Women's representation in the STEM workforce

Exemplifying obstacles to female employees in STEM with the Green Hydrogen Industry

Authors: Manuel Richard Löw,   University of Glasgow,

University of Barcelona,

Georg August University Göttingen

Francisca Manríquez Ubilla,   Autonomous University of Barcelona

Abstract

This research paper aims to analyze the role of gender in the still emerging green hydrogen industry. The work was done in cooperation with the United Nations Industrial Development Organization (UNIDO). Due to the agency's focus on technology relevant for the achievement of climate goals, there is an increased relevance to examine the gender inclusiveness of the industry. To approach the topic methodologically, academic literature on the general role of gender in the science, technology, engineering, and mathematics (STEM) fields was first systematically analyzed for frequently cited deficits. The findings from the literature review were then used to develop a questionnaire for a qualitative, semi-structured series of interviews with female experts from the Women in Green Hydrogen Network. The interview catalog is thereby divided into the following categories: before looking for a job, general challenges, recruitment, job experience (divided into tasks; department climate; work-life balance; return after paternity leave), promotion and recommendations. To analyze the interviews, codes were defined and counted to identify relative frequencies and provide a nuanced overview of the obstacles women face in green hydrogen. Generally, both overlaps and extensions to aspects of the female experience in the field of green hydrogen described in the literature could be made.

A particularly revealing academic contribution lies in the contrasting of frequent code mentions according to demographic characteristics. For instance, it stands out that women in higher management positions are more responsive to gender advantages and sometimes fail to recognize discriminatory patterns, while younger women are more sensitive to discriminatory practices, such as in recruiting or in the assignment of tasks. With regard to the region of origin, an increased sensitivity of women from the Global South to issues related to the traditional role of women can be observed. The work is concluded by a list of policy recommendations based on the statements of the interviewees. The recommendations are divided into suggested changes in work dynamics and work conditions.

Index

List of figures

1. Introduction

Science, Technology, Engineering and Mathematics (STEM) are vital for creating innovation and technological development (Kuschel et al., 2020). This is why STEM disciplines are seen as crucial by policy makers and economists for the economic and social development of nations (Verspagen, 2005). On the one hand, there is widespread consensus on the importance of STEM subjects for overall economic welfare in today's societies. Ideally, under perfect market conditions and without the influence of societal biases, the best possible available talents would be placed in relevant positions in the STEM field (or in other industries) from the complete pool of people in a society (Wanelik et al., 2020). In reality, however, a structurally distorted picture has prevailed for decades: worldwide, women are on average underrepresented in STEM fields both in academia (Piatek-Jimenez et al., 2018) and in the conventional labor market (Alam & Sanchez-Tapia, 2020).

Following this, given the context of the pandemic, the Global Gender Gap report (World Economic Forum [WEF], 2021) notes that only two of the so-called fast-growing "jobs of the future", i.e. work related to automation, digitization and with a high presence of technologies, have achieved parity, and these are precisely the more "people-oriented" jobs, i.e. work that requires direct interaction with people (Morgan et al., 2013).[1] Alongside this, the WEF report argues that gender inequality is more likely to be found in jobs that require disruptive technical skills. They highlight that in jobs such as Cloud Computing women represent only 14.2 percent of the workforce, in Engineering they represent 20 percent and in Data and AI they currently represent 32.4 percent. Gender equality is one of the 17 Sustainable Development Goals (SDGs). However, the report "Progress on the Development Goals – The Gender Snapshot 2019" (UN Women, 2021) sets out that 6 out of the 17 SDGs do not contain gender-specific indicators and targets regarding gender equality as an underlying goal, among them is SDG 9: "Industry, Innovation and Infrastructure". This is alarming, as only 28.8 percent of the world's researchers are women (UN Women, 2019) and one of the targets of Goal 9 is to increase scientific research and the number of people working in industrial sectors in all countries (United Nations [UN], 2022). Regional

---

[1] The WEF Global Gender Gap Report identifies eight "jobs of tomorrow" based on growth prospects, namely People and Content Production, Culture, Marketing, Sales, Product Development, Data and AI, Engineering and Cloud Computing. Only in the areas of content production and culture is the female employment rate above 50 percent.

differences in the representation of women can be observed, for example in the proportion of university graduates, but also in the labor force (Schmuck, 2017). Additionally, the extent of the underrepresentation of professional women differs significantly across STEM fields. By using US data drawn from the NSF's 2013 National Survey of College Graduates (NSCG), Kahn and Ginther (2017) reveal that women with a STEM bachelor's degree are more likely to take an education or health-related job, other than a computer, engineering, or business and management job, than are men. Given this context, it is paramount to adopt a gender policy in the transition to digitalization and industrialization of jobs, which includes flexible work options, childcare, and care options to reduce women's unpaid care work and equal parental leave (PwC, 2022).

Considering the above, the question naturally arises as to why there is an under-representation of women in the STEM workforce. This paper recognizes the global trends and, against this background, examines the situation of a specific group of people in order to highlight similarities and differences to the general situation in STEM professions. The inclusion of women in technical professions is relevant to the entire UN system, but the United Nations Industrial Development Organization [UNIDO] in particular has a special role to play in this regard, given its expertise and proximity to forward-looking and sustainable sectors of the economy. One of its focus projects relates to the propagation of clean energy access for productive use through green hydrogen - a technology that is essential for achieving a low-emission energy transition (UNIDO, 2022). Due to the relevance of this relatively young industry, this study aims to shed light on the situation of women engineers in the area of Green Hydrogen, a sub-area of the STEM-fields. Starting from these considerations, we pursue the following research question: **What obstacles are female engineers in the Green Hydrogen sector facing during the job entry and on the job and how can these obstacles be reduced?**

By examining the situation of female engineers in Green Hydrogen, two distinctive features emerge that are conducive to the underlying investigation. On the one hand, the focus on a specific subfield of STEM fields allows for a contrasting comparison to highlight differences between general challenges for women in STEM and Green Hydrogen. Furthermore, green hydrogen represents a relatively young industry, so it is interesting to learn about the

dynamics and experiences of women engineers in this sector. Hence, contemporary research on the sub-field and the preparation of policy recommendations are of particular pertinence.

To approach the research question, we follow a qualitative research method using a semi-structured interview series to collect data from a total of 11 female engineers in the field of green hydrogen. The interviews followed a predefined list of questions. These correspond to the different phases within the professional life frequently mentioned in the feminist STEM literature, namely (1) hiring, (2) work climate, (3) work-life balance, (4) parental leave, and (5) promotion.

In the following chapter 2, we will first examine the green hydrogen sector in more detail in terms of technological and social characteristics, before providing a comprehensive overview of literature on gender in STEM in chapter 3, which also explores important phases and areas in working life within which women experience discrimination. Chapter 4 provides a detailed presentation of the qualitative research method, followed by Chapter 5, which discusses the results of the same according to overarching and demographically specific characteristics. Conclusions and policy recommendations are presented in Chapter 6.

2. Gender in the energy sector and Green Hydrogen

In the context of this research, we focus on women working in the green hydrogen industry, therefore, a few contextualizing remarks about the industry which represents a sub-area within the STEM-field are to be mentioned. Green hydrogen belongs to the energy sector in a broader sense, as it is a fuel. For some years now, hydrogen has been traded as a leading option for storing energy, which is also emission-free when generated from renewable sources (Chugh & Taibi, 2021). Green hydrogen, on the other hand, is considered a form of clean energy with a low-carbon production method realized mainly through electrolysis of water using renewable energy. In principle, the production of green hydrogen does not cause any environmental pollution. The transition from grey or blue hydrogen to green hydrogen is the current idea for the development of hydrogen production (Li et al., 2022). Possible sources for green hydrogen generation via water electrolysis involve using electricity from renewable generators powered by wind turbines, photovoltaic panels or hydraulic turbines (Bellotti et al., 2015). Due to the technological nature of green hydrogen, knowledge-intensive professions such as engineers and chemists are in particular demand.

Much of the academic literature is concerned with the scientific properties of the technology, technological feasibility, and economic cost analyses. However, as Hanusch and Schad (2021) point out, the debate lacks a social science perspective. A feminist critique of the green hydrogen discourse sheds light on a traditionally post-colonialist system characterized by an asymmetry of power between the producers of green hydrogen in the global South and their consumers in the global North. Typically, the people most affected by these asymmetries at the global level are women and marginalized people. According to Kalt & Tunn (2022), "what leads to global inequalities at the macro level is also due to the personnel composition of companies and teams in the field of green hydrogen" (p. 75). For example, it is the case that only about 20 percent of all panelists at green hydrogen conferences are female, indicating a quantitative and power-related gender imbalance in the industry according to Schoettler (2022). Furthermore, existing literature points to gender inequalities in the energy and engineering sectors. The threats described above are part of what can be generally observed in the STEM fields, ranging from unfriendly working environments to unequal distribution of tasks according to gender stereotypes (Bell et al., 2020; Fouad & Santana, 2017).

3. Theoretical framework on overarching obstacles for women in STEM

Scholars tend to focus on structural and social circumstances that can explain the gender gap in STEM fields. Since Green Hydrogen represents a subfield of STEM, we will draw implications from the general STEM literature. So-called structural approaches in this context address, for instance, critical turning points along the so-called "leaky pipeline" (Pell, 1996, see fig. 1). The term is a descriptive metaphor often used among researchers to refer to the disadvantaged situation of women compared to men in STEM professions at different points in their careers, such as education, job entry or retention (Diekman et al., 2015, p. 54; Fouad and Santana, 2017, pp. 32–33). Vera-Gajardo (2021) argues that to address the gender gap in STEM areas, at least three axes should be considered: existing information on the under-representation of women in STEM; studying the consequences of this at different levels; and investigating the reasons that have led to the under-representation of women. By making use of the leaky pipeline perspective, distinct critical points in the career life of women can be addressed in this context, paving the way for detailed analysis of the aforementioned axes. Within the scope of this paper, both job entry and retention of

women engineers in Green Hydrogen as a subfield of the STEM areas shall be discussed. For this, we will firstly elaborate on barriers that women according to scholarship generally face in STEM fields to later contrast these with our specific findings for women engineers in Green Hydrogen.

Figure 1: Schematic illustration of the "leaky pipeline" metaphor for women in STEM fields
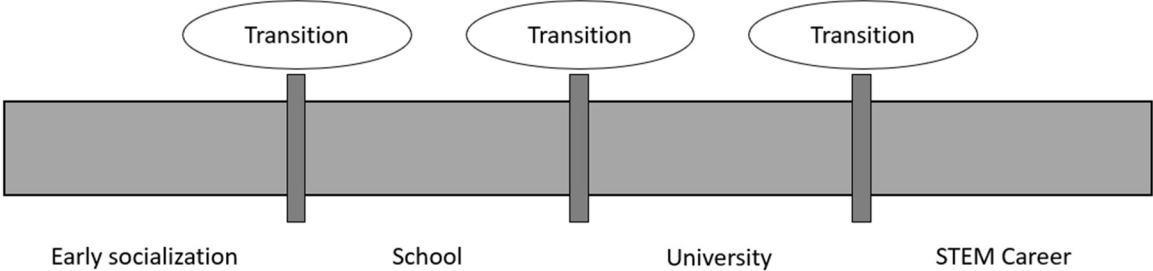
Source own illustration, based on Diekmann et al. (2015)

To understand the barriers women face at the moment of entering the professional field, theoretical approaches such as the Social Identity Theory (Piatek-Jimenez et al., 2018) or Communal Goal Congruity Perspective (Diekman et al., 2015) give an insight regarding the social-cognitive connotation of STEM and traditional gender role models. Both address the role of society in the socialization of girls, which leads to a role model that focuses more on social occupational fields in the broader sense than on the competitively connoted STEM fields. This bias then becomes apparent in the decisions of individual women who, due to the influences of their environment such as family and school, are taught an understanding that excludes STEM as a possible career option. An interesting overview in this regard is provided by the United Nations Educational, Scientific and Cultural Organization [UNESCO] model to illustrate external influences on women's values (UNESCO, 2017). It sets out an ecological framework on the factors that influence female participation, performance, and progression in STEM studies. This framework states that these factors are detected at the level of the student, family and peers, school, and society (See fig. 2). Furthermore, social biases become institutionalized the moment women are structurally disregarded in moving up the career ladder. This can happen through lack of encouragement and promotion through school teachers or biased decision-making by recruiters in selection interviews (Eaton, 2020; Piatek-Jimenez, 2018).

