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Striving for Gender Parity in the European Energy Sector by 2050

Policy Paper: Effective Policies for Sustainable Change

Greeting



Technology shapes our world – but it’s not gender-neutral

In a landmark study last year, commissioned by the European Commission Directorate-General for Research and Innovation, we and our partners explored the representation of women in the energy industry – a sector where gender equality metrics have been notably opaque.

We started with the assumption, derived from other studies, that the energy transition has a female face. This means that women are presumably more strongly represented among the employees of companies in the renewable energy sector than among the employees of companies in the fossil energy sector. We were surprised that this is not the case in Europe.

Instead, each energy technology has its own specific gender implications depending on its craft intensity, scientific maturity, or distribution characteristics. For instance, we observed the highest male dominance in the heat pump sector and the lowest in wind energy.

Parity in 2050? We doubt it.

In this policy paper, we address the question of what needs to happen to move closer to a balanced ratio of women and men in the energy industry workforce in the coming decades. We are skeptical and expect the proportion of women in the energy industry to stagnate. Factors for this are, as we discuss, a strong expansion of (male) blue-collar-work intensive heat pump technology, the so-called gender equality paradox (with increasing economic prosperity also gender stereotypical thinking in engineering increases), or the stagnating catch-up effect of female labor force participation.

Reflecting gender equality objectives

Consequently, we should take a critical look at the goal of gender parity. We also find strong horizontal segregation in the energy industry: Women are less likely to work in areas characterized by physical work and are more likely to work in administrative jobs. But what sense does it make if, as a result of our striving for parity, only more women end up working in assistant positions or women are pushed into jobs that might contradict their gender identity? Alternatively, we should rather strive for the reduction of the gender pay gap in the energy industry or the promotion of women in visible and influential fields of activity (e.g. management or R&D).

Achieving parity ultimately depends mainly on structural factors, such as politically promoted types of energy or state family policies. Yet the gender pay gap or the proportion of women in certain areas of activity are tangible targets that each company can influence. In this policy paper, we provide an overview of the measures and strategies that can be used to promote equal opportunities in the energy industry.

Yours sincerely,

Katharina Hölzle

Prof. Dr. Katharina Hölzle

Content

Key Messages 5

Parity in the Energy Sector of 2050 – A Self-Fulfilling Prophecy? 6

Parity in 2050 – What Forces Are at Work? 10

 National Context Factors Affecting the Parity Goal 10

 Situational-Organisational Factors Affecting the Parity Goal 11

 Organisational Factors Affecting the Parity Goal 12

A Comprehensive Toolbox of Measures 14

 Introduction 15

 What Business Can Do 16

 What Policies We Need 20

 What Higher Education Can Contribute 24

How to Achieve Parity in the Energy Sector by 2050 29

About our Methodology 32

Literature 34

Country-Specific Indicators 36

Overview: Definitions of Barriers and Measures 40

 Application Field: Business 40

 Application field: Higher Education 42

 Application field: Policy 45

Contact and Imprint 48

Key Messages

1

The goal of achieving gender parity in the energy sector by 2050 cannot be considered a self-fulfilling prophecy.

Current growth trends and various influential factors indicate a likely stagnation or even decline in the proportion of women in the industry. Despite an increase in women's education and workforce participation, the specific nature of energy-related roles, gender stereotypes, and the limited impact of corporate gender equality measures contribute to this challenge. To ensure progress, concerted efforts are needed from the energy sector, educational institutions, and policymakers.

2

Success hinges on strategic collaboration between companies, educational institutions, and policymakers.

Achieving gender parity in the energy sector by 2050 demands a nuanced understanding of complex interplays involving national, situational, and organisational factors. National contexts, including governance, societal expectations, and education structures, significantly impact gender dynamics. Policies promoting inclusive childcare, dismantling gender stereotypes, and fostering STEM education are imperative. Situational factors such as company size, regional disparities, and industry-specific demands pose challenges. Organisations must focus on the professionalization of their diversity management, fostering networks, demonstrating commitment through policies, nurturing inclusive corporate cultures, and ensuring career permeability. Policymakers must support these efforts with targeted policies, comprehensive educational reforms, and stringent monitoring to create a truly equitable energy sector.

3

A core of actions was identified that might build the foundation for a proactive intersectoral strategy for gender parity.

Policymakers must encourage companies to establish mentoring programmes and flexible work models, enabling women's professional growth while balancing family life. It is crucial to foster an inclusive corporate culture, to show that the energy industry is not just about engineering jobs while, at the same time, challenging stereotypes through transparent business initiatives supported by public funding. Collaborative efforts between educational institutions and the industry, promoting gender-sensitive curricula and breaking down societal stereotypes, are essential. Media campaigns challenging gender norms further contribute to creating an environment where gender equality is actively promoted, motivating more women to pursue STEM and energy careers.

Parity in the Energy Sector of 2050 – A Self-Fulfilling Prophecy?

With this publication we aim to familiarise you with the main factors influencing the gender ratio in the energy industry. Additionally, we explore measures and possible strategies for business, higher education, and policy to effectively contribute to gender parity in the energy industry within the framework of these influencing factors. Concrete recommendations of action are formulated which provide you with the basis to design a comprehensive gender equality policy for the energy sector or to position an effective contribution to it.

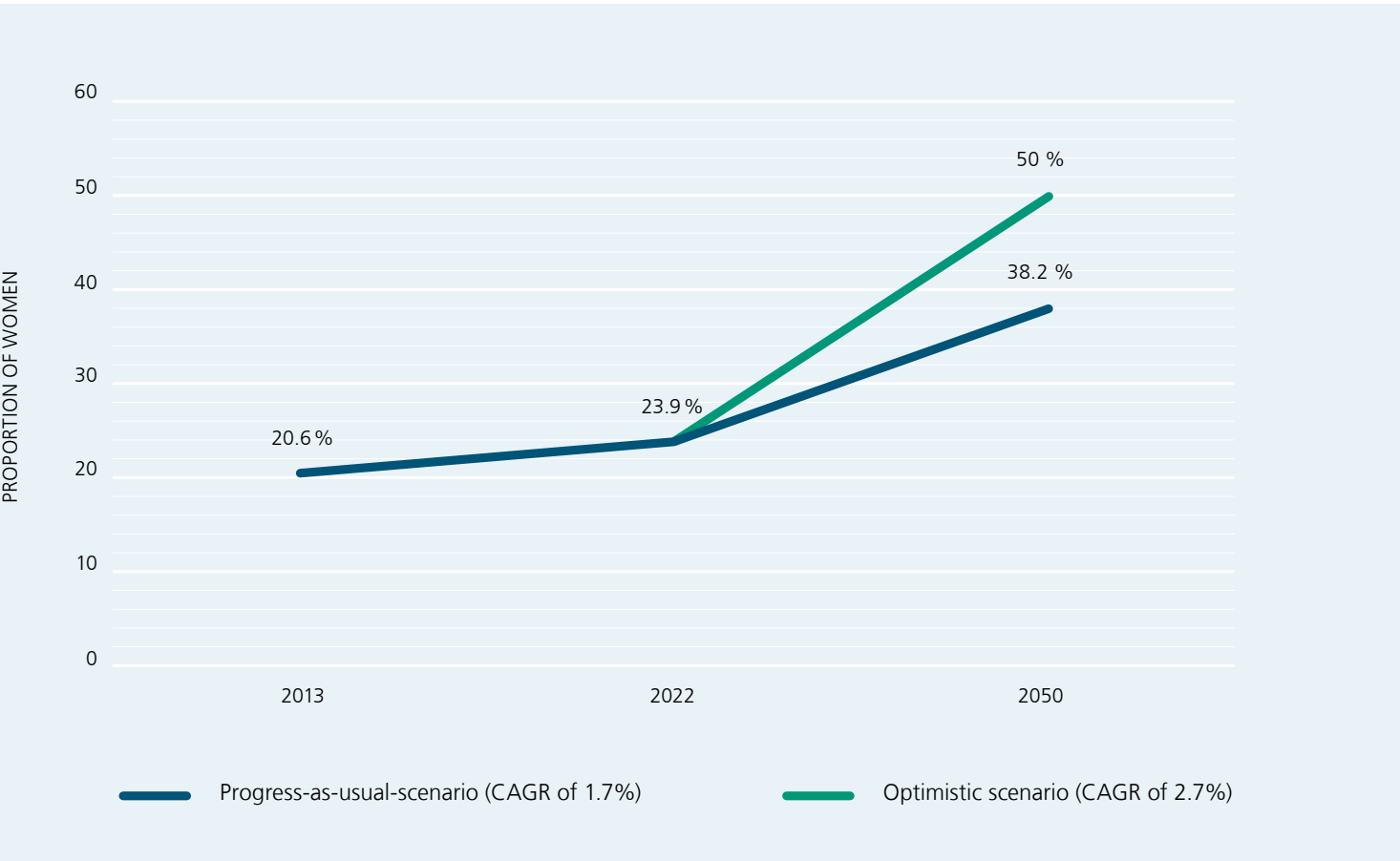


Exhibit 1: Projected Share of Women among Employees in the Energy Industry, Based on the CAGR Calculated for 2013 to 2022 (Source: Own calculations, based on Eurostat data (Labour Force Survey, NACE Rev. 2 sectors B05, B06, C19, D35).)

First, we explain why we believe that the expectation of gender parity in a more sustainable energy sector in 2050 will not be a self-fulfilling prophecy.¹

According to Eurostat data, the share of women in the European energy sector was 20.6 percent in 2013 and increased to 23.9 percent in 2022. By applying the Compound Annual Growth Rate (CAGR) calculated from this data, we can project the share of women for the year 2050. In Exhibit 1, the CAGR of the years 2013 to 2022 (1.7 percent) is projected into the year 2050. According to this estimation, the share of women in the energy sector would reach 38.2 percent, assuming no change in growth dynamics. This means that by 2050, which is 27 years from now, the proportion of women will still fall short of the minimum 40% defined by EIGE as ‘gender balance’ (EIGE, 2022). To achieve full parity, a considerably higher CAGR of 2.7 percent would be necessary (Exhibit 1, optimistic scenario).

