who conducted my technical interview impressed me with her explanation of the technology's potential, capturing my attention. I didn't know how long I would stay with that company, but I was clear that I wanted to learn more about this topic. This small company gave me the opportunity to get involved in all aspects of hydrogen, from driving collaborative projects to testing electrolysis equipment in various conditions, such as above a tank or in a stream for oxygen valorization in aquaculture.

WWR: What has been your experience within Repsol regarding the transition from oil and gas to hydrogen?

Maribel Rodríguez: At Repsol, most people have extensive technical knowledge in the petrochemical sector, as well as in gas sales, energy management, renewables, and more. All this knowledge is highly complementary to renewable hydrogen, as developing a business in this field requires not only expertise in electrolyzers but also in managing renewable energy, transforming and storing the product, and most importantly, knowing how to market it. Repsol focuses on providing training to these profiles to leverage their prior knowledge and actively contribute to the development of renewable hydrogen production and consumption projects. In the Industrial Organization School (EOI), where I teach the renewable hydrogen value chain module, training programs have been conducted to facilitate this transition, with high demand from students. At Repsol, internal training has been the norm, combined with skills brought from outside the company, as in my case.

WWR: What types of skills are most valued in the hydrogen sector?

Maribel Rodríguez: Perhaps the most valued profile in terms of "hard" skills is business development. Currently, it is challenging to find individuals who have participated in actual renewable hydrogen production projects and also have a comprehensive understanding of the sector's evolution, its integration with renewables, and the ability to optimize business cases to drive these projects forward. As for "soft" skills, resilience, tolerance for uncertainty, and creative problem-solving to address the challenges in this sector are highly prized.

WWR: What is your opinion on the growth of specialized personnel hiring in the hydrogen sector?

Maribel Rodríguez: From my perspective, it's true that we need more people in the sector, not only engineers but across the entire value chain to support maintenance, auxiliary services, regulatory support, and more. Currently, we are in a period of high uncertainty since there is no clear business model yet that can drive projects. Therefore, most companies are cautious, opting to increase internal training on these topics instead of rapidly hiring numerous external profiles, as is the case with Repsol. In my view, when there is a possibility to make these projects profitable, there will undoubtedly be an increase in hiring.

WWR: When do you think hydrogen will truly take off as an energy source?

Maribel Rodríguez: It's important to remember that renewable hydrogen is not an energy source but an energy carrier, and its decarbonization potential is closely linked to the deployment of new renewable energy parks. Europe has been one of the first economies to commit to achieving net-zero emissions by 2050, which entails various actions to reduce energy consumption, valorization, and the development of renewable hydrogen, encouraging its use and fostering new production projects to reduce hydrogen prices. In Europe, mechanisms to incentivize the launch of new renewable hydrogen production projects have been employed, such as support for CAPEX, along with regulatory measures to promote its use in different sectors. It's true that in the past year, the sector's evolution hasn't matched the expected pace of declining electrolyzer prices and low renewable production prices. In the next decade, significant CAPEX reductions of up to 65%, according to the best projections, are expected, followed by lower renewable electricity prices, which will promote more widespread use. Additionally, the deployment of heavy fuel cell vehicles has been slower than expected. In my opinion, this decade will see the real deployment of projects as renewable hydrogen becomes a relevant energy carrier, potentially accounting for 15-20% of final energy consumption by 2050, with projects ready for implementation. WWR: What is your opinion on Spain's role in the hydrogen industry? Maribel Rodríguez: In my opinion, Spain has a unique opportunity to attract companies and manufacture electrolyzers here while harnessing its high renewable capacity and its port and gas infrastructure to become an exporter of low-carbon footprint products and renewable hydrogen to the rest of Europe.

To seize this opportunity, we need to swiftly create a stable regulatory framework that instills confidence in investments in such projects, facilitates permitting, and focuses on the initial projects closest to the market, which will serve as catalysts for further development. Spain's location in relation to Europe is ideal for this opportunity, and we must work together, both private companies and public entities, to ensure that it doesn't slip through our fingers, as has happened with other industries.

WWR: How do you view the participation of women in the hydrogen sector, both technically and in leadership roles?

Maribel Rodríguez: There is still a long way to go to achieve gender parity in this sector, especially in leadership positions. Specifically, in Repsol, the hydrogen team consists of 55% women and 45% men. It has been demonstrated that diverse teams offer a more comprehensive perspective and generally achieve better results. In Spain, according to 2022 data, women have a participation rate of less than 30% in the energy transition and roles related to the energy sector. There is still much work to be done, but we are on the right path.

WWR: What advice would you give to individuals interested in entering the hydrogen sector?

Maribel Rodríguez: I would tell them that they are getting into an exciting sector, not without challenges and difficulties, but a sector that will set the foundations for the energy transition and the integration of two previously disconnected energy worlds: electrons and molecules. We are still in the early stages of takeoff, but there is no doubt that renewable hydrogen will gradually gain prominence and become a fundamental pillar in the energy transition in the coming years.

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Thank you all.

ALEJANDRO DIEGO
Professor EOI | author

MEET OUR TEAM

DANIEL REYES
Director Global Operations

HÉCTOR LATORRE
Business Development Director

RAFAEL LÓPEZ
Director Executive Search

Worldwide Recruitment ENERGY

www.energy.worldwiderecruitment.org
Gran Vía 4, Utopicus, Madrid, España
+34-647-462-396

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ENERGY

We are an international and multicultural company based in Madrid and with international reach uniting LATAM and EUROPE through our offices in Mexico City and Sao Paulo. Our objective, through the identification and selection of the most prepared profiles in the work environment for their landing in the renewable energy sector, is to help in the fight that the world is facing against climate change, in addition to training new talents.

On a social level, we have a direct ecological and development impact on local communities.

At the individual level, our focus is on solving the candidates' needs for their professional development, as well as being catalysts for professional ambitions and the integration of new talents for the ultimate goal, combating climate change.

VALUES

BE THE OWNER

We believe that if you limit a person, what you do is limit their potential. When people are free to make their decisions and responsible for their consequences, that is when they truly shine. When you own your actions is when you can truly grow, help others grow and give value to the world.

EMBRACE THE DIFFERENT

We believe that a person's potential is as great as the world in which they live. When people experience new things, their perspective changes, their limits expand, and their value increases exponentially. To truly grow, to grow to the fullest, you have to expose yourself to the different, try the new and venture into the unknown.

CREATE POSITIVE ENERGY

We believe that energy is the basis of happiness, that without energy it is impossible to be happy. We also believe that when a person is full of energy is when they can change things. But we also believe that having a lot of energy is worthless if you don't use it to do something good. In fact, we believe that in order to truly create maximum energy, it is essential to use it to improve the lives of others.

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