Figure 2: Ecological framework of factors influencing girl's and women's participation, achievement, and progression in STEM studies
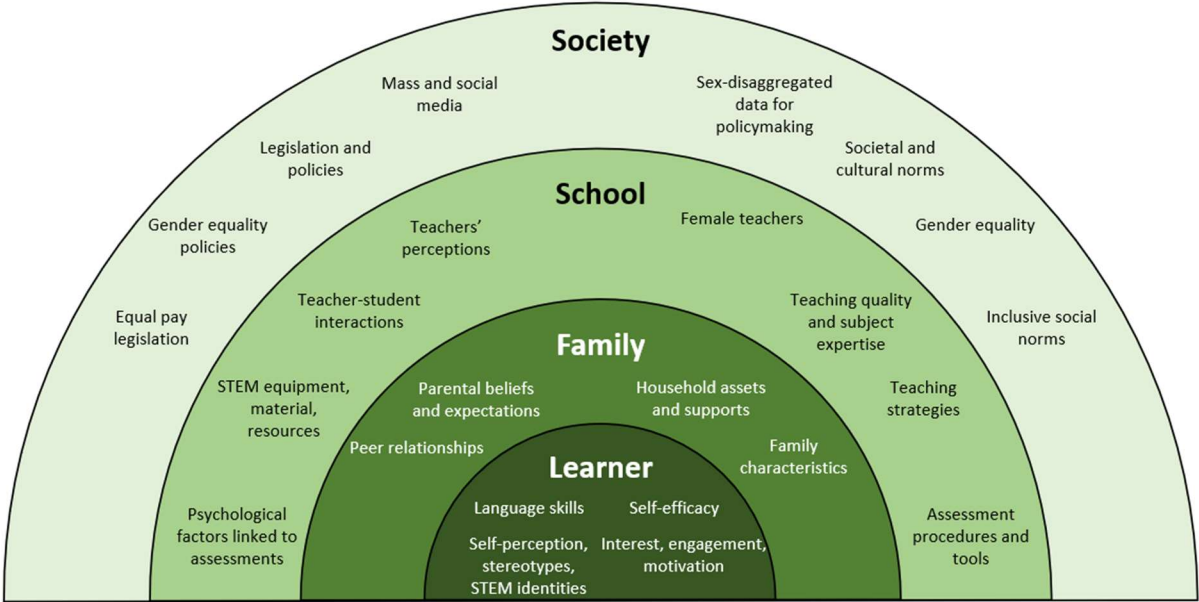
Source own illustration, based on UNESCO (2017)

A major component of gender research in STEM fields focuses on the social and institutional experiences of girls and young women in the field of education. Education plays an important role within the STEM pipeline. It decisively shapes girls at a young age and contributes to their orientation through institutional and social circumstances. Many scholars describe how traditional role models, a gender bias on the part of the teaching staff as well as the lack of role models cause children to take up or reject STEM-related interests and hobbies according to their gender at an early age. Due to the limited scope of the study to professional life, at this point we would just like to refer to some important research contributions instead of elaborating extensively on the relation between education and job entry in STEM-fields.[2] The following chapters provide some remarks on the barriers in the professional life for women in STEM, as listed set out earlier.

A number of barriers are mentioned in the literature in this context: Sanders and Ashcraft (2019) analyze (1) bias in recruitment mechanisms. Saxena et al. (2019) speak in this context of "workplace incivility", which becomes apparent through a non-inclusive (2) work environment (not least due to traditional underrepresentation). A distinction is made

---

[2] see, among others, Legewie and DiPrete (2014), Blackburn (2017), and McLean et al. (2020)

between "undermining" and "hostility" in work processes and dynamics. (ibid., 590) This problem is exacerbated for women belonging to ethnic minorities (McGee & Bentley, 2017; McWhirter & Cinamon, 2021). Other structural shortcomings are highlighted by Dasgupta and Stout (2014) - they observe the lack of opportunities for women to reconcile (3) work and family life. Women still have the primary role of caretaker, which could be why they are often more inclined to interrupt or abandon careers. Another problem arises for the (4) return to work after significant breaks, such as illness or maternity leave, according to the researchers. Further, in addition to these multiple barriers before and within jobs in STEM fields, deficiencies are also observed with respect to the (5) promotion of women (Sanders and Ashcraft, 2019).

3.1. Gender bias in hiring

In line with the metaphor of the leaky pipeline introduced above, the moment of hiring marks the entry into the working life phase from our perspective. According to some studies, here the first hurdles for women to start a successful career in Engineering occupations become apparent. For instance, the US National Research Council (2010) conducted research in engineering and science faculties to look at gender differences in this context of academic hiring. According to the investigation the hiring process involves three phases: application, interviews, and offers. In the application phase, it stood out that in fields where there is a lower percentage of women studying for a PhD, more women applied for a job in academia. However, "the proportion of female applicants in civil engineering, physics, and electrical engineering was significantly lower" (National Research Council, 2010, p.50) compared to chemistry and biology faculties. Along with this, the investigation states that recruitment committees that had a high percentage of women or where a woman headed the committee had a significant and positive association with the percentage of women who applied for these positions. In the second phase of the hiring process, it is observed that there is a higher percentage of women called for an interview compared to the percentage of women who apply for a job. Along with this, they notice that the likelihood of women being interviewed increases if there is a higher percentage of women applying for the job, if the committees are made up of women and if the job post has family-friendly policies. Regarding the process of offering the job to a woman as first choice, there is a higher probability of recruitment if the percentage of women interviewed is higher and if the dean approves the

offer. Finally, the US National Council Research (2010) emphasized that "In 95 percent of the cases in which a man was the first choice for a position, a man was ultimately hired in that position. Compare this to the case for women, where only 70 percent of cases in which a woman was first offered a position was a woman ultimately hired"[3] (p. 59). It was also observed that when weighing the reasons for accepting a job in science and engineering faculties, women significantly consider family-related aspects as opposed to men. In addition to the above, it has been noticed that women only apply for jobs where they believe to meet 100 percent of the requirements, while men only apply when the application requirements are partially met (Mohr, 2014).

3.2. Social department climate

In relation to the departmental work environment of women in STEM fields, a number of hindering influences can be identified. Workplace incivility is a phenomenon frequently described in the literature that women feel exposed to in a male-dominated domain, especially in STEM subfields with particularly low female representation (Saxena et al., 2019). Fouad et al. (2016) highlight two main behaviors in this regard, namely, undermining and hostility. In the first behavioral pattern, women are implicitly or explicitly deprived of competences through a harmful label, either by being ignored in discussions or by having their opinions belittled (Duffy et al., 2002). This uncompanionable behavior sometimes deprives women of networking opportunities, makes them feel excluded in formal and informal contexts, and prevents them from establishing relationships with senior faculty in the same way as male peers (Dasgupta and Stout 2014, p. 26). The verbal and social processes here mentioned coincide with the technical and social dualism mentioned elsewhere by Cech (2013). He describes that even within a professional domain such as engineering, knowledge-intensive technical, and non-technical social and administrative tasks are to some extent divided between the sexes, resulting in women being assigned the latter, i. e. At the same time, women are paid less than their male peers for performing technical tasks, even if these make up the majority of a female employee's range of tasks. A further important aspect is the symbolic belonging to a community, which can be assigned to a gender due to institutionalized social path dependencies - in the case of engineering, a masculine label is to be provided here (Vera-Gajardo, 2021). Furthermore, resulting from

---

[3] These data refer to the United States.

this circumstance, the phenomena "gender in/authenticity" and "gender in/visibility Paradox" are described by Faulkner (2011). On the one hand, the individual female perception of the person different from the engineering environment perceived as masculine leads to a feeling of alienation for those affected. In addition, women in the engineering environment are strongly perceived as women but hardly visibly perceived in their function as engineers.

3.3. Work-life-balance

Another often-described obstacle for women in STEM is the difficulty of balancing family life and career development. As Piatek et al. (2018) correctly point out, this is not a circumstance exclusively given in STEM fields. Interestingly enough, in a survey conducted by the scholars, the incompatibility of family and children was found to be relatively higher in STEM fields compared to other fields (2018, p. 1449). In the masculinized STEM fields, other values such as power and money are given more importance than family (Diekman et al. 2015, p. 66). This has implications for women with children, as family and work-life policies have an increased effect on the well-being of female employees compared to their male counterparts (Dasgupta & Stout 2014, p. 26). Furthermore, being a mother can have a negative impact on the monetary remuneration of women's working hours, as this is connoted with reduced productivity on part of employers (Cech, 2013, p. 1155). As women are also more likely to play the role of caregivers, they have practically greater problems in fulfilling professional responsibilities, let alone in taking advantage of informal events and networking opportunities that are important for career advancement in addition to formal working hours (Piatek-Jimenez et al., 2018). In this context, a study by Frehill et al. (2008) found that women are more likely than men in STEM to end their careers because of children.

3.4. Return to STEM careers after parental leave

Furthermore, it is more difficult for women to seamlessly re-enter their jobs after career breaks without their career development being affected. Their personal networks are weakened by their absence and lack of exposure to the professional environment. In addition, a lack on the part of hiring organizations can also be identified here, as non-linear careers are all too often still stigmatized. Similarly, in the absence of appropriate training

opportunities, the skillset of the person concerned may diminish during prolonged periods of absence, which can also have a negative impact on seamless re-entry into the workforce (Dasgupta and Stout, 2014, p. 26).

3.5.   Gender bias in promotion

Diekman et al. (2015) show that women who stay in STEM tend to be confronted with situations of disregard. On the one hand, women in STEM tend to face exclusion because they are minorities in a highly masculinized environment, and on the other hand, women in STEM jobs are often tasked with administrative jobs. The National Research Council (2010) observed in US electrical engineering faculties that women are more likely to plan to leave their jobs in addition to receiving offers from elsewhere. Also, in every scientific field, "women were underrepresented among candidates for tenure relative to the number of female assistant professors" (p. 149).

4. Methodology

We position our research within an interpretative paradigm with a qualitative research approach, since "the central endeavour in the context of the interpretive paradigm is to understand the subjective world of human experience" (Cohen et al., 2007, p.21).

Data collection instrument. Our data collection instrument is a semi-structured interview, which will be designed around the barriers faced by women in the STEM workforce identified in the literature. From these pre-existing categories we generated a list of questions that aim to collect information about women's experience in STEM areas both when they enter the workforce, when they are in it, as well as when they leave it. The list of interview questions is presented in Annex 1.

Selection of participants. UNIDO is currently working on projects concerning green hydrogen, so for the agency, it is of great relevance to focus our research on women's representation in one of these areas. In this research our focus group is women working in the area of green hydrogen. The selection process for the women interviewed was as follows: 1) We accessed the database of experts on the Women in Green Hydrogen website;[4] 2) We used certain filters in order to search for potential participants. We were interested in

---

[4] https://women-in-green-hydrogen.net/expert/

finding women working in engineering areas in industry, therefore in the filter "sector" we chose the filters "engineering" and "energy", in the filter "focus topic" we chose "industry". On the other hand, we were interested that the interview could be in one of these three languages: English, Spanish or German, given our' fluency in these languages. Finally, we were interested in interviewing women in any of the job profiles present in the database. 3) From the contact information in the database, we sent an email to 31 women who met the above filters inviting them for an interview. Out of the total of 30 applications, 11 women have so far agreed to give us an interview. 5 of these women are working in Europe, 1 in Asia, 1 in Africa, 3 in North America and 1 in Latin America. The characteristics of the interviewees are presented in figure 3. Thus, when we quote a sentence said by an interviewee, we will refer to it with a tag such as "I1_U45_E_NCh_PM" which means "Interview 1_ Under 45_ Europe_NoChildren_ProjectManager".