However, as the result of the foresight conducted in the study, we do not believe that the progress-as-usual scenario is even realistic. Considering the factors explained in more detail in the following sections, a significant slowdown in the growth of the share of women in the energy sector seems more accurate. We base this assessment on the following trends:

- A central result is that the expansion of green, renewable energies does not automatically lead to a stronger inclusion of women in the labour market of the energy industry. **Functional aspects are decisive** for the share of women in the different areas of the energy transition. Notably, the proportion of women is particularly low in hydrogen energy, which is very research-intensive, and in heat pumps, which are heavily dependent on manual labour. Heat pumps, in particular, are a central element of the energy transition policy in many European countries. However, the disparities

in female representation across energy sectors are generally not very large. In the renewable energy sector, the average workforce representation of women ranges for 30 percent in wind power to 20 percent in heat pumps and 18 percent in geothermal energy.

- Recent studies indicate a so-called ‘**gender equality paradox**’. This paradox suggests that with increasing prosperity and higher levels of equality in a country, gender stereotypes regarding aptitude for STEM studies become more pronounced (Breda et al., 2020). Thus, a progressive shift in values towards higher representation of women in STEM subjects within the EU may not be realised. The opposite might be the case, with increased prosperity leading to lower participation of women in STEM fields.
- Over the past decade, the higher labour force participation of women in STEM occupations has been largely due to an increase in their proportion among academic degree holders (Striebing et al., 2020). Already today, the share of women among graduates with tertiary education in the EU-27 has reached a plateau at 57 percent.² This figure stood at 58 percent in 2013. It is expected that the **catch-up effect for women in labour force participation** based on academic education will stagnate. Moreover, within the group of women with tertiary degrees, there is no discernible shift towards more STEM degrees.³
- A substantial **expansion of care provision** for children and elderly, as well as an increase in the equitable sharing of care responsibilities between men and women seems unlikely. This would require massive, concerted investment in the care system across numerous European countries, along with a significant shift in societal values regarding gender roles. The origins of such a progressive shift in values remain unclear.

1 A self-fulfilling prophecy is “a negative or positive belief or expectation that affects a person’s [...] actions in a way that leads to the fulfillment [sic] of those expectations” (Midlarsky & Rosenzweig, 2018, p. 1). We use this term for the parity in energy challenge because our impression is that the current belief in a steady increase in the proportion of women in energy professions is not based on factual structural factors, which we explain below.

2 Own calculations for years 2013 and 2021, based on the Eurostat dataset “Graduates by educational level, programme orientation, gender and field of education”. online data code: educ_uoe_grad02.

3 See Eurostat dataset “Graduates in tertiary education, in science, math., computing, engineering, manufacturing, construction, by sex – per 1000 of population aged 20-29”. (online data code: educ_uoe_grad04).



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Parity in the Energy Sector of 2050 will therefore by no means be a self-fulfilling prophecy but will require increased joint efforts by the energy industry, education sector, and policy.”



2,700

HR managers from a global survey provided the data we used to calculate what best predicts the proportion of women in the workforce in the energy industry

■ Another important finding of the study is that **companies have limited strategic control** over the proportion of women in their workforce. Using the data we gathered from a global survey of around 2,700 HR managers, we calculated what best predicts the proportion of women in the workforce in the energy industry. We compared the explanatory power of the sector as an indicator of the specific requirements in the energy industry (e.g., strong focus on STEM research, sales activities or manual labour), the respective home country of a company, government involvement and the gender equality measures implemented.

The result: sectoral characteristics have the greatest explanatory power for the share of women in the workforce. The effect of gender equality measures in a company appears to contribute only marginally to explaining the low share of women. However, the context, commitment, and conditions for implementation success vary widely. If the measures presented in this study are fully implemented by the Business, Higher Education and Policy sector, their effect should increase significantly.

Also this report presents a series of indicators that give an impression of how the factors mentioned above are characterised for the EU27 and several non-EU countries. The country-by-country analysis shows that the proportion of women employees in the individual sub-sectors of the energy transition vary greatly.

While already almost one in five employees in Germany worked in the heat pump sector in 2021, in other countries such as Croatia, Slovenia and Belgium, just 1 percent of employees worked in this sector. In general, there are very pronounced genderrelated STEM biases in the EU27, least of all in Romania and (by some distance) other Eastern and South-Eastern European countries.

In all EU27 countries women already make up the majority of graduates with tertiary education qualifications, with a minimum of 54 percent in Luxembourg and a maximum of 65 percent in Poland and Latvia. The proportion of women among graduates with a tertiary education has stagnated at a high level for a decade, meaning that this factor is not expected to have any further impact on the

proportion of women in the energy industry as it might had in the past years.

A positive effect on the proportion of women in the energy sector due to endeavours of couples to reconcile career and family also is unlikely. Across all EU27 countries, the proportion of young children who are cared for only by their parents has decreased only marginally in the last decade. The proportion of women among engineering graduates at Bachelor level is also stagnating across the EU27.⁴

In summary, the arguments presented lead us to the point of not assuming a continued linear growth of the share of women in the energy industry. A stagnation at a slightly higher level than today seems more plausible to us.

If the growth dynamics of the proportion of women’s participation in the labour market and in tertiary education slows down or reverses, we see no reason why the share of women in the energy industry should not stagnate or decline.

Parity in the Energy Sector of 2050 will therefore by no means be a self-fulfilling prophecy but will require increased joint efforts by the energy industry, education sector, and policy. In this report, we present a comprehensive toolbox and possible strategies to help achieve the parity target after all.

First, however, we would like to give you a brief overview of the many factors that influence the proportion of women in the energy industry.

⁴ For country-specific forecasts of the proportion of women, the respective patterns of the factors mentioned should be taken into account. For example, in Germany, a possible positive effect on the proportion of women in the energy sector may be counteracted by a higher childcare rate for young children due to the expansion of the heat pump sector and the high STEM stereotypes. In Poland, on the other hand, presumably higher childcare rates and low STEM stereotypes could be inhibited by a stagnation of female bachelor’s degrees in engineering.

Parity in 2050 – What Forces Are at Work?



“...pregnancy, family responsibilities, and/or accommodating a spouse’s career have negative impact on their careers”

National Context Factors Affecting the Parity Goal

National context can be systematised into Governance, Society and Education (based on Kwan, 2022).

Governance: Encompassing standards, regulations, and funding implemented by companies and regional programmes – has a significant impact on gender dynamics in the energy sector (EIGE, 2017 & OECD Family Database, 2022). This includes guidelines on women’s workforce proportion and factors such as variations in daycare availability and the distribution of parental leave and care, which exhibit significant international differences (OECD Family Database, 2022). Addressing these governance factors is vital for fostering gender equality by enhancing childcare options, implementing inclusive policies, and promoting women’s participation in the energy sector.

The importance of this is, among others, supported by a NEA study in which women in the nuclear energy sector “overwhelmingly [stated] that pregnancy, family responsibilities, and/or accommodating a spouse’s career have negative impact on their careers” (NEA, 2023, p. 10).

Society: Social expectations of gender roles, such as the perception of men as breadwinners and women as part-time workers,

contribute to the gender disparities in the labour market (Kwan, 2022). In addition, societal norms often dictate that care work for family members, such as children or sick parents, often falls on women. These expectations can limit women’s access to full-time employment and career advancement opportunities. Additionally, there are strongly gendered images associated with industries and occupations, particularly in STEM fields, which are often seen as masculine domains (Priest, 2017). These gendered stereotypes can discourage women from pursuing careers in STEM and contribute to their underrepresentation in these fields.

Education: The issue is not that girls universally have no access to STEM education, but rather the presence of systematic barriers and biases that can deter them from pursuing it. In many education systems, there is a trend towards early specialisation which might discourage students from exploring STEM fields if they did not initially select them. More open and flexible education systems that allow students to decide on their specialisation at a later stage can increase the appeal of STEM fields to a broader range of students, including girls (Alam & Sanchez Tapia, 2020). Implementing mandatory gender mainstreaming in educational institutions is also crucial to promote equal opportunities for all genders and ensure inclusive educational environments.

Organization-Specific Context Factors Affecting the Parity Goal

Situational-organisational factors are difficult to influence by individual organisations and thus form essential framework conditions for the achievable effectiveness of gender equality measures in the industry.

Fluctuation of personnel and size of the company: A company that grows has more opportunities to fill new positions with women, enabling a faster change in the gender ratio compared to a shrinking or stagnant organisation. For example, for the nuclear sector it is found that the share of women among new hires (28.8 percent) is higher than the workforce percentage (24.9 percent). However, the proportion of women among STEM hires is only 24.6 percent (NEA, 2023, p. 9). Company size is relevant, as well. Replacing a position that was previously held by a man or a woman with a person of another gender has stronger implications for the gender ratio in smaller companies (or at higher hierarchical levels with fewer employees).

Regional context: Regional context is another factor that can influence the gender ratio in companies in the energy industry. Several aspects come into play, including the location of the company’s headquarters, the level of recruiting (global or national), national and regional differences in the proportion of women among STEM graduates, the attractiveness of the area (urban areas might have more choice in selecting employees than rural ones), and regional concentrations of certain sectors of the energy industry.

Socio-technological factors: Different characteristics of the energy industry sectors, such as coal, wind, or hydrogen, can influence the gender ratio in companies. The orientation of a company towards research, service, or production, as well as the specific content focus of a company, can also influence the positions available for women. For example,

women in Germany are significantly more likely to be found in commercial and service occupations and very rarely work as plant and machine operators or craftswomen (DESTATIS, 2021).

That is, an important contextual condition of the share of women in the energy industry sectors is the extent to which a technology for energy production and distribution requires the influence of manual labour (as it is very pronounced for heat pump technology). The gendered image of a sector, negotiated in the context of societal and technical developments, might also be a relevant characteristic (Gupta, 2015 & Blackburn, 2002).