Figure 3: Characterization of the interviewed women experts

Label	Age group	Place of work	Occupational level	Children?
I1	35-45 (U45)	Europe (E)	Project Manager (PM)	No (NCh)
I2	25-35 (U35)	Africa (Af)	CEO (C)	No (NCh)
I3	35-45 (U45)	Europe (E)	Project Manager (PM)	Yes (Ch)
I4	Under 25 (U25)	Asia (As)	Project Manager (PM)	No (NCh)
I5	25-35 (U35)	North America (NAa)	Project Manager (PM)	Yes (Ch)
I6	Above 45 (A45)	Europe (E)	Head of department (HD)	No (NCh)
I7	25-35 (U35)	Europe (E)	Project Manager (PM)	No (NCh)
I8	Above 45 (A45)	Europe (E)	Head of department (HD)	No (NCh)
I9	35-45 (U45)	North America (NAa)	Project Manager (PM)	Yes (Ch)
I10	25-35 (U35)	North America (NAa)	Project Manager (PM)	No (NCh)
I11	25-35 (U35)	South America (SAa)	Project Manager (PM)	No (NCh)

Data collection. Data collection was carried out through semi-structured interviews lasting between 45 and 60 minutes using the Zoom platform. One of the authors led and conducted the interview, based on the list of questions in Annex 1. The other author took notes on the responses of the women interviewed. It should be noted that at the beginning of each

interview, the interviewees were explicitly asked for their consent to the anonymous use of their answers as sources of information. All interviewees gave their consent.

Limitations of the study. We chose women working in the green hydrogen sector as it is an accessible sample, given that UNIDO is currently developing a project in this area. Because of this, the results we obtain after the interviews are not generalizable and only represent the interviewees and their particularities. However, they can be of guidance to further explore the issue of the representation of women engineers in the STEM workforce. It is also important to note that although we made increased efforts to include women from South America, Africa and Asia for the interviews, only three women responded, which is due on the one hand to the relatively small number of experts listed in the database and on the other hand to a weak response rate (see figure 3).

Data analysis. We developed an inductive analysis of the accumulated data. From the notes of an interview, we identified "ideas" around the experiences of the women interviewed. Each of these ideas became a code, to which we assigned a name and a representative example. When we went on to analyze the notes of the next interview, if appropriate, we identified the previously generated code and/or identified a new idea, to which we assigned a name and a representative example. This process was carried out individually by each of the authors and with the 11 interview notes. In a second stage, both authors reviewed, discussed, and refined the generated code list until a final version of the codes obtained (see Annex 2). The codes are divided into six dimensions, the order of which reflects the structure of the interviews. The first dimension before the job refers to the experiences of the interviewees before looking for a job and thus before taking up concrete professional steps in the field of green hydrogen. The second dimension of general challenges covers hurdles highlighted by participants at the beginning of the interview - these are particularly interesting for the analysis, as this is a relatively unprompted interview section and only spontaneous and authentic contributions can be made. Dimensions 3, 4 and 5 cover the domains recruitment, experience on the job and promotion, whereby the experience on the job is again divided into the sub-dimensions tasks, department climate, work-life balance and parental leave. Dimension 6 recommendations concludes the catalogue.

The table in Annex 2 is organized as follows: for each mention of a code made by an interviewee, an entry is made in the table, taking into account only whether an interviewee mentions a code in a dimension, not how often. Thus, a code in a given dimension X can be counted a maximum of n (=11) times. This approach offers the advantage that the overview is always maintained of how many interviewees name a code; multiple namings by an interviewee within the same dimension do not distort the picture.

5. Discussion of results

The results of this research will be presented in three sections. In the first section we will present the list of categories describing the experience of a group of women engineers in the Green Hydrogen industry. In the second section, we will present the overall results on the presence of the codes in the 11 interviews developed.

In the last section we will focus on presenting some differences between the experiences of a group of women engineers according to some of the demographic variables presented in the methodological section.

5.1. Categories describing the experience of a group of women engineers in Green Hydrogen

We have characterised the experience of the group of women engineers through 78 categories, which are grouped into six dimensions. A description and representative examples of the interviews for each of these categories can be found in Annex 2. In this section we will only review a few examples that we consider relevant to highlight, as well as contrast them with the literature review. As to why the interviewees chose the field of Green Hydrogen, we observed that some of the reasons presented were the *care for the environment* in order to contribute to the development of this new type of energy, and on the other hand, the *lack of green hydrogen in country*, either due to a lack of knowledge of this type of energy, as well as the scarce or non-existent presence of this type of industry in their country. On the other hand, from the point of view of why the interviewees decided to start a career in engineering, we find, for example, the fact of having had an *affinity for science* during school or a *family environment* that allowed them to approach the world of engineering. These last two characteristics coincide with some of the factors identified by UNESCO (2017) that encourage girls to pursue STEM careers.

On the other hand, from a general overview, some of the challenges faced by the women engineers in the GH area who were interviewed coincide with some of the challenges presented in the literature. For example, the field of engineering is a *male-dominated field*, which generates an *(in)visibly paradox,* since on the one hand, women engineers tend to be a minority in the environments in which they operate, which means that they are highly visible among their peers, often leading to differential treatment, which is in line with the observations of Diekman et al. (2015). Along with this, some interviewees stated that one of the cultural-personal challenges they face in this area of knowledge is the *traditional role of the woman*, which could be related to a *low self-esteem of women* that is reflected in doubting their own position as engineers in their workplaces.

When we move on to the recruitment process dimension, some women comment on the difference between men and women categorised as *performance vs. potential*, as it is often the case that when faced with a list of requirements for a job, women only apply for it when they meet 100 percent of the requirements, while men do not, which is in line with Mohr (2014). Another aspect reported by the interviewees is the *gender discrimination* that occurs both in the choice of candidates and in the salary they earn in the initial years of their careers, as also discussed by Cech (2013). Along with this, the women engineers highlighted during the recruitment process the *availability as a facto*r when it comes to being hired, i.e. having enough flexibility and availability of time to attend to different work contingencies, which leads to women being regularly asked about whether they wish to *become pregnant in the future during job interviews*. Finally, some interviewees stated that due to the GH boom and the large investment of money being made in this field, many men have started to apply for these jobs. For many of them, they see this as an example of a difference between men and women in why they enter the GH field, translating this difference as an *emotional vs. financial approach to Green Hydrogen*.

In terms of task distribution at work, women engineers report a greater *male-domination of production sites*. On the other hand, some women report that there is a *distribution of tasks influenced by gender*, where for example, the innovation sector tends to be associated with women engineers, while the more technical sectors with men; or they report that because they are women, people assume that they will become pregnant, so they are not assigned certain types of tasks, such as project execution.

On the other hand, the *department climate* presents some characteristics consistent with the literature. Women engineers point out the presence of *sexist comments and behavioural patterns* such as labelling women as crazy if they speak louder or with an imposing voice, or infantilising and/or objectifying women engineers. Along with this, there is a *discrepancy in the infrastructures* of highly masculinised workplaces, with, for example, deficiencies in the structure of the toilets available for women. However, in the field of GH, the interviewees point out that there is an *inclusive environment* in this area, as well as positively highlighting the generation of networks among women, such as the network of women in green hydrogen. Along with this, the interviewees highlight the fact of having an *advantage networking* in the area of engineering, which they consider to be due to the fact that women tend to have better communication skills than men in this area.

If we consider aspects such as *work-life balance*, the interviewees pointed out that often in the companies where they work, meetings are *scheduled at times that are outside working hours* or that they do not take into account the timetable adaptations of people who have children. On the other hand, some women pointed out that having a *senior position* helps them to reconcile work schedules that allow them to carry out their role as mothers.

Regarding the *return to work after a break*, women engineers point out that *paternity leave is an uncommon situation*, but that it has recently begun to be introduced in companies. On the other hand, they indicate that a common situation is *women going part time or resigning after giving birth while men continue* and that there are negative consequences after a maternity leave both on a personal level and for the company.

Finally, with regard to *gender bias in promotion*, the interviewees highlight what they call the *male feedback cycle*, which means that men in positions of power tend to promote other men who often meet their own definitions of a "good worker" or with whom they have a close relationship. On the other hand, women engineers highlight *the importance of a mentor* during their careers, as this could influence and guide them in different aspects of their work. Along with this, there is a tendency for women not to actively seek promotion at work, or to negotiate certain working conditions, while men continually seek to advance and/or negotiate their careers.

5.2. Characterisation of the experience of a group of women engineers in Green Hydrogen

To highlight the most important overarching results of the interview series, the main criterion for considering the overall most relevant codes will be the number of interviewees who mentioned the code, not the sum of mentions. This increased level of abstraction is recommended since the sum of mentions counts multiple mentions by individual interviewees across the different dimensions, which can lead to a distorted weighting.

The single most frequently mentioned code is thus *male-dominated field* from the dimension *general challenges*. This is remarkable insofar as codes from this dimension show a special degree of authenticity, since within this dimension an unprompted questioning took place, which aimed at spontaneous answers on the part of the interviewees, without illuminating special subranges of the job life of women in Green Hydrogen more closely. Thus, it can be stated that despite the personal social and regional differences that as a matter of course prevail within any given sample, an overwhelming 100 percent of interviewees considers their work environment to be dominated by men. This observation ranges from the reduced amount of female persons handing in their applications during recruitment processes to the underrepresentation of women in teams or in panels on conferences.

This is followed by three codes from the superordinate dimension *experience on the job*, each of which is named by 10 of the 11 interviewees. Due to the multiple naming across different dimensions, the code *sexist behavioural patterns* from the sub-dimension *department climate* stands out slightly. Thereby, the observations of our interviewees differ, which opens up a spectrum of ways of sexist behaviour. Participant I1_U45_E_NCh_PM, for example, feels infantilized by her supervisor and treated differently than her male colleagues because of her gender; interviewee I10_U35_NA_PM_NCh points to the objectifying communication of male peers on professional social networks, through which she feels reduced to her appearance. Furthermore, the codes *gender difference in balancing family* and *work and paternity leave as an uncommon situation* stand out – both alluding to a similar phenomenon within their respective subdimensions. The former code refers to the perceived ease of male peers to reconcile family responsibilities with work, while the latter code describes the fact that men rarely make use of paternity leave. Ultimately, both codes aim at the fact that family tasks of household management and child rearing are often perceived as female responsibilities, both by organizations and individuals (Ex1).

Ex1: "I have seen it with fellow students and former employers. If you're a woman, you take maternity leave and it's considered normal. But if you take parental leave as a man, you are often confronted with astonishment." (I7_U35_E_PM_NCh)

Within the same topic area of job leave, the code *maternity leave* also stands out, with 9 interviewees mentioning it. Within this code, interviewees mention the general perception of maternity leave and the problems that arise for individuals as a result. Also mentioned by 9 interview participants was the code *importance of skills*, within which despite the observed gender inequalities, the general importance of skills is emphasised over gender distinctions.

For reasons of increased authenticity described at the beginning of the chapter, special mention is to be made of other relatively frequently mentioned codes of the dimension *general challenges* due to their unprompted nature. Thus, 8 interviewees applied the code *low self-esteem of women* and 6 persons applied *traditional role of the woman*. The former code refers to the interviewees' perception that women hesitate to make seemingly daring decisions in their professional life in the field of engineering or especially in green hydrogen due to a lack of self-esteem. This ranges from the initial application to industry where women may not feel suitable for a job until there is a 100 percent match with the entry criteria to the reluctance to negotiate promotions and salary increases. The traditional role was mentioned across most dimensions and refers to traditional values around the suitability of women for technical occupations or the emphasised role in fulfilling household tasks, which ultimately prevent them from making a career.