24.6 %
women among
STEM hires



Controllable Organisational Factors Affecting the Parity Goal

The following set of potentially positive factors for women’s advancement can be directly influenced by the organisation. However, correlations between measures for the advancement of women and their effects are often fuzzy. In principle, it is recommended to manipulate the following factors (based on Lagesen et al., 2022) through a broad set of measures with high commitment (Schmidt & Graversen, 2020).

Professionalisation: The efforts an organisation makes or can make, to recruit women and the resources available are crucial factors in promoting gender diversity among employees (Lagesen et al., 2022). This includes the level of professionalism within the organisation, which is measured by the efforts and resources invested in the HR area to promote gender equality. This encompasses the presence of equal opportunity policies and the number of HR managers employed by the company, as they are related to the capacity for management of corporate culture. Moreover, an organisation’s commitment to further education combined with an open and positive work climate is integral to professionalisation. Developing HR innovations to create opportunities for upskilling, recognising transferrable skills from degrees not directly related, and facilitating re-entry into the workforce through skill development programmes can greatly contribute to increasing gender diversity.

Institutional Exchange: The promotion of women networking and visibility have a positive impact on increasing the representation of women in the workforce (Striebing et al., 2022). Furthermore, this refers to the establishment of cross-company or HR-specific networks that facilitate mutual learning and the exchange of experiences among professionals. Additionally, the source of recruitment plays a crucial role, such as directly hiring from study programmes offered by regional and national universities (Lagesen et al., 2022). By fostering networking opportunities and recruiting from diverse educational institutions, organisations can enhance women’s participation and contribute to a more balanced gender representation in the workforce. However, it is important to avoid one-sided cooperation with the same educational institution without a concept of women’s advancement, as it may also contribute to the formation of a homogenously male workforce.

Commitment: Efforts to advance women within an organisation become evident in strategic plans and specific policies addressing harassment and gendered violence. The allocation of resources for recruiting women, the regular monitoring of equality figures, and the imposition of sanctions for non-compliance with gender quotas also contribute to gender diversity (Lagesen et al., 2022). Additionally, a clear commitment from political and organisational leaders positively influences the promotion of gender equality.

Corporate Culture: The corporate culture of a company, whether it is a start-up, family business, or multinational corporate group, can have a significant impact on the exclusion of women (Lagesen et al., 2022). The company’s selfimage, which is closely tied to its size, demographics, and market sector, also plays a role. For instance, if women are in the minority in the company, they are more likely to experience a marginalising work culture (Striebing, 2022).

It is essential for organisations to cultivate an inclusive corporate culture that values diversity and provides equal opportunities for all employees, irrespective of gender. The way leadership is lived is also an important part of the corporate culture. Leadership and culture are those aspects that tolerate or encourage certain behaviours or not.

Permeability of Careers: The permeability of careers within companies is a crucial factor in promoting gender diversity. Companies that require a broader range of professional degrees have the potential to draw from a larger pool of female professionals (Lagesen et al., 2022), considering the underrepresentation of women in STEM fields compared to the humanities.

Additionally, the permeability of professional development opportunities within organisations is important. The negative effects of rigidly separated career paths in areas such as research and development, production, sales, and administration can hinder women’s advancement (Lagesen et al., 2022). By creating more flexible and interconnected career paths, organisations can facilitate the upward mobility and growth of female professionals, enhancing gender diversity within the workforce.



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A Comprehensive Toolbox of Measures

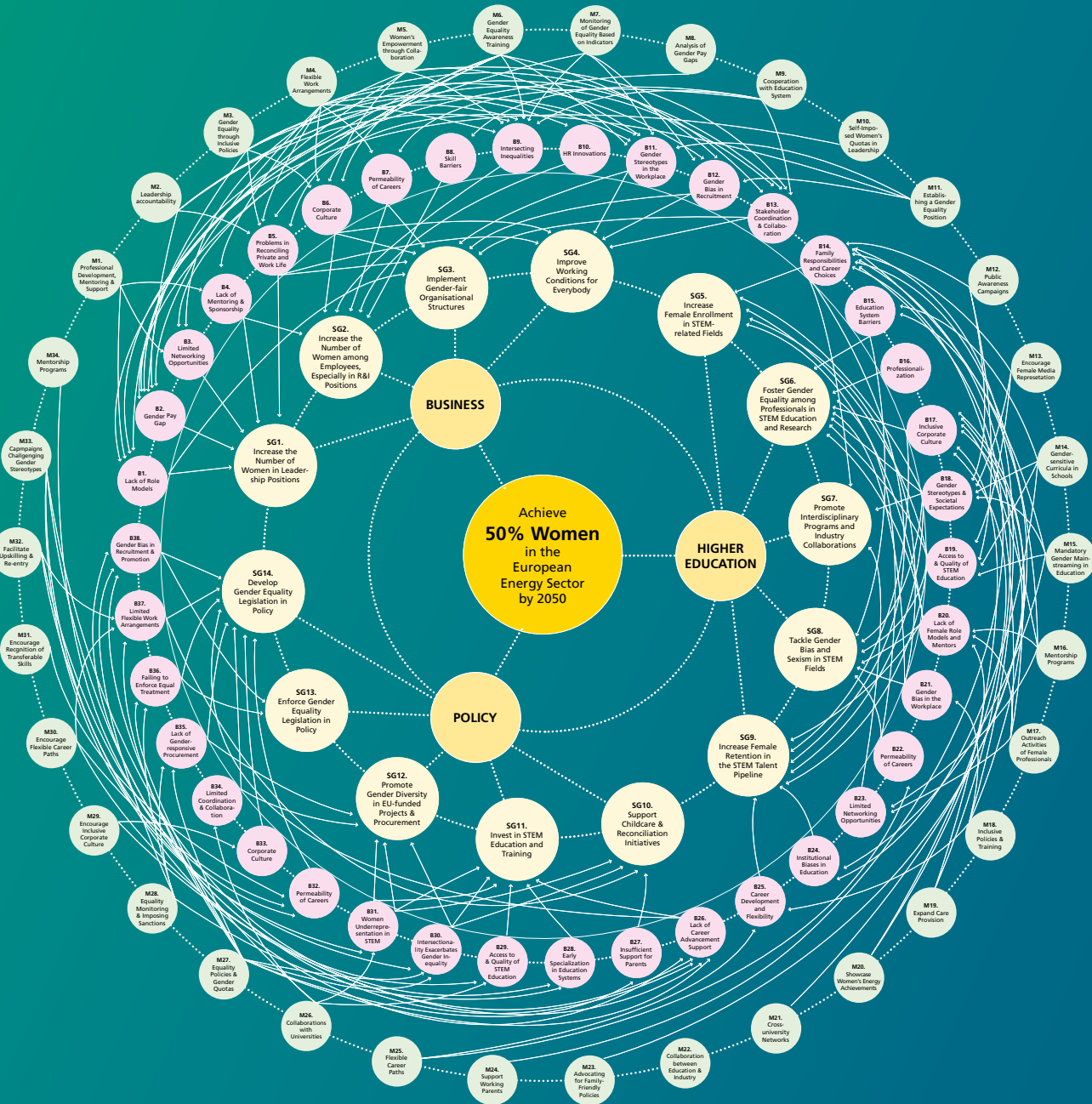


Exhibit 2: Visualisations of the measure-barrier-subgoal links

Achieve 50% Women in the European Energy Sector by 2050”

Introduction

The vision of gender equality in the energy sector in 2050 will – according to the assessment of this report – not happen by itself. Business, Policy and Higher Education can use the comprehensive toolbox of possible measures now at their disposal to achieve this goal in a systematic way. Within the framework of the research project carried out, possible instruments were identified and compiled with an unparalleled range, using expert knowledge and artificial intelligence. These instruments can contribute to achieving the parity target. It is the task of all stakeholders involved to use these instruments as broadly and bindingly as possible so that they can make an effective contribution towards achieving parity in 2050.

You can find the detailed process for producing the toolbox explained below in the section “About our Methodology”. Additionally, detailed descriptions of the gender equality barriers and gender equality measures included in the toolbox’s visualisations can be found at the end of this report in the section “Overview: Definitions of Barriers and Measures”. In a strategy workshop with experts on the interface between the European energy sector and gender equality policy, it was discussed how the respective measures could be prioritised and strategically bundled. On the following pages we provide you with visualisations of the barriers-measures interrelationships identified in the project, as well as a presentation of the results of the strategy workshop.