5.3. Discussion of results by demographic variables

After the previous chapter presented the code structure as well as salient codes within the respective content dimensions constructed by us, the following section will highlight the most important codes according to differing demographic characteristics of the interviewees. For this purpose, the statements of women with different demographic characteristics are contrasted in the following subchapters. After the already provided general overview of the most frequently mentioned codes, we compare the statements of women with a high level of professional experience with those of newcomers, as well as the statements of members of the Global North with those of people from the Global South.

5.3.1. Seniority versus novice

During the development of the interviews, we noticed that there were some differences between different profiles of women engineers. The first of these corresponds to the differences in experiences as women engineers between what we will call *senior engineers*, those who are in charge of a group of people, and *novice engineers*, those who are not in charge of a group of people. Some examples of these differences are presented below.

Regarding the general challenges identified by the interviewees, we observe that senior women consider the (in)visible paradox as one of the main challenges (Ex2), while for junior engineers, they all agree that the main challenges are the gap between performance vs. potential in recruitment/job application and the imposter syndrome (Ex3).

> Ex2: "Most of the time I was the only woman, it's special. Everybody knew me, I was treated differently. In a negative sense, but also in a positive sense, I was the first female academic, but I never felt it was a problem, I was used to working with women, at school, at university, they always keep an eye on you". (I8_A45_E_NCh_HD - senior)

> Ex3: "For women, the challenge is that we have to be fully qualified to do a job. I always want to know 100 percent of how to do something. From my experience, a lot of men don't know 100 percent of one thing to do a job. They start doing with 60 percent and then they start to know it." (I5_U35_Na_Ch_PM)

As regards the recruitment process, we observed that novice women identify a difference between the approach between men and women towards the green hydrogen industry, as well as the majority of them identify gender discrimination during this recruitment and/or promotion process (Ex4). On the other hand, out of the total number of women who identified gender discrimination in the distribution of tasks, 80 percent of them are newcomers. Of the total number of interviewees who identified a difference in the perception of the technical skills of female engineers, 66.7 percent of them were novice engineers.

> Ex4: "If I look at my current company, we have the same job (with a male colleague), he was very successful, but his whole team quit. I lead a group with a very good feeling, but he got promoted to direct management and I didn't. So I asked myself, why, why did this happen?" (I9_U45_Na_Ch_PM)

We also observed that all the women who indicated that they had an advantage of networking were senior engineers (Ex5), and most of them indicated differences in networking behaviour. Also, of the total number of women who named the disregard of female leadership, 80 percent were senior engineers. On the other hand, senior women highlighted the importance of a mentor for promotion.

> Ex5: "Networking is very important, a lot of my day is spent networking with European companies. Sometimes it helps as an exotic factor [being a woman], as they are always written to by men and then suddenly a woman writes to them. It can often help to differentiate yourself" (I3_U45_E_Ch_PM - senior)

Finally, the majority of the senior women put forward recommendations for the creation of informal spaces in the workplace where information can be shared, while the novice engineers propose a change of mentality regarding the gender stereotypes that exist in the field of engineering (Ex6), as well as the clarity and specificity of the requirements in job advertisements.

> Ex6: "Treat women as human beings. People still see these [gender] differences. We should focus more on the brain than the physical." (I10_U35_Na_NCh_PM - novice)

Thus, in general terms we note that novice women tend to express and identify more situations that involve a gender difference in their experiences as women engineers, while senior women tend to expose some advantageous aspects of being few women in the field of engineering.

5.3.2. Global North versus Global South

Despite the limited number of individuals with a geographic background from the Global South (27.2% of the overall sample), this section will make a cautious attempt to identify specific differences in the frequency of the codes mentioned according to the geographic provenance of the interviewees. Relatively frequent mentions are only taken into account if there are at least two interviewees.

Taking into account the special importance of the dimension *general challenges*, it is appropriate to first highlight the code that is disproportionately mentioned by women from the global South within this unprompted interview section. Particularly noteworthy in this regard is the code *traditional role of the woman*, where 50 percent of the mentions are attributable to women with the demographic item mentioned. This is accompanied by an

increased number of mentions of the code *low self-esteem of women* (37.5%). Both of these characteristics point to a particularly rigid role image of women, which hinders access to jobs, especially in the field of engineering. Due to a more restrictive environment, our interviewees also observe a more internalised low self-confidence, which can proof to be disadvantageous when it comes to pioneering career steps (Ex7).

> Ex7: "The problem is the culture; women have to stay at home and men go to work. When women go to work, they have family problems because they don't have family support." (I2_U35_Af_C_NCh)

With regard to the situation before starting a job, only women from the global south mention the code *being a role model* (100%). Furthermore, they also disproportionately criticise the non-existence of green hydrogen technology in their countries (*lack of green hydrogen in country of origin*, 66.7%). Both of these represent significant reasons when deciding to pursue a career in the industry. In addition, women from the Global South more often described the presence of *gender discrimination* in the recruitment process as well as in the distribution of tasks (37.5%).

Regarding the further progression of job life within the industry around Green Hydrogen, women with the specified demographic attribute cite a handful of other codes with disproportionate frequency. These include the perceived *disregard of female leadership* (40%) and the fact that women tend to reduce or drop out of employment entirely after the birth of a child, compared to their male counterparts (*female reduction or termination of work after giving birth while men continue* 50%). It reads like a logical consequence of the previously mentioned codes that the interviewees from the global South also comment more on the absence of female persons in leadership positions (*Less women in positions of power,* 40%). All in all, it can be seen that with the globally continued charged view of the social role of women, the situation in the global South is additionally aggravated for women in engineering - not necessarily for industry-specific reasons, but due to overarching societal mechanisms and values. As a consequence, the most mentioned recommendation for achieving change in the situation of women in green hydrogen and engineering in general is that a *change of minds* (42.9%) would be necessary in the respective societies. This was stated by all interviewees from the Global South.

6. Conclusion and policy recommendations

The research paper at hand provides a contribution to gender research in the still young field of green hydrogen. This is relevant as in the sense that professional practices do not yet look back on decades of tradition and are thus still malleable. After first describing the state of research in the current scholarly literature, we used the qualitative method of semi-structured interviews, for which we interviewed 11 female engineers in the industry about their impressions. The literature analysis helped us in particular to obtain a guideline for the content of the questionnaire of our qualitative method of the semi-structured interview series. The latter, in turn, enabled us to enrich the existing findings with an increased granularity through the collected statements of the interviewees, for the categories *before looking for a job, general challenges*, *recruitment*, *job experience* (divided into *tasks*; *department climate*; *work-life balance*; *return after paternity leave*), *promotion* and *recommendations*. Generally, both overlaps and extensions to aspects of the female experience in the field of green hydrogen described in the literature can be made. On the one hand, despite the young age of the industry, the statements of the interviewees corroborate the picture of another STEM subfield with male dominance, although it should be pointed out that, according to the interviewees, the social structures are relatively progressive compared to more traditional fields. However, this alone is of course insufficient, as a glance at the frequency with which some other shortcomings are mentioned reveals. In general, it can be said that there is potential for improvement in the appreciation of female work, which is reflected in social hurdles in addition to mere structural deficits such as discrimination in job interviews and a lack of female persons in leadership positions. The social layer includes observations such as the feeling of having to outperform male counterparts to be professionally recognized, and also the social ostracism towards men who make use of paternity leave. A particularly revealing academic contribution to us lies in the contrasting of frequent code mentions according to demographic characteristics. For instance, it stands out that women in higher management positions are more responsive to gender advantages and sometimes fail to recognize discriminatory patterns, while younger women are more sensitive to discriminatory practices, such as in recruiting or in the assignment of tasks. With regard to the region of origin, an increased sensitivity of women from the Global South to issues related to the traditional role of women can be observed.

Further research is needed and strategically relevant, as a young industry is more malleable than more established equivalents. Researchers should pay particular attention to the different social dynamics in the Global North and Global South, as business practices in different countries can be very different and the industry is expected to still ramp up in more parts of the world. Furthermore, the differing generational viewpoints on organizational culture issues also offers increased potential for investigation, since the industry is particularly interesting for young engineers. In both cases, it is advisable to draw on a larger study sample to achieve representative results, given more availability and resources of researchers.

After developing this research and drawing on the feedback of our interviewees, we can put forward policy recommendations along two axes: recommendations focused on improving work dynamics and recommendations referring to working conditions.

In terms of work dynamics, we consider the following recommendations:
- Provide spaces, both in meetings and at the organisational level, for women engineers to freely express their opinion on different topics and obtain more visibility. In particular, their knowledge of engineering should not be underestimated.
- Promote collaborative workspaces through diverse groups of people.
- For women engineers who are starting their careers in the field, establish dynamics that allow them to have a mentor with more work experience to guide them during their journey in the field of engineering.
- Communicate and respect the work-life balance that women with children may request. This means, for example, not scheduling meetings at times when women engineers are not available because they are attending to family matters.
- Promote work-family conciliation not only for senior women, but also as an option for all women workers with children.
- Strengthen networks between women from different subfields of engineering in order to learn about and work on the difficulties they face, as well as to make visible the work they do in the different areas of expertise.
- Establish spaces in workplaces to share information on the different tasks, projects, etc., that are being carried out in the company.

On the other hand, in terms of working conditions, we propose the following recommendations:

- Normalise paternity leave. This can lead to companies providing incentives for men to actively take paternity leave, such as giving them an extra week of leave in addition to requested paternal leave.

- Allow remote working where possible. For example, remote work could be reconciled on certain days of the week or when necessary due to personal life eventualities.

- Develop company policies that address the difficulties faced by women engineers. For example, establish a gender committee in an accessible physical location where they can communicate and resolve different situations that arise from day-to-day work.

- All workplaces should have access to structural conditions that allow working freely in the different spaces. The fact that a workplace has only men's toilets continues to perpetuate the masculinisation of production spaces. In other words, it continues to send the message that women are not welcome in production sites.

- Promote specific training that addresses the diversity of profiles found in the company. This implies consulting workers about their needs and/or weaknesses in order to generate training courses that address these difficulties.

- In order to attract women to the field of engineering, it is necessary to promote the diversity of jobs in engineering. For example, it is necessary to publicise the fact that engineering requires technical skills as well as communication skills to be able to perform in this job.

- In terms of job offers, clearly describe the requirements in terms of what skills are needed to apply for the job, as well as what prior knowledge is required.

- Promote the use of evaluation rubrics for interview processes. For this, the dimensions to be assessed in the interview process should be clearly described, as well as the progression of assessment levels.

- During the job interview process, the evaluation panels should be composed of both men and women.

References

Alam, A. & Sanchez-Tapia, I. (2020). Mapping gender equality in STEM from school to work. UNICEF. Available online at https://www.unicef.org/globalinsight/stories/mapping-gender-equality-stem-school-work (accessed 7/9/2022).

Bell, Shannon Elizabeth; Daggett, Cara; Labuski, Christine (2020): Toward feminist energy systems: Why adding women and solar panels is not enough. In Energy Research & Social Science 68, p. 101557.

Bellotti, D.; Rivarolo, M.; Magistri, L.; Massardo, A. F. (2015): Thermo-economic comparison of hydrogen and hydro-methane produced from hydroelectric energy for land transportation. In International Journal of Hydrogen Energy 40 (6), pp. 2433–2444.

Blackburn, Heidi (2017): The Status of Women in STEM in Higher Education: A Review of the Literature 2007–2017. In Science & Technology Libraries 36 (3), pp. 235–273.

Blair-Loy, M., Mayorova, O. V., Cosman, P. C., & Fraley, S. I. (2022). Can rubrics combat gender bias in faculty hiring?. Science, 377(6601), 35-37.

Cech, E. A. (2013): Ideological Wage Inequalities? The Technical/Social Dualism and the Gender Wage Gap in Engineering. In Social Forces 91 (4), pp. 1147–1182.

Cohen, L., Manion, L., & Morrison, K. (2007). Research methods in education (6th edition). Routledge.

Dasgupta, Nilanjana/Stout, Jane G. (2014). Girls and Women in Science, Technology, Engineering, and Mathematics. Policy Insights from the Behavioral and Brain Sciences 1 (1), 21–29.

Diekman, Amanda B./Weisgram, Erica S./Belanger, Aimee L. (2015). New Routes to Recruiting and Retaining Women in STEM: Policy Implications of a Communal Goal Congruity Perspective. Social Issues and Policy Review 9 (1), 52–88.

Duffy, M. K.; Ganster, D. C.; Pagon, M. (2002): Social undermining in the workplace. In Academy of Management Journal 45 (2), pp. 331–351.

Eaton, Asia A./Saunders, Jessica F./Jacobson, Ryan K./West, Keon (2020). How Gender and Race Stereotypes Impact the Advancement of Scholars in STEM: Professors' Biased Evaluations of Physics and Biology Post-Doctoral Candidates. Sex Roles 82 (3-4), 127–141.

Faulkner, Wendy (2011). Gender (In) Authenticity, Belonging and Identity Work in Engineering. Brussels Economic Review 54, 277–293.

Fouad, Nadya A./Santana, Mercedes C. (2017). SCCT and Underrepresented Populations in STEM Fields. Journal of Career Assessment 25 (1), 24–39.

Frehill, Lisa; Fabio, N. M.; Hill, S. T.; Traeger, K.; Buono, J. (2008): A review of the 2007 literature women in engineering. In SWE Magazine 54, pp. 34–70.

Kahn, S., & Ginther, D. K. (2017). Accounting for the gender pay gap in STEM salaries. Working Paper, Mimeo, Boston University.

Kalt, Tobias; Tunn, Johanna (2022): Shipping the sunshine? A critical research agenda on the global hydrogen transition. In GAIA - Ecological Perspectives for Science and Society 31 (2), pp. 72–76.

Kuschel, K., Ettl, K., Díaz-García, C., Alsos, G. (2020). Stemming the gender gap in STEM entrepreneurship – insights into women's entrepreneurship in science, technology, engineering and mathematics. International Entrepreneurship and Management Journal 16 (1), 1–15.

Legewie, Joscha; DiPrete, Thomas A. (2014): The High School Environment and the Gender Gap in Science and Engineering. In Sociology of education 87 (4), pp. 259–280.

Li, Chengzhe; Zhang, Libo; Ou, Zihan; Ma, Jiayu (2022): Using system dynamics to evaluate the impact of subsidy policies on green hydrogen industry in China. In Energy Policy 165, p. 112981.

Morgan, S. L., Gelbgiser, D., & Weeden, K. A. (2013). Feeding the pipeline: Gender, occupational plans, and college major selection. Social science research, 42(4), 989-1005.

McGee, Ebony O./Bentley, Lydia (2017). The Troubled Success of Black Women in STEM. Cognition and Instruction 35 (4), 265–289.

McLean, Mandy; Nation, Jasmine M.; Spina, Alexis; Susko, Tyler; Harlow, Danielle; Bianchini, Julie (2020): The Importance of Collaborative Design for Narrowing the Gender Gap in Engineering: An Analysis of Engineering Identity Development in Elementary Students. In Journal of Pre-College Engineering Education Research (J-PEER) 10 (2).

McWhirter, Ellen Hawley/Cinamon, Rachel Gali (2021). Old Problem, New Perspectives: Applying Anzaldúan Concepts to Underrepresentation in STEM. Journal of Career Development 48 (6), 877–892.

Mohr, T. (2014). Why Women Don't Apply for Jobs Unless They're 100% Qualified.

https://hbr.org/2014/08/why-women-dont-apply-for-jobs-unless-theyre-100-qualified

National Research Council. (2010). Gender differences at critical transitions in the careers of science, engineering, and mathematics faculty. National Academies Press.

Pell, Alice (1996). Fixing the Leaky Pipeline: Women Scientists in Academia. Journal of animal science 74, 2843–2848. https://doi.org/10.2527/1996.74112843x.

Piatek-Jimenez, Katrina/Cribbs, Jennifer/Gill, Nicole (2018). College students' perceptions of gender stereotypes: making connections to the underrepresentation of women in STEM fields. International Journal of Science Education 40 (12)

PwC (2022). Women in work 2022: Building an inclusive workplace in a net zero world.https://www.pwc.co.uk/economic-services/WIWI/pwc-women-in-work-index-2022.pdf

Sanders, Lucinda/Ashcraft, Catherine (2019). Confronting the Absence of Women in Technology Innovation. In: Matthew Wisnioski/Eric Hintz/Marie Stettler Kleine et al. (Eds.). Does America Need More Innovators? MIT Press, 323–343.

Saxena, Mahima/Geiselman, Timothy Adam/Zhang, Sheng (2019). Workplace incivility against women in STEM: Insights and best practices. Business Horizons 62 (5)

Schmuck, C. (2017). Women in STEM Disciplines. Cham, Springer International Publishing.

Schoettler, Maren (2022): Women in Green Hydrogen tackles Inequality in the Sector. Available online at https://changing-transport.org/women-in-green-hydrogen-tackles-inequality-in-the-sector/, checked on 9/11/2022.

UNESCO (2017). Cracking the code. Girls' and women's education in science, technology, engineering and mathematics (STEM). Paris, UNESCO.

United Nation Women (2019). Progress on the sustainable development goals: the gender snapshot 2019. https://www.unwomen.org/sites/default/files/Headquarters/Attachments/Sections/Library/Publications/2019/Progress-on-the-SDGs-The-gender-snapshot-2019-two-page-spreads-en.pdf

United Nation Women (2021). Progress on the sustainable development goals: the gender snapshot 2021. https://www.unwomen.org/sites/default/files/Headquarters/Attachments/Sections/Library/Publications/2021/Progress-on-the-Sustainable-Development-Goals-The-gender-snapshot-2021-en.pdf

Vera-Gajardo, Andrea (2021). Belonging and Masculinities: Proposal of a Conceptual Framework to Study the Reasons behind the Gender Gap in Engineering. Sustainability 13 (20)

Verspagen, B.(2005). Innovation and Economic Growth. In: Jan Fagerberg/David C. Mowery/Richard R. Nelson (Eds.). The Oxford handbook of innovation. Oxford/New York, Oxford University Press.

Wanelik, Klara M./Griffin, Joanne S./Head, Megan L./Ingleby, Fiona C./Lewis, Zenobia (2020). Breaking barriers? Ethnicity and socioeconomic background impact on early career progression in the fields of ecology and evolution. Ecology and evolution 10 (14)

World Economic Forum (2021). Global Gender Gap Report 2021: Insight report. https://www.weforum.org/reports/global-gender-gap-report-2021

Annex

A.1 List of questions for interviews with experts listed in the database of women in green hydrogen

Statements	Main question	Sub-questions
0. Before looking for a job	What factors contributed to your entry to an academic or professional career in Engineering?	• What made you choose Green Hydrogen as your professional focus?
1. Challenges for women in engineering / green hydrogen	What challenges are facing men and women in the green hydrogen industry and engineering sector?	• In what context do these challenges arise? • Are they challenges faced by everyone in the field or have they only happened to you? • Do these challenges vary according to the individual and/or group of people? For example, are they more or less recurrent for women?
2. Recruitment process	How is the recruitment process like in your area of work?	• When you are presented with a job advertisement, what aspects do you evaluate when applying for this job in the industry? • What factors do you think are taken into consideration when hiring a person in your sector? Do you think there are any differences depending on the profile of the job applicant?
3. Situation on the job	-	-
3.1 Tasks	What are the characteristics of the tasks you perform in your job?	• Do you consider that you have experienced differences in the distribution of tasks in your work? Why? • Based on your experience or what you have observed in your work environment, do you think there is any bias in the distribution of responsibilities in the work team? For example, gender bias, ethnicity bias, experience bias, etc.
3.2 Department climate	How would you describe your work environment, both on company and department level? If self-employed: How would you describe the work environment in your sector?	• What are the dynamics of the working meetings like? Do you consider that all voices are heard in a meeting? • What are the social dynamics like in your workplace? • Have you witnessed differences in treatment in your company? • Based on your experience, how important are social events for your career?
3.3 Work-Family balance	How do you manage the balance between life outside work	• Do you consider that this balance or non-balance between life outside

	and at work?	• work and at work influences your work performance? • Do you consider this situation to be different for men and women in the sector in which you work?
3.4 Return to job after parental leave	Is there a possibility to take a break at your workplace or in the sector in which you work? By break we mean e.g. parental leave, health leave, sabbatical, personal leave, etc.	• If there is a possibility to take a break, what is the opinion of the people working in your sector (colleagues, bosses) about this situation? • What are the advantages and/or disadvantages of taking a career break?
4. Gender bias in promotion	Based on your experience, what factors do you think influence job promotion in engineering?	• Is there a possibility to attend further training and/or leadership courses in your area of work? If so, how does one access these courses? • How important is lifelong learning in your sector and how does this influence promotion?
5. Recommendations	Based on your experience in Engineering and Green Hydrogen, If you had the power to change the situation for Women in your field - what would you change? What aspects do you consider relevant to address in order to try to reduce gender bias/gaps in engineering work environments?	
6. Demographic Items	What is your age? What is your occupational level? What is your family status?	

A.2 List of categories, their description and representative examples.

Dimension	Category	Description	Example
0.Before looking for a job	Childhood dream	They enter engineering because it leads them to work on something they have wanted to do since they were children.	"When I was little - 6 years old - I wanted to be an astronaut. So, to start as an astronaut I had to study about the field of technology, so I went into this area." (I1_U45_E_NCh_PM)
	To be a role model	Due to the under-representation of women engineers in their country, they decide to study engineering.	"In my country there are few women in engineering, when I studied in Russia, only 2 women in this context. [...] I really want to make a difference. My first motivation is because are a few engineering women in Angola." (I2_U35_Af_NCh_C)
	Challenge	They decide to study engineering because it is a challenge, as other people have told them that it is something they cannot do (because they are women).	"Because it's a challenge and it motivates me. When people say it is no going to happen I do it, to prove I can do it." (I2_U35_Af_NCh_C)
	Affinity for science	They express it as a logical path to study engineering since they were good achievers and/or liked science and mathematics.	"I liked mathematics, chemistry and physics the most, so chemical engineering was a logical thing to study." (I3_U45_E_Ch_PM)
	Engineering vocation	Shows a lifelong interest in technological development.	"My interest was always born for technical developments, directly I already had an engineering vocation profile." (I6_A45_E_NCh_HD)
	Family environment	A family member has been involved in aspects of engineering, leading them to follow that path.	"I grew up in the US my dad was a mechanic, so I became to have technical background." (I5_U35_NA_PM_Ch)
	Curiosity for new technology	They start in Green Hydrogen because of the interest in the development of new technologies and innovation.	"I started in energy innovation because of an opportunity linked to the University. In this first company I was recruited for a new team to develop hydrogen technologies 20 years ago" (I6_A45_E_NCh_HD)
	Care for the environment	They start in Green Hydrogen because of your interest in the environment.	"At my university, there was a course in chemical engineering specialising in the environment and [...] this environmental component is a bit of what motivated me to follow the path." (I3_U45_E_Ch_PM)
	Lack of Green Hydrogen in country	They start in Green Hydrogen due to lack of research/information in their countries.	"It's strange to know that the world is developing fast, and yet in my country people don't know what Green Hydrogen is. I had to start from scratch and bought an engine to show people at my university that Green Hydrogen can work." (I4_U25_As_PM_NCh)