What Business Can Do

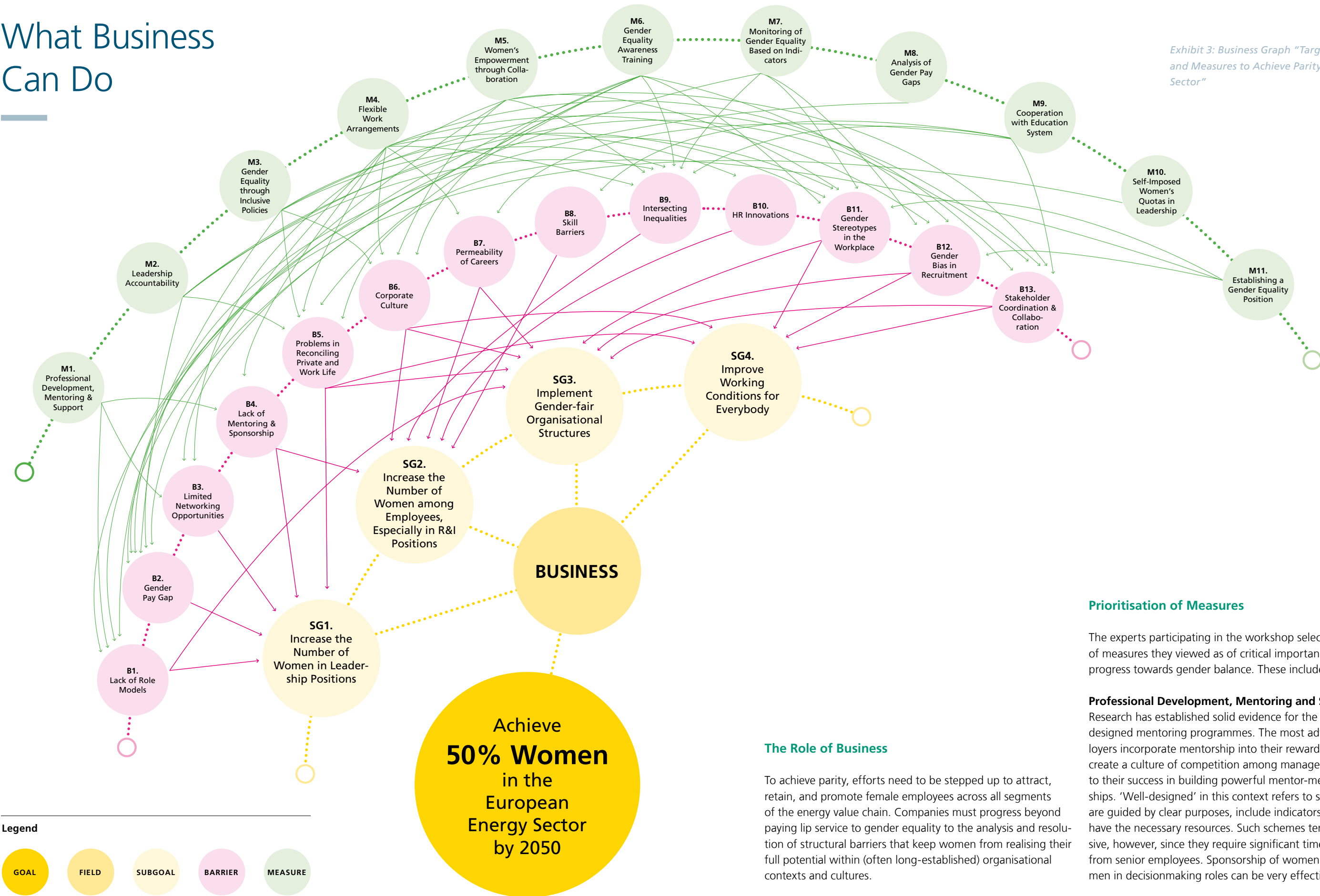


Exhibit 3: Business Graph "Targets, Barriers and Measures to Achieve Parity in Energy Sector"

Prioritisation of Measures

The experts participating in the workshop selected a range of measures they viewed as of critical importance for making progress towards gender balance. These include:

Professional Development, Mentoring and Support (M1)
Research has established solid evidence for the impact of well-designed mentoring programmes. The most advanced employers incorporate mentorship into their reward systems, i.e., create a culture of competition among managers according to their success in building powerful mentor-mentee relationships. 'Well-designed' in this context refers to schemes that are guided by clear purposes, include indicators of success, and have the necessary resources. Such schemes tend to be expensive, however, since they require significant time commitment from senior employees. Sponsorship of women employees by men in decisionmaking roles can be very effective.

The Role of Business

To achieve parity, efforts need to be stepped up to attract, retain, and promote female employees across all segments of the energy value chain. Companies must progress beyond paying lip service to gender equality to the analysis and resolution of structural barriers that keep women from realising their full potential within (often long-established) organisational contexts and cultures.



Leadership Accountability (M2)

The fact that many managers in the energy sector publicly promote gender equality should not blind us to the fact that a large number still tend to ignore their responsibility for the issue. If managers are expected to practice what they preach, they need to be held accountable (Hunt et al., 2020).

A top-down approach is often the most effective, i.e., the most senior managers need to publicly endorse gender equality to provide guidance and set the example for its implementation. Leadership accountability typically requires agreement on objective indicators, setting ambitious targets, systematic data collection, and transparent reporting (see M7 below). It is preferable to involve thirdparty expertise to avoid ‘politically correct whitewashing’ of the status quo.

Flexible Work Arrangements (M4)

While there was agreement among the workshop participants that well-managed flexible work arrangements are essential to enable women (and men) to balance work and family demands, they also warned that flexibility (especially as part-time work) can disadvantage female employees if they feel stronger pressure than men for being responsible for the care work. Implementation of flexible work arrangements should therefore be accompanied by holistic approaches to develop an organisational culture that includes awareness about the gendered priorities concerning work-family balance and the provision of different types of flexible work.

Monitoring of Gender Equality Using Indicators (M7)

Databased monitoring of gender equality is often a ‘low-hanging fruit’, as the necessary data is typically already there, ready to be used for the analysis of gender-related structures and developments within an organisation. Without a serious commitment to monitoring, companies cannot claim to achieve progress, as there is no proof and you do not know what is really going on.

Cooperation with Education System Stakeholders (M9)

Experts representing either the business or the education system agreed that internships for students can work very well in creating awareness about career possibilities in STEM-dominated fields, such as the energy sector. Internships can enable students to get to know a professional field, and companies can benefit significantly from cultural enrichment and fresh recruitment opportunities. There are also positive accounts of universities supplementing Ph.D. training with a period spent in industry. More generally, however, workshop participants agreed that collaboration between businesses and higher education tends to suffer from a lack of mutual understanding of job roles and career pathways. In some countries, such as the UK, there is limited mobility between these spheres: talent that leaves university for the business sector is very unlikely to return to academic jobs. The business sector should also cooperate with higher education institutions to attract highly qualified women from non-engineering majors, as there are women with non-technical backgrounds who could excel in the energy sector as well.

To a lesser extent, experts also agreed on the significance of **Self-imposed Quotas on the Share of Women in Leadership Roles** (M10). In the Nordic countries, e.g., Iceland, quotas for the Board of Directors have been established and work well. Quotas can also be a useful approach for publicly listed companies that need to demonstrate to the shareholders that they are taking serious action to address gender inequalities. If companies were to implement quotas for the share of women among new hires, that would have an immediate and strong effect. However, given the current labour market shortages, a quota could also further complicate the already challenging search for skilled workers.

Experts did not consider the remaining measures as unimportant – rather, they often need to be part of the bigger plan. For instance, establishing a person or group with responsibility for gender equality can be required to avoid fragmentation of actions across the organisation. What needs to be avoided is gender equality becoming a “siloe problem”, allocated solely to a certain person or group, making others feel free from taking responsibility.

Strategic View of the Measures

Experts were asked to arrange the selected measures according to their perceived importance (see last section) and potential for achievement. This was done using a matrix with a timespan and impact dimension, and distinguishing between short-term, mid-term, and long-term implementation horizons. The participants agreed that measures with impact in the short-term are very hard to find because of the relevance of the companies’ internal organisational culture. For example, a policy recommending leadership accountability could be introduced quickly, but consistent and lasting effects on organisational culture may take several years.

Experts agreed that government-level action to promote gender equality can make a big difference. For instance, in some European countries, companies of a certain size are expected to publish data regarding the gender pay gap (e.g., in the UK). This can work as a trigger for challenging deeply embedded decisionmaking structures within an organisation and facilitates national monitoring of key indicators. Experience shows that the existence and support of women’s groups

within an organisation can also help speed up the implementation of measures to advance gender equality.

Another result of the discussion was the recommendation to cluster interrelated measures that can be implemented together and produce better overall results. From an organisational view-point, different departments within a company should collaborate closely together towards the goal of supporting gender equality (e.g., PR, CSR, HRM, ...). However, in practice, this is hardly the case even in more advanced organisations due to the hierarchical structuring of company functions.

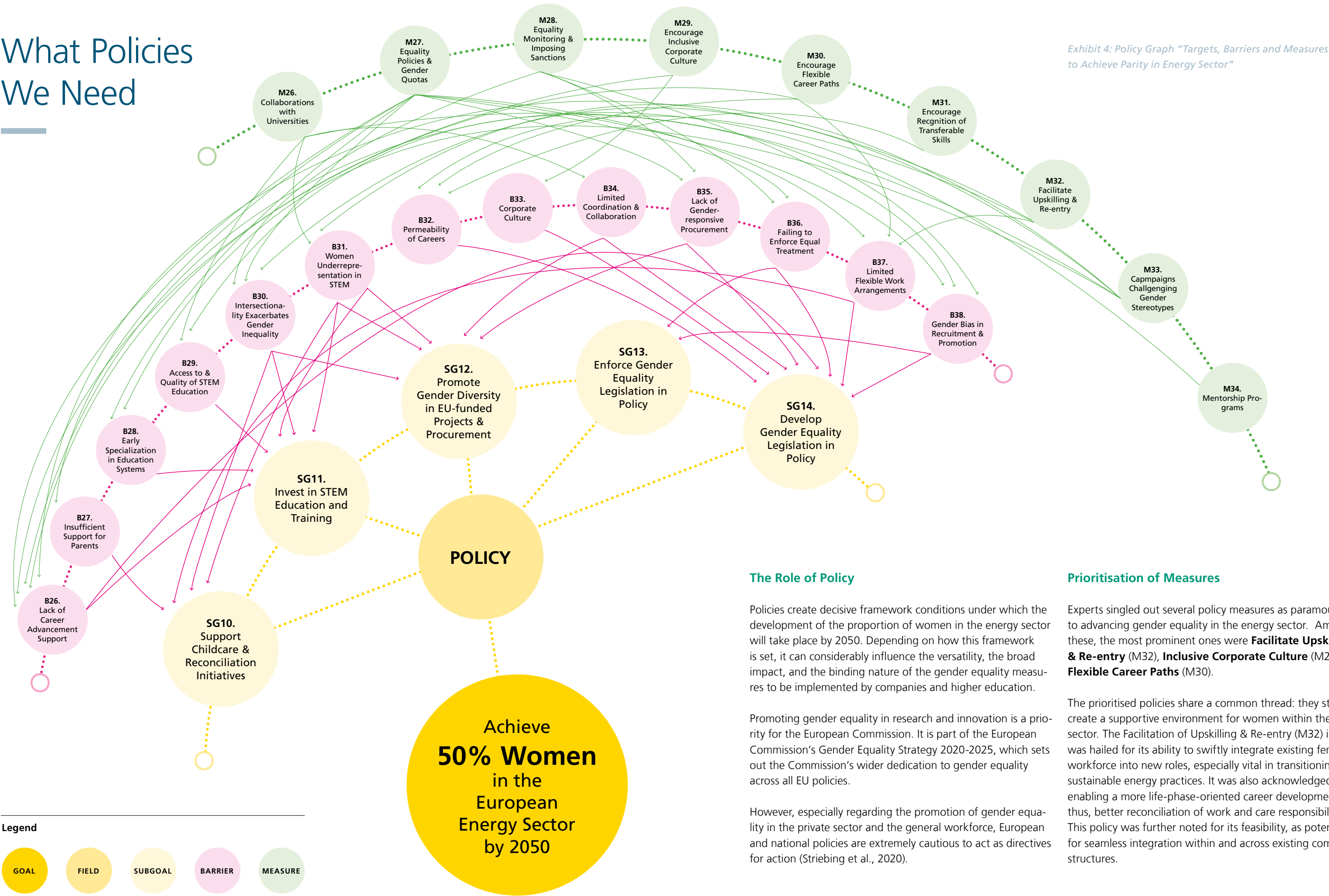
Summary

In summary, within the framework of the goal “Parity in Energy in 2050”, the gender equality responsibilities related to Business include actions:

- to implement the political gender equality goals with high-level commitment from leaders. This top-level commitment should be reflected in comprehensive and binding measures with demonstrable positive effects;
- to build bridges to higher education institutions, as well as to regular and vocational schools, to provide students with little knowledge of employment opportunities in the energy sector to envision their future career in this field of work;⁵ and
- to promote career flexibility and inclusive corporate culture with transparent action plans to minimise conflicts between work and life responsibilities; create appreciation of diversity; and encourage career pathways spanning different company functions.

⁵ Such cooperation measures must have a clear focus on the advancement of women, otherwise, they risk merely reinforcing the homogeneity of the current workforce.

What Policies We Need



The Role of Policy

Policies create decisive framework conditions under which the development of the proportion of women in the energy sector will take place by 2050. Depending on how this framework is set, it can considerably influence the versatility, the broad impact, and the binding nature of the gender equality measures to be implemented by companies and higher education.

Promoting gender equality in research and innovation is a priority for the European Commission. It is part of the European Commission’s Gender Equality Strategy 2020-2025, which sets out the Commission’s wider dedication to gender equality across all EU policies.

However, especially regarding the promotion of gender equality in the private sector and the general workforce, European and national policies are extremely cautious to act as directives for action (Striebing et al., 2020).

Prioritisation of Measures

Experts singled out several policy measures as paramount to advancing gender equality in the energy sector. Among these, the most prominent ones were **Facilitate Upskilling & Re-entry** (M32), **Inclusive Corporate Culture** (M29), and **Flexible Career Paths** (M30).

The prioritised policies share a common thread: they strive to create a supportive environment for women within the energy sector. The Facilitation of Upskilling & Re-entry (M32) initiative was hailed for its ability to swiftly integrate existing female workforce into new roles, especially vital in transitioning to sustainable energy practices. It was also acknowledged for enabling a more life-phase-oriented career development and, thus, better reconciliation of work and care responsibilities. This policy was further noted for its feasibility, as potential for seamless integration within and across existing company structures.



Similarly, the policy of **Encouraging Flexible Career Paths** (M30) found favour due to its role in empowering women to effectively balance their professional and family lives. By enabling women to pursue careers in the energy sector without compromising their family responsibilities, this policy actively promotes participation and inclusivity.

In the case of **Inclusive Corporate Culture** (M29), experts underlined the critical nature of institutional change. In the effort to create an inclusive corporate culture, the intrinsic value of employees is emphasised and the aim is to create an atmosphere in the workplace in which diversity is not only accepted, but celebrated. Transparency emerged as a key theme here, with suggestions pointing toward linking corporate culture inclusivity to public funding, making the efforts of organisations visible to the public eye.

While these policies might not directly address early gender awareness, they play a crucial role in reshaping the energy sector into an inclusive space for all genders and minority groups. These policies, akin to the educational measures, serve as vital bridges, connecting women with opportunities in the energy industry. Importantly, they acknowledge the value of existing talent, fostering an environment where everyone, regardless of gender, can thrive and make meaningful contributions – not being locked up in professional silos due to early-year study decisions or family time.

Strategic View of the Measures

In the expert workshop, the experts reviewing policy-related measures focused on the time horizon of the measures to be implemented.

Short-Term Measures refer to the immediate strategies that are essential for the progress of gender equality within the energy sector. Experts have suggested initiating **Campaigns Challenging Gender Stereotypes** (M33). They were inspired by the influential “Scully Effect” (21CF et al., n.d.). Participants emphasised the importance of media collaborations in challenging gender roles and promoting rapid societal change.

Furthermore, experts emphasised the need for organisations to establish **Flexible Career Paths** (M30) that focus on revising parental leave policies and promoting a healthier work-life balance. This is crucial in addressing the challenges faced by female employees and making the workplace more inclusive and attractive for women in the short term.

The participants also recommended **Facilitating Upskilling & Re-entry** (M32) programmes for women entering or re-entering the workforce. These programmes focus not only on technical expertise but also on essential soft skills. This comprehensive approach bolsters inclusivity and ensures that women have the necessary tools for success.

Although not explicitly listed as a measure, experts emphasised the importance of collaboration and diverse perspectives. They recommended implementing multi-disciplinary research grants that encourage a wide range of fields and foster inclusivity as a short-term measure. Additionally, experts discussed the need for rapid reskilling initiatives, specifically targeting women in related sectors. These initiatives aim to bridge skill gaps, ensure quick, short-to-medium-term impact, and facilitate smoother transitions into the energy sector.

Mid-Term Measures are strategies implemented over a moderate timeframe. In this domain, experts underscored the pivotal role of **Gender Quotas** (M27). Acknowledged for their substantial impact, quotas take precedence despite the time required for contractual adjustments. They emerged as a fundamental strategy for achieving significant and lasting gender balance within the energy sector in the medium term.

Long-Term Measures are comprehensive strategies implemented over an extended period, aimed at fostering profound and enduring change. During the discussion, experts proposed that the energy sector should invest in long-term efforts to promote cultural change initiatives. These initiatives should focus on **Encouraging an Inclusive Corporate Culture** (M29) that fosters diversity. To achieve this, experts proposed a forward-thinking approach towards transparency in pay that links funding with positive reinforcement for gender equality plans. This shift from punitive measures to constructive encouragement would help create an environment that values equality.

Equality monitoring in the **Equality Monitoring & Imposing Sanctions** (M28) measure, grounded in data-driven insights and continuous evaluation, should operate without immediate sanctions as proposed by the experts. This would highlight the significance of a progressive, evolving framework that promotes enduring change. Integrating funding with gender equality contract requirements would ensure that gender equality plans are an integral part of the funding acquisition process, leading to long-lasting transformation within the energy sector.

Furthermore, although it is not currently included among the proposed measures, experts have also suggested the inclusion of new educational fields such as renewable energy, nature conservation, and climate change, starting from primary school through to universities. This is aimed at promoting a diverse education system and highlighting its vital role in facilitating the sustainable transformation of the energy sector over the long term.

Interconnections between the measures can either reinforce or hinder each other’s effectiveness. Experts recognised that Gender Quotas (M27) were intrinsically linked to Equality Monitoring (M28) efforts, underscoring the need for

data-driven decision-making. Additionally, Gender Quotas were linked to Campaigns Challenging Gender Stereotypes (M33) as these campaigns lay the societal groundwork necessary to make quotas more acceptable and necessary in the eyes of the public and stakeholders. Upskilling & Re-entry (M32) was seen as a practical pathway to achieve gender balance, empowering women with skills tailored to positions targeted by quotas.

Experts have suggested that the measures of Flexible Career Paths (M30) and Inclusive Corporate Culture (M29) are closely connected, highlighting the importance of flexible career paths in promoting inclusive work cultures. Encouraging flexible career options, especially in relation to parental leave, helps to promote inclusivity. It was deemed essential to continuously monitor equality (M28) to maintain an inclusive workplace.