1.Challenges for women in Green Hydrogen	Male-dominated field	The field of engineering is a male-dominated field, which is reflected in the application to jobs, conferences and work environments.	"For engineering generally, unless you are in biochemical or chemical engineering, all the classes, all the departments are usually male dominated." (I1_U45_E_NCh_PM) "I went to a conference related to Green Hydrogen and there were around 20 panels […]. In two days they had only 2 female speakers." (I9_U45_NA_PM_Ch) "We try to recruit women, but there are few who apply. It's lucky if they (the women) fit in." (I8_A45_E_HD_NCh)
	Need to outperform male colleagues	Women often fear that their competences will be doubted, which leads to a tendency to do more work. In order to be perceived on par with male colleagues, they have to outperform them by performing better.	"As a woman I need to be better than men to be accepted, I have to be better from the beginning." (I1_U45_E_NCh_PM) "Women have the tendency to do the best, I've seen this on many levels, they try to prove themselves, and sometimes they overdo it. It's not natural, it's the education that makes it. When you try to do it as a man, you become unhappy. Women have to find their own way to do the job." (I8_A45_E_HD_NCh)
	Gaining the respect of colleagues	Women are confronted with the challenge of first having to earn the respect and appreciation of their own voices by male colleagues.	"I ended up being the boss, but because of the results I generated, because you end up working hard. This means that your opinion is valid and that you are listened to, but you have to earn it. A man also has to earn it, but in my case you also have to overcome this cultural barrier." (I6_A45_E_NCh_HD) "We have the same background. The problem is not the skills, the problem is to be respected." (I2_U35_Af_C_NCh)
	Lack of female role models	Women lack female reference persons in relI8_A45_E_HD_NChnt positions in engineering and other places in public life such as Academia, which would be important for orientation.	"In the world of engineering in general, there are very few women, so there are very few female leaders, all the leaders have always been men." (I3_U45_E_Ch_PM)
	Performance vs potential	Women have the feeling they need to be 100% suitable for a job, while men also apply for positions they don't necessarily meet all requirements for.	"For women, the challenge we have is to be fully qualified to do a job. I always want to know 100% how to do it. In my experience, a lot of men don't know 100% of one thing in order to do some work. They start to do 60% and then start to know about it." (I5_U35_NA_PM_Ch) "You should know that women are paid for their performance and men for their potential. At all levels of my career, women have to perform to apply for a job, men apply and then perform." (I9_U45_NA_PM_Ch)

Less job offers at the sight of potential motherhood	When there are young female candidates, the possibility that they may have a child is considered. This possibility puts them at a disadvantage compared to their male colleagues with the same characteristics.	"I think it is often in the minds of managers and recruiters that when you are looking at a young female candidate, you ask yourself if she might not have children soon. That presents a kind of risk. Given that there is a male person with the same background and the same grades, he is preferred." (I7_U35_E_PM_NCh)
Low self-esteem of women	Women tend not to be confident in their knowledge, which leads them not to speak up in certain situations, not to apply for a promotion or not to apply for a job.	"In the case of women, they tend to be more conservative, more subdued. No! You have to put your voice out there and you have to be more forward. Men tend to be, they tend to be more daring. The challenge is to believe that you are worth the same, that you have ideas and you have to share them. The challenge for women is that you have to speak up more." (I6_A45_E_NCh_HD)

"Women only apply for a job if they meet 100 per cent of the established criteria, while men do so when there's only an overlap of fifty to sixty percent." (I9_U45_NA_PM_Ch)
"It is more likely to ask directly for a promotion. Men tend to actively ask about promotion, and women do not." (I7_U35_E_PM_NCh)

For women the challenge is to believe in yourself. Women don't consider engineering as an option and don't believe in making a career in it." (I2_U35_Af_C_NCh) |
| Traditional role of the woman | Women are assigned a role according to the culture under which they have grown up. | "The problem is the culture; women have to stay at home and men go to work. When women go to work, they have family problems because they don't have family support." (I2_U35_Af_C_NCh)

"If we want to work in a place (where only there are men) it's a problem for us with our husband, because it's a place where only man works. If you are women, you have to stay in home care for the children." (I2_U35_Af_C_NCh) |
| Imposter syndrome | The impostor syndrome is a feeling of massive self-doubt about your own professional performance. One may feel like an impostor because they think they don't deserve the job. This behavior can be observed on women with more frequency then for men. | "In my experience every person from my perspective has impostor syndrome, i.e. they have doubts whether what you do is good or not very important. Both for women and men." (I5_U35_NA_PM_Ch) |

	(In)visibility paradox	Women tend to be a significant minority in the engineering sector. However, as the only women, they attract attention and are treated differently from their male colleagues.	"Most of the time I was the only woman, it's special. Everybody knew me, they treated me differently. " (I8_A45_E_HD_NCh)
2.Recruitment process	Asking about pregnancy in the interview	They are asked in job interviews if they plan to become pregnant in the future.	"I didn't experience myself. But I hear that some ask questions to women about pregnancy, or children." (I1_U45_E_NCh_PM) "It is a fact that women are asked if they want to stay pregnant, it is illegal, but it is done." (I3_U45_E_Ch_PM)
	Importance of skills	For the assignment of a job or task, it is considered to be able to perform it, irrespective of gender.	"We have equal treatment, depend on your skills" (Verónica) "For the position I have now, I believe that experience and track record were highly valued." (I3_U45_E_Ch_PM) "You are hired for your qualifications and experience. They hire you for your ability." (I6_A45_E_NCh_HD) "For a special task, you have to look for a specific person." (I8_A45_E_HD_NCh)
	Gender discrimination	There are gender differences in the engineering sector when it comes to promotion, as well as in the first salary.	"I applied to a position and after passing all interview stages, at the last stage I was told that I could not get the job because I'm a woman. They even asked me if I could recommend them a male colleague that would suit the position." I4_U25_As_PM_NCh "If I look in my current company, we have the same work (with a man). He was very successful, but all the team quit. I managed a group with a very good feeling, but he was promoted to direct management and I didn't. So I asked myself, why? Why did this happen?" (I9_U45_NA_PM_Ch) "The first salary is lower for women. Maybe it is because we have less confidence and we don't ask for more salary, when we ask for a raise, it is like if we are asking for charity. The first salary is important considering gender." (I10_U35_NA_PM_NCh)
	Availability as a factor	An important factor in the recruitment process is the availability and flexibility of time to meet the demands of the job, such as travel.	Managers don't understand a business person wouldn't put their career first [before other matters like family]". (I9_U45_NA_PM_Ch)

	Importance of (scarce) Expertise in GH	Expertise in a particular subject area is valued, for example, in the Green Hydrogen.	"The challenge in itself as a sector, especially GH, is that there is little research on it, there are companies trying to incorporate it into their business, but they don't know how to work with it. One of the challenges is how to simplify the knowledge about GH for the client, more specific to the economic sector." (I10_U35_NA_PM_NCh)
	Emotional vs financial approach to Green Hydrogen	Financial power is traditionally attractive to men. Since a lot of money is currently being invested in green hydrogen, men are seeking employment in this field partly because of this component.	"I guess from a male perspective [...], right now how the sector currently is, a lot of it is driven by money. Me as a woman, I approach topics from an emotional perspective, whereas men approach things from a practical, financial perspective. This leads to a lot of men gravitating to GH." (I5_U35_NA_PM_Ch)
3.1 Tasks	Male-domination of Production sites	While the engineering field is dominated by men, this is even more so in the production sectors.	"The biggest difference in treatment I have noticed is when you have to go to the plant, places where there is more production." (I3_U45_E_Ch_PM)
	Distribution of tasks by competencies	Tasks are distributed according to the skills and level of specialization of each person.	"In my team, everyone has a different experience, and I distribute the task by competences and experience, equally, according to what they know how to do." (I1_U45_E_NCh_PM)
	Perception of female technical skills	Women are not associated with technical skills.	"Differences exist about mechanical tasks, when we change our equipment when we distribute the work, they don't look for me, because I'm a woman." (I2_U35_Af_C_NCh)
	Distribution of tasks influenced by gender	The distribution of tasks is different if you are a woman: you are either not considered for tasks of technical specialization or you are not assigned tasks because a possible maternity leave may prevent you from completing the task.	"I think innovation is more often associated with women and being more specialized in engineering is more often associated with men." (I6_A45_E_NCh_HD) "Example of myself, 29 years old - married. I was not assigned to the project because of the assumption that "you got married, so you are going to have children, so you won't have time." (I9_U45_NA_PM_Ch) "Men get offered more interesting projects because they know they're gonna be around [not affected by maternity leave]." I9_U45_NA_PM_Ch
	Bypassing of women in flows of information	Passing over women in information flows that would be important for getting work done.	"Sometimes other team leaders bypass me to have a faster connection, to have a faster task completion. But this is when I don't feel respected as a woman." (I1_U45_E_NCh_PM)

3.2 Department climate	Female voices not equally heard	A distinction of the importance assigned to a female opinion at meetings compared to men.	"We can speak normally; in meetings we have training. The problem is not only in the work. If you have a big voice, they are going to listen, but you have to work on it. The challenge is being heard the first time, but when you have 2 o 3 years probably, they listen." (I2_U35_Af_C_NCh) "Very experienced male engineers try to express what they want to say no matter what. Sometimes I want to say something, but people didn't stop talking and there is no time in the end." (I1_U45_E_NCh_PM)
	Networking advantage	The fact that there are few women in the industry and that they often have better communication skills helps them to network.	"For networking I think I have more advantages than men. A lot of females they are very open, they want to change information and they have a good communication skill, so we know a lot of information." (I1_U45_E_NCh_PM) "Sometimes it helps as an exotic factor [being a woman], men always write to me and then a woman writes to them. It's complicated because sometimes it can help to differentiate yourself." (I3_U45_E_Ch_PM) "It makes a lot of difference whether you are a woman or not. In some cases, you take advantage of the female quota (which annoys me), this puts you in the spotlight, but those are the minimal cases." (I6_A45_E_NCh_HD)
	Sexist comments	Colleagues make comments to women engineers about their presence, treat them differently and start with certain labels if they behave in a way they do not expect.	"They tell you a lot more things like "when you have children what are you going to do" which my colleagues didn't do." (I3_U45_E_Ch_PM) "Comments from clients when they see you: "look, now that they have women, they are improving their presence [in the industry]". They differentiate you from your colleagues, who shouldn't differentiate you. It is not comfortable." (I3_U45_E_Ch_PM) My approach in the past was less mature, I used to be less aggressive, you have to show your opinion. As a woman, something I learned is that you sit in the conversation with the label but without the label (of being a woman). Women are more labelled: "she's crazy, because she talks faster or loudly." (I9_U45_NA_PM_Ch)
	Importance of Management	Good leadership is necessary for a good departmental climate.	"I am grateful for the equity my manager is applying. He treats me the same way as he treats others and helps me to grow professionally. As a leader it's important to act like it, not like a boss. When you live it you feel the impact it has on you." (I10_U35_NA_PM_NCh)