Other input from the experts:

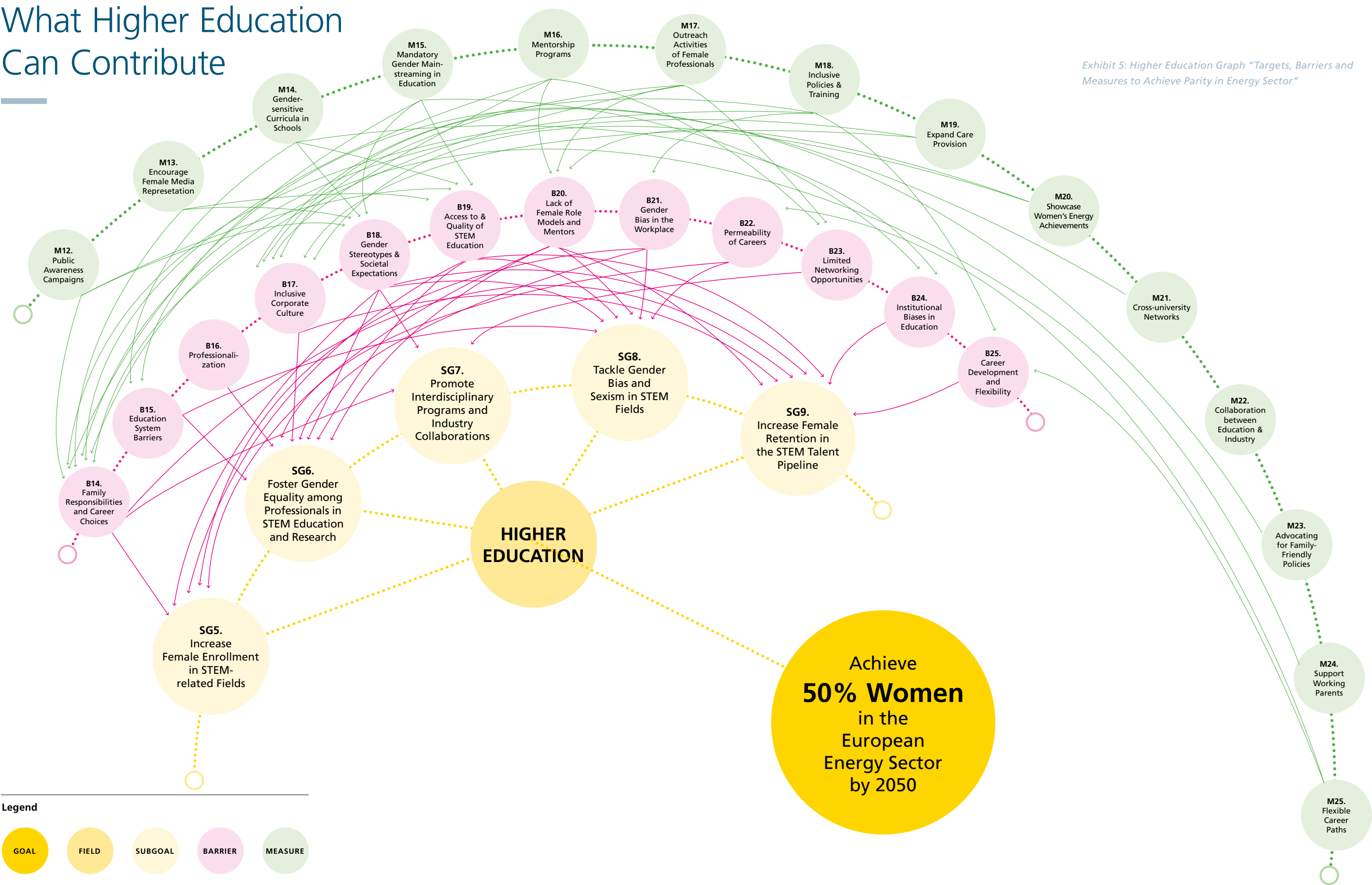
Experts also highlighted the need for societal mindset shifts to streamline processes for smaller enterprises. Strategic planning within budget constraints was underscored, with a focus on initiatives with the highest potential impact. The collective perspective emphasised the responsibility of educational institutions to amplify the visibility of women in STEM, cultivating social networks, ensuring gender-sensitive education, and nurturing inclusive work environments. These efforts collectively pave the way for achieving gender parity in the energy sector.

Summary

To summarise, to achieve gender parity in energy in 2050, policy actions should help:

- create an effective legal framework for realistic gender equality measures in the energy sector by binding regulations for a variety of corporations, taking into account the dependence on the number of female graduates in STEM fields e.g., by applying so-called cascade models [EIGE, n.d.];
- support women’s advancement and ensure gender equality through political initiatives, such as upskilling and re-entry programmes, the promotion of inclusive corporate cultures and flexible career paths;
- challenge gender stereotypes through media campaigns and advocating for family-friendly policies; and
- show commitment from political leaders towards the target of parity in the energy sector by 2050.

What Higher Education Can Contribute



The Role of Higher Education

The skilled workers in the energy industry are initially trained in the general education system. To achieve our political goal of increasing the share of women in the energy industry, a comprehensive consensus must be reached with the representatives of the education system to ensure the necessary preconditions for this (first and foremost, to achieve sufficient qualification of a satisfactory number of female professionals). As a direct precursor to a possible career entry into the energy sector, the educational institutions of academic and vocational training are particularly challenged in this regard.

Educational silos are harmful: the earlier the education system forces a person to follow a certain profile (e.g., STEM or linguistic), the more likely this decision is influenced by social stereotypes. The goal of coordination between the energy industry and higher education should be to enable a high degree of permeability of educational and professional careers. This allows women without a distinct STEM profile to pursue a career in the energy industry in later phases of their education.

Prioritisation of Measures

From the toolbox created for Higher Education to promote gender equality in the energy sector, the consulted experts prioritised three measures in particular: **Mentorship programmes** (M16), **Collaboration between Education & Industry** (M22), and **Gender-sensitive Curricula in Schools** (M14).

The three prioritised measures have in common improvements in connecting girls and women with STEM disciplines and energy companies. For the mentorship programmes and collaborations between education and industry, the experts emphasised the high importance of effective social networks designed according to current findings of diversity research (see Dobbin & Kaleev, 2022) as a bridge between studies and career entry in the energy sector. Ideally, personal contact between female students and successful STEM professionals could help ignite women's interest in working in the energy sector whilst pursuing their studies.

On the other hand, the schools that precede vocational and academic education are also of great strategic importance for the goal of parity. The gender-sensitive design of STEM

subjects, STEM studies or STEM-related training should and can increase women's tendentially lower interest in STEM and, in the long term, also their interest in professions in the energy sector.

Strategic View of the Measures

The consulted experts sorted the measures for the Higher Education toolbox into four thematic clusters, to which they attributed medium to high impact potential. The clusters were linked to whether a possible impact can be expected in the short term or only in the long term.

Visibility measures encompass public awareness campaigns (M12), promotion of women's presence in the media (M13), outreach activities by female professionals (M17), and presentation of women's energy achievements (M20). In essence, all of these measures aim to present STEM fields to a wider or more targeted audience as a field of work in which women can be successful and are already active today. The aim here is to influence girls (their parents and teachers!) in the career orientation phase to make a decision that tends to be less gender-stereotyped towards taking up an apprenticeship in the STEM field or for a career in the energy sector. The package of measures has been attributed a short-term effectiveness, as the possible effects of the corresponding measures tend to be evaluable directly after their implementation.

Reconciliation advocacy includes Advocating for Family-Friendly Policies (M23), Support Working Parents (M24), and Flexible Career Paths (M25). This refers to the role of higher education institutions as advocates for a gender-equitable and inclusive work culture in companies in the energy sector. In the view of the consulted experts, such a role does not belong to the primary responsibility of educational institutions. Nevertheless, it must be mentioned as part of a comprehensive toolbox: if educational institutions participate in collaborations with companies in the energy sector, they can work towards a more inclusive work culture within their framework. The Higher Education expert group perceived the package of measures to have short to medium-term impact potential.

Collaboration measures are Mentorship Programmes (M16), Cross-University Networks (M21), and general formats of Collaboration between Education and Industry (M22).



The goal of the mentorship programmes and the intersectoral collaborations, which were particularly prioritised by the expert panel, is to establish social contacts between STEM students and professionals in the energy sector, ultimately influencing the students' choice of employer. Cross-university networks, on the other hand, aim to transfer knowledge on good practice between educational institutions. The experts considered this package of measures to be effective in the medium term, as the returns from cooperation are usually more indirect.

Cultural change measures were considered by the expert group to be particularly effective in the long term against the background of sustainable implementation. The strategy package includes Gender-Sensitive Curricula in Schools (M14), Mandatory Gender Mainstreaming in Education (M15), and Inclusive Policies and Training (M18). The measures aim to improve the study climate for female students. Especially in fields of study where women are traditionally in a minority position, a climate perceived as hostile and sexist can negatively influence the choice of profession in the same field. Another goal of this package of measures is to make the traditionally male-dominated content of STEM fields more accessible to girls and women.

Summary

In summary, within the framework of the goal "Parity in Energy in 2050", the responsibility of the higher education system is:

- to make the work of women in STEM fields even more visible;
- to promote the social network of its female students to potential employers;
- to make its own STEM education more gender-sensitive and inclusive, and thus more connectable and attractive for women and other potentially marginalised groups of people; and
- to also work towards a gender-sensitive inclusive work culture vis-à-vis business partners.



Recommendations for Action

1. Overcoming Structural Barriers
2. Promoting Inclusive Corporate Culture
3. Facilitating Reconciliation of Work and Non-Linear Career Pathways
4. Counteracting a Competitive Culture
5. Fostering Interest in STEM Careers
6. Creating Gender-Sensitive Study Environments
7. Increasing the Attractiveness of Higher Technical Degree Programmes
8. Increasing the Visibility of Non-Engineering Jobs in Energy
9. Challenging Gender Stereotypes

How to Achieve Parity in the Energy Sector by 2050

As a result of the study conducted on the likelihood, framework conditions, and strategic steering options towards parity in 2050 in the energy sector, we identified a series of recommendations for action and illustrate them here with examples of good practice. The recommendations for action link central goals with measures that appear to be effective and can thus form the basis for an intersectoral strategy roadmap of business, policy, and higher education.

1. Overcoming Structural Barriers

To ensure the professional development of women in the energy sector, companies should implement comprehensive mentoring programmes integrated into reward systems. These programmes establish strong mentor-mentee relationships, offering guidance and support. An analysis of a 5-year period of mentoring experience at Sun Microsystems has shown that mentoring returns good value for the time and money it takes.

The ROI on mentoring can be 1,000 percent or better and grows as the programme matures. The caveat is that “strong and visible long-term executive sponsorship and funding are needed for mentoring to thrive and become part of an organizational culture” (Dickinson et al., 2009, p. 64).

2. Promoting Inclusive Corporate Culture

Fostering an inclusive corporate culture that celebrates diversity can be achieved by ensuring that organisational processes and practices are transparent, and by linking the organisation’s corporate mission and operations with common good, e.g., societal responsibility and sustainability. Thus, a more inclusive corporate culture is achieved through comprehensive, transparent and common good-oriented measures aimed at breaking down traditional stereotypes and promoting a more considerate and accepting attitude towards different lifestyles and identities in society.