Sexist behavioral patterns	The treatment of women engineers can be infantilizing or objectifying.	"Sometimes my boss treats me like a little girl, sometimes it's good or bad. The good thing is that he tries to coach me, so he tries to behave positively towards me. On the other hand, I don't get information that other people do get." (I1_U45_E_NCh_PM) "One thing I've noticed is about LinkedIn. Whatever the profile, when you put a good picture, you are selling yourself. And as women, we get messages that are not related to your skills. They are messages that are not related to work." (I10_U35_NA_PM_NCh)
Missing connection with male colleagues	Lacking connection with male peers in social contexts due to differences in behavior or external circumstances.	"Discussions in networking, being a woman you have to work harder, it is a hindrance. Normally in that networking, those coffee chats, social chats where you are looking for closer ties, men feel more comfortable with men, and the few women end up making a group because there are few of us." (I6_A45_E_NCh_HD)
Friendly department climate	Friendly and constructive work environment where individual team members feel comfortable and do not face discrimination of any kind.	"Regarding the social dynamics in meetings, as engineers we always want to work on solutions. Here I have never noticed any differences in treatment. Especially in Green Hydrogen, I have noticed a very friendly working environment where people want to learn from me as an expert." (I5_U35_NA_PM_Ch)
Inclusive environment in green hydrogen	Teams in the Green Hydrogen sector tend to be more inclusive than in more traditional engineering environments.	"There is not that much difference because it is a new company and sector, it is mostly women and it tends to attract attention. Everything that is coming in new has been a virgin and there is no difference in the equipment. In contrast, the steel industry is very traditional." (I6_A45_E_NCh_HD) "From the collaborative point of view, it is totally participatory, there is no distinction, I think this is because the sector is new, there is a lot of opportunity to create and on the other hand it is a young field, young people come with concerns." (I6_A45_E_NCh_HD) "People working in this field (renewable energy work) are younger and less misogynistic. There are more women in this field." (I9_U45_NA_PM_Ch)
Strength of supportive female networks	They highlight the fact of generating networks among women, such as the network of women in Green Hydrogen, which generates support among them.	"In my region there is only one other woman who works in Green Hydrogen. Of course, we are in contact and help each other out." (I3_U45_E_PM_Ch)
Infrastructural discrepancy	In highly masculinized production environments, there are no infrastructural conditions compatible with women.	"Another problem I had was when I had an appointment at a production facility, there was no way for me to go to the toilet, there were only standing toilets." (I3_U45_E_PM_Ch)

	Differences in networking behavior	Networking may occur differently between men and women.	"Naturally women make networking with peers and down. We never go out or up. Because we see this behavior in the past." (I9_U45_NA_PM_Ch)
	Body challenges	Physiological changes experienced by gender are not considered within the work dynamics.	"It's easier for men to take on the job because they have more flexibility, they don't have to deal with the challenges of the body. They don't have a lot of changes in their body that can affect their performance. There are no "rules" about managing this situation related to the body. It is more about the body, not the mind." (I10_U35_NA_PM_NCh)
	Disregard of female leadership	Leading a group of people can be a challenge, whether you are a woman and/or a young person.	"If it is difficult to lead people regardless of gender, it is even more difficult as a young woman." (I1_U45_E_NCh_PM)
	Disregard of young colleagues	The relationship between colleagues can be challenging if you are female, young and/or foreign.	"I feel like there is lack of credibility for young employees. I have a younger age and also from my appearance I might seem to be young. They sometimes take me for a student." (I11_U35_SA_PM_NCh)
	Disregard of colleagues with migration background	In addition to cultural and language barriers, people with a migration background also have difficulties being perceived as fully-fledged colleagues.	"I have not always felt heard in meetings when working abroad. A few things came together here, including that I am a woman, that I am young. I knew the language, but I had my limits. But as a migrant, you are seen differently." (I3_U45_E_PM_Ch)
3.3 Work-Life-Balance	Parent-unfriendly meeting schedules	Despite the reconciliation of family and work, these agreements are not respected when it comes to organising the work agenda.	"I need time to plan around my kid's schedules to be able to meet with clients. And that's not always thought of." (I9_U45_NA_PM_Ch)
	Hard working employees	The working climate in the engineering sector tends to be one of high workload and task demands.	"Every is very hard working, the boss is very hard worker, he is very nice, everybody tries to support him, so we are very hard worker." (I1_U45_E_NCh_PM)
	Family status matters	There are differences in work dynamics depending on family status, in particular whether one has children or not.	"It is true that it is very different for people who have children and those who don't, I don't have children and I don't know how my colleagues do it." (I6_A45_E_HD_NCh) "Only the women in the management are childless." (I9_U45_NA_PM_Ch)
	Motherhood	Motherhood can be a challenge, either because there is little availability to travel, because male bosses do not understand the	"Women can get pregnant and therefore be on leave for a certain amount of time. Especially in engineering, we do a lot of business trips, and a lot of clients ask us to visit their sites. [...] It's all about how available you are to perform work." (I10_U35_NA_PM_NCh)

		situation so there is less work/life balance, or because of combining childcare with work.	"A colleague said to me that as a young woman she had to put her job back in order to raise her children and take care of preparing the food." (I2_U35_Af_C_NCh) "Work-life balance in private companies is not something that is overly facilitated. [...] This generates special dynamics. Above all, the fact that we don't have references, that they are all men, that they don't apply these work-life balance measures in their lives, makes it difficult for them to understand us." (I3_U45_E_Ch_PM) [Work-life balance] of course is different when you have children. For women with children, the situation is very tough, even if it has now improved somewhat. Many women in my company are happy that they can now better balance their work with their child-rearing through home office. But of course, having a home office and children is still far from easy." (I8_A45_E_HD_NCh)
	Gender difference in balancing family and work	Perceived difference in family and work life handling between men and women.	"I see [increased stress] among my female colleagues with children. I have a colleague with two children who complains about the increased workload regarding family but continues to do her job full time. Another colleague has gone part-time." (I1_U45_E_NCh_PM)
	Benefits of a senior position	The ability to plan time more flexibly due to advanced seniority and rank within a company.	"I need to have a personal life at the moment, so you negotiate to fit in leisure work. But that's because of the position I have. It is difficult for both men and women. On the other hand, as you have a higher position, your responsibility increases, but at the same time you have more options for work-life balance." (I6_A45_E_NCh_HD)
3.4 Return to job after a pause	Women going part time or resigning after giving birth while men continue	The observation of women limiting or terminating their employment after the birth of children, while men do not take these measures.	"The problem is not the breaking, the problem is when you have a child, you stop to think only in yourself […] Man continues they life. The problem is not children, the problem is that women have to stop and men continue, we have to fix this idea." (I2_U35_Af_C_NCh)
	Paternity leave	The observation that paternity leave is	"I have seen it with fellow students and former employers. If you're a woman, you take

less common	culturally unfamiliar and less likely to be utilized.	maternity leave and it's considered normal. But if you take maternity leave as a man, you are often confronted with astonishment." (I7_U35_E_PM_NCh) "Maternity leave is a complicating factor. Lately, maternity leave has become equal to paternity leave, so companies are starting to have problems with men, and that has helped us." (I3_U45_E_Ch_PM) "Males take shorted time of parental leaves, and more if the man is in the higher level in the company." (I1_U45_E_NCh_PM)
Paternity leave socially frowned	The observation that men are socially discredited when they use paternity leave.	"My husband took paternity leave, and he was made fun of." (I9_U45_NA_PM_Ch) "Men suffer a lot of sexism when they ask for paternity leave. For women it is more "accepted", but for men it is frowned upon." (I3_U45_E_Ch_PM)
Paternity leave welcomed	The observation that paternity leave is welcomed and appreciated by management and the work environment.	"Taking paternity leave is welcome and encouraged in my company." (I1_U45_E_NCh_PM)
Maternity leave	Notation of observations regarding the existence and modalities of maternity leave in general.	"It is more complicated, the fact that there are very few women complicates things, because in environments where there are more women, they are more used to this, it is more embedded in the structure." (I3_U45_E_Ch_PM) "In a woman's life, the problems of motherhood are for 4-5 years, the working life is 40 years. It should not be such a problem, but it is still a problem." (I3_U45_E_Ch_PM) "In the States you have the situation where maternity and paternity leave by law doesn't really exist." (I5_U35_NA_PM_Ch)
Impact of paternal/maternal leave for the company	Identification of disadvantages that arise for companies in connection with maternity and paternity leave for employees.	"Maternity/parental leave is a difficult thing for the company to live with, but it is a right, and it is recognized. You can't say it, but it has repercussions." (I6_A45_E_NCh_HD)

	Personal Negative personal impact of maternity leave	Personal negative consequences that arise for women in connection with maternity leave.	"I get the maternity leave and all my peer receive a bonus for Christmas, but I didn't because I was in the maternity leave." (I9_U45_NA_PM_Ch) "They accept it [work-life balance], but because no one else does it, it tends to feel like a personal favor done for you, which you don't know how it will affect you in the future." (I3_U45_E_Ch_PM)
	Accumulated work	Accumulation of unprocessed work tasks due to employee absences related to maternity and paternity leave.	"When you are in a multinational, if one person disappears for 6 months, there are colleagues who take on that workload. On the other hand, in smaller companies, the work I do is done by myself. If I'm not there, it's work that doesn't get done [...] You come back with a 6-month workload because nobody has done it for you, it's complicated". (I3_U45_E_PM_Ch)
4.Gender bias in promotion	Training	Companies' handling of training in the working life of employees.	"Professional development plans are made, each person is assigned a profile, but it's not very structured [...] everything is more subjective on the fly, it's not so structured. Which I don't think helps. If it were more structured, it would be more objective." (I3_U45_E_Ch_PM) "As expertise in the field is so narrow, what a lot of companies are trying to do is to offer training to their employees to obtain knowledge in these new technologies." (I5_U35_NA_PM_Ch)
	Less women in positions of power	The observation of less women ending up in hierarchical positions of power within an organization.	"In the companies I have been in, in large companies, there are women in positions of responsibility, far fewer than men, but there are [...] you have to go to the fourth level to find women. It is true that there are very few women and in proportion there should be fewer, but there are none." (I3_U45_E_Ch_PM) "About management, it's not a bunch of women. It's like a law, and part of our identity. You don't really care who is in the position of manager." (I8_A45_E_HD_NCh)

		Male feedback cycle	The term refers to the perceived phenomenon that men in positions of responsibility will tend to promote men who fit their idea of good workers, as they are more likely to associate with their own gender.	"For me, a lot of it is that feedback between men, you can see it in their behavior. The bosses start to train people who I think are often people with whom they feel identified, when they were 30 years old and it feeds back into the system, that mentoring is seen more among them than when it is a woman." (I3_U45_E_Ch_PM) "When bosses appoint managers, they choose from among their most like-minded people, who are usually men, so that men end up being appointed as the future bosses." (I3_U45_E_Ch_PM)
		Communication and networking skills	Emphasis on the importance of these skills in order to obtain promotions.	"My boss promotes me to this manage position I think he value my communication skill as well as my network that I have. The communication skill and network skill are very important skill regard the gender you are." (I1_U45_E_NCh_PM)
		The importance of a mentor	Emphasis on the importance of people available to workers through mentoring.	"For me personally, the mentors that I had in companies, they guide me into different networking mechanisms." (I5_U35_NA_PM_Ch) "When it comes to young people, we have to teach them, we don't have mentoring, but we tell them what we want for them. If you are afraid, you will not have a career." (I8_A45_E_HD_NCh)
		Actively reaching out for a promotion	The importance of actively seeking promotion oneself, a trait more commonly held by men, while women are more reluctant to negotiate.	"When I started working, I was forced to present, to be on stage [...] You have to be training, you're going to hate it, but it gives you opportunities. You need someone to push you, if you're not born with some skill, you have to have someone to teach you, and push you. You have to be aggressive, maybe men take it easy." (I8_A45_E_HD_NCh) "You have to look for you, no one is going to read your mind, you have to know what you want, if not, you are going to get lost in the sea of company. You have to speak up." (I9_U45_NA_PM_Ch) "When I look at the promotion that I had, I loved to do things that other people didn't want to do. I like challenges. When we started in Italy, I was able to do it. If you have the ability of do thing that no one want to do, you can do a career." (I8_A45_E_HD_NCh)