A 2019 McKinsey analysis found that companies in the top quartile of gender diversity in executive teams were 25 percent more likely to experience above average profitability than peer companies in the fourth quartile. This was up from 21 percent in 2017 and 15 percent in 2014 (Hunt et al., 2020).

3. Facilitating Reconciliation of Work and Non-Linear Career Pathways

Introducing flexible work models, especially regarding parental leave, is crucial. These models enable an inclusive work environment and support for working parents. This especially allows women to balance professional and family responsibilities effectively and encourages people with substantial care responsibility not just to fulfil a job, but to pursue a career.

Furthermore, upskilling and re-entry should be promoted: the younger men and women are forced to take a certain career path, the more gender-stereotyped this decision will tend to be. Professional silo careers from school STEM profile, via STEM studies into STEM professions, should be broken down. A 2023 survey of employees in the UK has found that “six percent of employees say they have left a job in the last year specifically due to a lack of flexible working, and 12 percent have changed their careers/profession due to a lack of flexible working options within the sector. This represents almost 2 million and 4 million workers respectively”(CIPD, 2023, p. 18).



4. Counteracting a Competitive Culture

According to a Goldin (2021), there are two main issues with career paths that make them challenging for women: insufficient flexibility due to demanding schedules and a strong emphasis on competition. The second factor, among others, also explains why a large number of women (78.6%, see table 1) choose to work in the health and social sector. While this sector may have drawbacks such as shift work and limited flexibility, it offers less competition. On the contrary, in engineering, which typically offers flexible working hours and a high level of independence and therefore has a low gender pay gap, it is crucial to ensure that excessive competition does not undermine these positive aspects.

5. Fostering Interest in STEM Careers

Educational institutions and the employing organisations in the energy industry should collaborate on mentorship programmes. Personal interactions between female students and energy sector professionals during their studies can spark interest in STEM and energy careers. By overcoming social stereotypes, these interactions encourage a more diverse group of students to explore and pursue careers in male-dominated STEM fields. Since 2016, the Enel Group has been promoting numerous initiatives for girls in middle and secondary schools and has engaged more than 20,000 female students worldwide in open and innovative educational initiatives that have involved many Enel staff members as testimonials and role models (Enel Group, 2022).

6. Creating Gender-Sensitive Study Environments

Schools and universities should integrate gender-sensitive curricula into STEM education. These curricula require validation

that gEneSys can provide to help make male-dominated fields more accessible to girls and women exploring careers in energy. A ‘gender-inclusive’ curriculum is one that has been consciously designed to recognise and acknowledge the evidence that males and females are likely to bring different cultural experiences to their learning experience. In an applied area such as engineering, this would include students’ experiences of the applications of engineering in daily life, which may vary according to gender, race, culture, and class (Mills et al., 2010).

7. Increasing the Attractiveness of Higher Technical Degree Programmes

An enhanced appeal of technical degree programmes can be achieved by making the social effects of technical degree programmes more visible and critically reflecting on them during students’ studies or by designing them in a more interdisciplinary way. By creating an inclusive educational framework, educational institutions empower women to pursue STEM careers, ensuring a diverse talent pool in the energy sector. Research advises that “for an equitable sustainable education in the areas of energy and sustainable society, science and technology knowledge should be acquired in conjunction with humanities and arts, through a multidisciplinary approach that infuses technical training with social sciences, arts, ethics, and business” (Skowronek et al., 2022, p. 1).

8. Increasing the Visibility of Non-Engineering Jobs in Energy

While achieving gender parity in technical professions is a commendable goal, it is currently unrealistic due to the influence of women’s personal preferences. Dislikes and preferences for a profession are often formed in childhood and can be difficult to change later in life. In almost all OECD countries boys are more

likely pursue a career in science and engineering than girls.⁶ Furthermore, an experimental study demonstrated that brief information on the costs of studying and the potential salaries by field of study had a greater impact on male participants, leading them to choose more technical fields with higher earnings prospects (Peter et al., 2023). Women, on the other hand, were less likely to choose little-paid social subjects, but often went into other non-technical fields instead. Once women have made a decision against entering the technical field, it becomes challenging to alter their paths. Therefore, it is important to advertise and promote non-engineering positions in the energy sector, which still require a high level of qualification, in order to increase their visibility and attract more women.

9. Challenging Gender Stereotypes

Media and society should conduct awareness campaigns challenging gender stereotypes. These campaigns play a pivotal role in influencing public perception. By challenging existing norms, these initiatives create a societal environment where gender equality is not only accepted but actively promoted. This, in turn, motivates girls and women to consider and pursue STEM and energy-related careers. Researchers found that, when implemented correctly, entertainment-education outreach was an extremely effective and cost-efficient method of changing individual attitudes, behaviours, and beliefs (Singhal & Rogers, 2012). This phenomenon creates an opportunity for media and society to make a positive difference in the overall composition of STEM top talent.

It is difficult to identify all the factors behind the proportion of women in the individual occupational fields listed in table 1, as each profession has very individual and dynamic characteristics. The macro differences can perhaps best be explained by the gender image associated with each occupation. This image encompasses various factors, including compatibility with personal life and competitiveness (Goldin, 2021). To encourage more women to pursue careers in traditionally male-dominated fields, it is crucial to soften and destereotype gender images.

Table 1: Share of women in EU27 different fields of work (2022)

Field of work	Share of women (EU27)
Human health and social work	78.6%
Education	72.7%
Financial and insurance activities	52.6%
Energy ⁷	24.5%
Construction	10.4%

(Source: Own calculations, based on Eurostat dataset.⁸)

6 OECD (2018) ‘PISA 2018 Results Where all Students Can Succeed. Volume II’.

7 The energy sector is defined as comprising the following NACE codes: B05 (Mining of coal and lignite), B06 (Extraction of crude petroleum and natural gas), C19 (Manufacture of coke and refined petroleum products), D35 (Electricity, gas, steam and air conditioning supply).

8 See Eurostat dataset “Employment by sec, age and economic activity (from 2008 onwards, NACE Rev. 2) - 1000”. (online data code: lfsq_egan2).

About our Methodology

Part of the project’s scope was to develop a vision on how to achieve the goal of gender parity in the European energy industry by 2050.



Exhibit 6: Hybrid Strategy-Foresight-Methodology (Source: own visualisation, Fraunhofer)

To develop a strategic vision, it is necessary to:

- identify influential factors for the gender ratio in the energy sector;
- comprehensively identify measures for the fields of business, policy, and higher education that can plausibly contribute to increasing the proportion of women in companies in the energy sector; and
- bundle the measures into strategies to derive an intersectoral strategy roadmap.

To achieve these work objectives, a five-stage process was followed, which is shown in Exhibit 6.

We have integrated Perplexity.ai, a generative AI research tool and search engine, as an assistant in the research process. At the time, Perplexity.ai had the advantage that documents can be attached to the prompts, thus ensuring that the AI constantly takes all considerations and the feedback from the advisory board into account. The tool was used exclusively as an aid for generating text and ideas for barriers and measures. In each step, the input to the AI and the output of the AI was generated or reviewed by expert assessment and literature review. In the following, the individual steps of the AI-assisted process are explained in more detail.

First, the key factors and contextual conditions influencing the proportion of women in the energy industry were presented as part of a literature review. Based on the literature review, subgoals were formulated for the three sectors of business, policy, and higher education on the path to achieving gender parity in 2050 (e.g., “Increase the number of women among employees, especially in R&I positions”).

The compact summary of the literature review results was entered into Perplexity.ai with appropriate commands (“prompts”). The aim was to generate a list of suitable actions for the Business, Policy, and Higher Education sectors to contribute to an increase in the proportion of women in the energy industry and to condense these measures into an intersectoral strategy.

The input and output of Perplexity.ai were compiled into a comprehensive text document and presented to the Advisory Board of this project. The purpose was to assess the plausibility of the propositions, identify any blind spots, and enhance the quality of the analysis through further comments and feedback. The feedback received from the Advisory Board was integrated into the overall document by the research team.

The revised text was once again entered as input into Perplexity.ai, along with corresponding prompts. The goal of this step was to comprehensively generate potential barriers for each of the sectoral subgoals, as well as measures to overcome these barriers. The generated barriers and measures were ordered by hand and any duplicates were removed. Using Perplexity.ai, plausible measure-barrier-subgoal connections were also identified and reviewed by the research team. The resulting network was then graphically visualised.

In the final participatory event of this project, various stakeholders were involved in discussing and evaluating the visualisations of the measure-barrier-subgoal links. This was done in small groups to assess their potential impact and determine whether the selected measures can be implemented in the short or long term.

The workshop material was evaluated and used to formulate strategy packages. The presentation of the results for Business, Policy, and Higher Education differs from each other, as they depend strongly on the situational course, as well as the expertise and experience of the respective groups involved in the discussions.



Exhibit 7: This policy paper is an excerpt of the final report of the project “Gender balance in the R&I field to improve the role of women in the energy transition”. The final report can be downloaded [here](#).

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Country-Specific Indicators

Country	Share of women in energy (2022) ⁹	Compound annual growth rate of share of women in energy (2013-2022) ¹⁰	Share of women among graduates with tertiary education in 2021 (Growth since 2013 in percentage points) ¹¹
EU27			
France	32.2%	2.3%	55.8% (-0.3)
Spain	31.7%	4.6%	56.5% (0.7)
Portugal	31.3%	n.a.	58.5% (-0.8)
Belgium	28.1%	3.8%*	59.6% (0.5)
Sweden	28.1%	1.3%	61.6% (-0.1)
Latvia	28.0%	2.2%*	64.9% (-4.1)
Finland	27.8%	0.1%	60.7% (0.5)
Ireland	27.6%	n.a.	55.3% (1.6)
Germany	26.8%	1.3%	51.1% (0.4)
Italy	26.5%	3.2%	57.7% (-1.8)
Slovakia	26.4%	9.5%*	61.4% (-2.2)
Hungary	26.4%	2.4%	59.3% (-4.6)
Denmark	26.3%	0.5%	56.2% (-1.3)
Netherlands	24.0%	3.0%*	56.1% (-0.8)
Lithuania	23.8%	-0.6%	61.6% (-1.7)
Estonia	23.6%	3.3%*	62.0% (-3.4)
Greece	22.3%	2.1%	59.2% (0.4)
Austria	21.9%	4.9%	55.3% (-0.6)

⁹ Own calculations based on Eurostat dataset “Employment by sec, age and economic activity (from 2008 onwards, NACE Rev. 2) - 1000”. (online data code: lfsq_egan2); The energy sector is defined as comprising the following NACE codes: B05 (Mining of coal and lignite), B06 (Extraction of crude petroleum and natural gas), C19 (Manufacture of coke and refined petroleum products), D35 (Electricity, gas, steam and air conditioning supply).