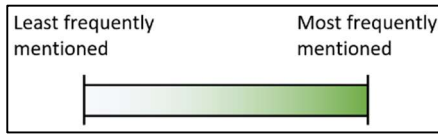| 5.Recommen-dations	Chances to speak up	Opportunities and platforms for women to freely voice their opinions.	"More chances to speaks up, every level technical, management." (I1_U45_E_NCh_PM)
	Promotion of the diversity of engineering	Call for more visibility of unknown subfields in engineering. Arises from the observation that traditionally only a few subfields of engineering are known by the population, while some niches remain unnoticed.	"For me an engineer was someone who was with the car, but in engineering there are so many positions. The media convey a message of only men in this area." (I3_U45_E_Ch_PM)
	Exposure of female role models	Call for greater visibility of female role models to increase the motivation of women to orientate themselves towards an engineering career.	"When a man enters a company and sees all the positions occupied by men, you can imagine yourself in that position. When you come in as a woman, it's harder to imagine being in those positions, to have those ambitions." (I3_U45_E_Ch_PM)
	Normalization of paternity leave	Call for a destigmatized approach to paternity leave in the workplace.	"I am very much in favor of the paternity leave reconciliation measures. Positive discrimination, that it becomes normal that men can take paternity leave. Stop women being the differentiated ones, or that we are a problem for the company." (I3_U45_E_Ch_PM)
	Remote Work	Emphasis on the benefits of remote working options to manage personal and professional life more flexibly.	"Nowadays, teleworking helps women a lot. In your day-to-day life, women tend to be more involved in care work. In remote villages it is necessary to attract more people." (I3_U45_E_Ch_PM)
	Change of minds	Promotion of a changed social consciousness in which women are accepted in engineering professions regardless of their gender.	"Change the mentality of the family. The culture. Men are a part of the family who give this education to a woman, we have to change our mind. Some men try to defend me, but the problem is that some women attack other women. The problem is not the men, it is the mentality of women." (I2_U35_Af_C_NCh) "About women in engineering, it's school. When I was in high school, a math's teacher told me 'you'll never succeed.' " (I8_A45_E_HD_NCh) "Best practice is to make sure we are very open-minded, have the space to share and talk about what you want and how you work. Communication." (I8_A45_E_HD_NCh)
	Management attention for women	Emphasis on the importance of special management attention to address gender issues sensitively in the workplace.	"As a company, you can try to focus on gender topics. For example, by organizing trainings etc." (I7_U35_E_PM_NCh)

Political attention for women	Emphasis on the importance of political attention by state authorities to tackle gender inequalities at work.	"I want the [state] authorities to take responsibility for that. The female population is equally intelligent, it's equally capable, it's equally deserving for all the positions that men are occupying." (I4_U25_As_PM_NCh)
Collaborative work	The power of a cooperative approach to collaborative problem solving through mutual support within the organization.	"I have a very collaborative way of working, I work with a very broad vision, if I identify something I share it. As I am a person who shares, others count on me." (I6_A45_E_NCh_HD)
Places at work to share	Provision the opportunity to exchange views on gender-specific topics within the framework of task forces, platforms, programs.	"Saying a company has an area for coffee breaks or communal areas makes you connect with your colleagues and share information about work." (I6_A45_E_NCh_HD)
Inclusive decision-making bodies	Creation of inclusive decision-making bodies within the organization in relation to different areas such as recruitment, strategy, management, etc.	"To a certain extent we have to accept that we all have a certain amount of bias. [...] You have to make sure that your [hiring] committees are diverse." (I5_U35_NA_PM_Ch) "I think we unconsciously have some prejudices, I try to fight them so that we don't depend on the opinion of just one person [in an interview], make sure that the person who is going to be part of the process has different characteristics and always try to make sure that it is at least a woman, because maybe she can feel more comfortable." (I5_U35_NA_PM_Ch)
Specific training	Assignment of specific training measures to raise awareness for gender sensitive topics.	"Leadership training helps me. I think they have specific female leader training. Specific training even for non-binary people, because everybody has different barriers. You can't think that the same message is going to be the same for everyone." (I9_U45_NA_PM_Ch)
Job description by skills	Changed focus when creating job postings. Instead of focusing on experience, more emphasis is to be placed on technical and social skills.	"Be aware of the bias in the job description of the job offer, write the job description based on skills." (I9_U45_NA_PM_Ch)

A.3 Listing of absolute counts of codes by dimension.
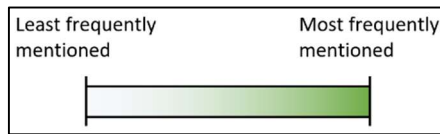
	No.	Code	1. Before the job	2. General challenges	3. Recruitment	4.1 Tasks	4.2 Climate	4.3 Work-Life	4.4 Parental leave	5. Promotion	6. Recommendation	Total mentions	No. of interviewees
0. Before looking for a Job	1	Childhood dream	1	0	0	0	0	0	0	0	0	1	1
	2	Being a role model	2	0	0	0	0	0	0	0	0	2	2
	3	Challenge	2	0	0	0	0	0	0	0	0	2	2
	4	Affinity for science	8	0	0	0	0	0	0	0	0	8	8
	5	Engineering vocation	4	0	0	0	0	0	0	0	0	4	4
	6	Family environment	2	0	0	0	0	0	0	0	0	2	2
	7	Curiosity for new technology	6	0	0	0	0	0	0	0	1	7	6
	8	Care for the environment	5	1	0	0	0	0	0	0	0	6	5
	9	Lack of Green Hydrogen in country	2	1	0	0	0	0	0	0	0	3	3
1. General challenges for women in Green Hydrogen	10	Male-dominated field	5	9	6	3	2	0	0	3	2	30	11
	11	Need to outperform male colleagues	1	3	1	2	3	0	0	1	0	11	7
	12	Gaining the respect of colleagues	1	2	0	2	2	0	0	1	0	8	5
	13	Lack of female role models	1	5	1	0	0	0	1	0	0	8	5
	14	Performance vs potential	1	1	0	0	0	0	0	0	0	2	2
	15	Less job offers at the sight of potential motherhood	0	2	2	0	0	0	0	0	0	4	3
	16	Low self-esteem of women	0	4	3	0	2	0	0	3	0	12	8
	17	Traditional role of the woman	0	2	3	1	3	3	0	0	2	14	6
	18	Imposter syndrome	0	1	0	0	0	0	0	0	0	1	1
	19	(In)visibility paradox	0	2	0	1	1	2	0	0	1	7	4
2. Recruitment process	20	Asking about pregnancy in the interview	0	0	3	0	0	0	0	2	0	5	5
	21	Importance of skills	0	1	8	0	0	0	1	1	0	11	9
	22	Gender discrimination	1	0	7	3	0	0	0	0	0	11	8
	23	Availability as a factor	0	1	5	0	0	1	0	0	0	7	6
	24	Importance of (scarce) Expertise in GH	0	1	4	1	1	0	0	2	0	9	7
	25	Emotional vs financial approach to Green Hydrogen	0	1	1	0	0	0	0	0	0	2	2
3.1 Tasks	26	Male-domination of production sites	0	1	2	5	0	0	0	1	0	9	7
	27	Perception of female technical skills	0	3	0	2	0	0	0	0	2	7	6
	28	Distribution of tasks by competencies	0	0	0	5	1	0	0	1	0	7	6
	29	Distribution of tasks influenced by gender	0	0	1	5	0	0	0	0	0	6	5
	30	Bypassing of women in flows of information	0	0	0	1	2	0	0	0	0	3	2
3.2 Social department climate	31	Female voices not equally heard	0	0	0	3	5	0	0	0	0	8	6
	32	Networking advantage	0	1	0	0	4	0	0	0	0	5	4
	33	Sexist comments	0	0	0	1	5	0	0	0	0	6	5
	34	Importance of Management	0	0	0	3	2	0	1	0	1	7	5
	35	Sexist behavioural patterns	1	3	2	4	8	0	0	0	0	18	10
	36	Missing connection with male colleagues	0	0	0	0	3	1	0	0	0	4	4
	37	Friendly department climate	1	0	1	1	6	0	0	1	0	10	6
	38	Inclusive environment in green hydrogen	1	1	0	1	7	0	0	1	0	11	8
	39	Strength of supportive female networks	0	0	1	0	3	0	0	1	1	6	5
	40	Infrastructural discrepancy	0	0	1	1	0	0	0	0	0	2	1
	41	Differences in networking behaviour	0	1	0	1	3	0	0	0	0	5	4
	42	Body challenges	0	1	0	1	2	1	0	0	0	5	5
	43	Disregard of female leadership	0	3	1	0	3	0	0	0	0	7	5
	44	Disregard of young colleagues	0	3	0	0	3	2	0	0	0	8	6
	45	Disregard of colleagues with migration background	0	0	0	0	3	1	2	0	0	6	6

Least frequently mentioned — Most frequently mentioned

Least frequently mentioned — Most frequently mentioned

	No.	Code	1. Before the job	2. General challenges	3. Recruitment	4.1 Tasks	4.2 Climate	4.3 Work-Life	4.4 Parental leave	5. Promotion	6. Recommendation	Total mentions	No. of interviewees
3.3 Work-Life-Balance	46	Parent-unfriendly meeting schedules	0	1	1	0	2	6	1	0	0	11	8
	47	Hard-working	0	0	0	0	1	4	1	0	0	6	6
	48	Family status matters	0	0	0	0	1	6	0	0	0	7	6
	49	Motherhood	0	2	1	0	1	6	2	0	0	12	8
	50	Gender difference in balancing family and work	0	0	1	1	1	9	0	0	0	12	10
	51	Benefits of a senior position	0	0	0	0	0	1	1	0	0	2	2
3.4 Return to job after parental leave	52	Women going part time or resigning after giving birth while men continue	0	0	0	0	0	3	2	0	0	5	4
	53	Paternity leave - less common	0	0	2	0	1	2	6	1	0	12	10
	54	Paternity leave - socially frowned	0	0	0	0	1	0	2	0	0	3	2
	55	Paternity leave - welcomed	0	0	0	0	1	0	2	0	0	3	3
	56	Maternity leave	0	0	2	0	0	2	7	1	1	13	9
	57	Impact of parental leave	0	0	1	0	0	1	7	0	0	9	8
	58	Personal negative impact of maternity leave	0	1	0	1	0	1	2	0	0	5	3
	59	Accumulated work	0	0	0	0	0	0	4	0	0	4	4
4. Promotion	60	Training	0	0	1	0	0	0	2	3	2	8	6
	61	Less women in positions of power	0	2	1	2	0	0	1	3	0	9	5
	62	Male feedback cycle	1	0	0	0	0	0	1	2	0	4	3
	63	Communication and networking skills	0	1	1	2	0	0	4	7	0	15	8
	64	The importance of a mentor	0	0	0	0	1	0	0	4	0	5	4
	65	Actively reaching out Pushing yourself for a promotion	0	0	0	0	0	0	0	3	0	3	3
5. Recommendations	66	Chances to speak up	0	0	0	0	1	0	0	0	6	7	6
	67	Promotion of the diversity of engineering	0	0	0	0	0	0	0	0	2	2	2
	68	Exposure of female role models	0	0	0	0	0	0	0	0	8	8	8
	69	Normalization of paternity leave	0	0	0	0	0	1	1	0	2	4	2
	70	Remote work	0	0	0	0	0	1	1	0	1	3	2
	71	Change of minds	1	0	1	0	2	1	0	1	6	12	7
	72	Management attention for women	0	0	1	0	1	0	0	2	7	11	8
	73	Political attention for women	0	0	0	0	0	0	0	0	3	3	3
	74	Collaborative work	0	0	0	0	0	0	0	0	1	1	1
	75	Places at work to share	0	0	1	0	1	0	0	0	5	7	5
	76	Inclusive decision-making bodies	0	0	3	0	1	0	0	1	2	7	4
	77	Specific training	0	0	0	0	0	0	0	1	2	3	2
	78	Job description by skills	0	0	0	0	0	0	0	0	2	2	2