¹⁰ Own calculations based on Eurostat dataset “Employment by sec, age and economic activity (from 2008 onwards, NACE Rev. 2) - 1000”. (online data code: lfsq_egan2); The energy sector is defined as comprising the following NACE codes: B05 (Mining of coal and lignite), B06 (Extraction of crude petroleum and natural gas), C19 (Manufacture of coke and refined petroleum products), D35 (Electricity, gas, steam and air conditioning supply); percentages marked with an asterisk should be interpreted with caution as their variances are high.

¹¹ Own calculations based on Eurostat dataset “Graduates by education level, programme orientation, sex and field of education” (online data code: educ_uoe_grad02) and on the OECD dataset “Graduates by field”.steady increase in the proportion of wom-en in energy professions is not based on factual structural factors, which we explain below.

Compound Annual Growth Rate in female Bachelor’s graduates in engineering (2010-2020) ¹²	Proportion of children under 3 years cared only by their parents in 2022 (Growth since 2014 in percentage points) ¹³	Share of employment in the heat pump sector in the total energy sector (2021) ¹⁴	Implicit gender-math stereotype (GMS) ¹⁵
1.8%	39.0% (-2.2)	11.3%	0.281
5.8%	37.3% (-11.8)	8.3%	0.149
3.0%	27.8% (0.4)	3.4%	0.01
10.3%	35.1% (-3.9)	1.0%	0.346
7.2%	40.9% (-1.0)	4.4%	0.244
-5.5%	59.6% (-10.0)	1.5%	0.17
0.3%	53.9% (-9.2)	2.4%	0.217
22.7%	64.6% (16.9)	0.4%	0.218
3.2%	69.2% (7.5)	17.2%	0.411
24.9%	43.4% (-7.0)	13.8%	0.186
-14.5%	74.0% (6.0)	1.0%	0.257
7.4%	58.8% (-8.9)	2.4%	0.38
6.6%	21% (-9.4)	3.7%	0.291
9.9%	16.2% (-7.0)	5.3%	0.357
-5.2%	65.8% (6.8)	1.6%	0.189
-4.3%	52.9% (-6.6)	1.0%	0.172
0.2%	39.2% (2.6)	1.8%	0.18
7.5%	51.4% (-5.2)	3.6%	0.365

¹² Own calculations based on Eurostat dataset “Graduates by education level, programme orientation, sex and field of education” (online data code: educ_uoe_grad02) and on the OECD dataset “Graduates by field”.

¹³ Own calculations based on Eurostat dataset “Children cared only by their parents by age group - % over the population of each age group – EU-SILC survey” (online data code: ilc_caparents).

¹⁴ Own calculations based on the 21st annual overview barometer from EurObserv’ER: <https://www.eurobserv-er.org/21st-annual-overview-barometer/>; For interpreting this indicator, it is important to know, that the share of women is usually lower in the heat pumps sector than the average in the energy sector.

¹⁵ See Table 2 in Breda et al. (2020); the higher the GMS, the higher the gender gap in the the agreement to the math-related statements „Doing well in math is completely up to me“ and „My parents believe that math is important for my career”.

Country-Specific Indicators

Country	Share of women in energy (2022) ⁹	Compound annual growth rate of share of women in energy (2013-2022) ¹⁰	Share of women among graduates with tertiary education in 2021 (Growth since 2013 in percentage points) ¹¹
Bulgaria	20.8%	-1.4%	61.4% (0.7)
Cyprus	20.0%	n.a.	64.0% (2.9)
Croatia	18.7%	-2.2%*	60.9% (2.1)
Czech Republic	17.9%	0.6%	60.5% (-1.3)
Romania	17.7%	1.5%	59.3% (-0.4)
Poland	17.6%	-0.2%	64.9% (-1.5)
Slovenia	15.5%	0.0%	60.3% (-1.2)
Luxembourg	10.6%	n.a.	53.8% (0.0)
Malta	n.a.	n.a.	59.7% (4.0)
Non-EU Countries			
Australia	n.a.	n.a.	56.9% (-0.7)
Canada	n.a.	n.a.	56.5% (-2.1)
Switzerland	21.0%	2.2%	49.6% (1.4)
Iceland	26.0%	n.a.	68.0% (3.5)
Norway	23.5%	-7.7%	56.9% (-1.8)
Türkiye	8.7%	n.a.	52.5% (5.4)
UK	n.a.	n.a.	58.6% (1.5)
USA	22.7%	n.a.	60.1% (1.6)

Compound Annual Growth Rate in female Bachelor's graduates in engineering (2010-2020) ¹²	Proportion of children under 3 years cared only by their parents in 2022 (Growth since 2014 in percentage points) ¹³	Share of employment in the heat pump sector in the total energy sector (2021) ¹⁴	Implicit gender-math stereotype (GMS) ¹⁵
-9.0%	71.7% (-1.5)	1.4%	0.103
0.4%	25.3% (-6.5)	0.1%	n.a.
13.2%	52.7% (-12.8)	0.9%	0.241
1.0%	65.4% (5.0)	2.0%	0.328
-4.0%	55.6% (1.5)	2.2%	0.016
0.7%	52.2% (-8.1)	8.7%	0.149
17.3%	33.3% (-5.4)	0.3%	0.165
25.9%	41.1% (6.0)	0.1%	0.234
-0.4%	32% (-28.6)	0.3%	n.a.
3.3%	n.a.	n.a.	0.278
4.8%	n.a.	n.a.	0.148
8.8%	n.a.	n.a.	0.4
-0.4%	n.a.	n.a.	0.133
0.4%	43.6% (3.0)	n.a.	0.172
22.5%	n.a.	n.a.	-0.015
4.6%	n.a.	n.a.	0.206
9.2%	n.a.	n.a.	0.082

Overview: Definitions of Barriers and Measures

Application Field: Business

Business Structural Barriers		
Number	Barrier	Barrier Explanation
B1	Lack of Role Models	The energy sector has historically been male-dominated, resulting in a lack of female role models in leadership positions. This can make it difficult for women to envision themselves in these roles and may discourage them from pursuing leadership opportunities.
B2	Gender Pay Gap	The gender pay gap persists in the energy sector, with women earning less than their male counterparts. This can contribute to a perception that women's work is less valuable and may discourage women from pursuing leadership positions.
B3	Limited Networking Opportunities	Networking is crucial for career advancement, but women may have fewer opportunities to build professional relationships due to gender segregation in the energy sector. This can result in women being excluded from informal networks and decision-making processes, which can impact their career progression.
B4	Lack of Mentoring and Sponsorship	Women may have limited access to mentors and sponsors who can provide guidance, support, and advocacy for their career advancement. This can hinder their professional growth and limit their opportunities for leadership roles.
B5	Problems in Reconciling Private and Work Life	Women often face a disproportionate burden of caregiving and household responsibilities, making it difficult to balance work and personal life. Consequently, they may opt for less demanding roles or exit the workforce, restricting their career advancement opportunities. Many companies lack gender equality-promoting policies, including flexible work arrangements, parental leave, and gender-neutral recruitment, further hindering women's career progression.
B6	Corporate Culture	A company's corporate culture can significantly impact the exclusion of women. A culture that perpetuates gender stereotypes, tolerates discriminatory behaviour, or lacks diversity and inclusion initiatives can create an unwelcoming environment for women, discouraging them from pursuing careers in the energy sector.
B7	Permeability of Careers	The permeability of careers within companies is a crucial factor in promoting gender diversity. Companies that require a broader range of professional degrees have the potential to draw from a larger pool of female professionals, considering the underrepresentation of women in STEM fields compared to the humanities. Additionally, the permeability of development opportunities within organisations is important. The negative effects of rigidly separated career paths in areas such as research and development, production, sales, and administration can hinder women's advancement. By creating more flexible and interconnected career paths, organisations can facilitate the upward mobility and growth of female professionals, enhancing gender diversity within the workforce.
B8	Skill Barriers	Women's representation among graduates in post-secondary non-tertiary and tertiary education is relatively low in STEM-related fields of study, particularly in Information & Communication, Technologies & Engineering, and Manufacturing & Construction. The typical differences in skills and interests between men and women often emerge in the early stages of education. There is a close connection between the development of cognitive abilities, personal motivations, and socialisation processes.

B9	Intersecting Inequalities	The combination of several identity features can compound gender inequality in the energy sector. Women from marginalised groups may face additional barriers to accessing opportunities and advancing in the industry, such as discrimination or lack of access to education and training. This can limit the diversity of perspectives and experiences in the energy sector, perpetuating gender inequality in the industry.
B10	HR Innovations	Energy companies operate within a complex network of stakeholders and must consider the needs of customers, suppliers, investors/shareholders, membership organisations, banks, NGOs, local authorities and communities, and their employees. This complex web enables diverse job profiles that can go beyond a classic STEM profile. HR departments must recognise these opportunities for innovation and the associated opportunities for gender equality and create appropriate job descriptions and competency profiles.
B11	Gender Stereotypes in the Workplace	Women often face gender stereotypes and unconscious bias in the workplace, which can hinder their career progression. These biases can manifest in various ways, such as being overlooked for promotions, receiving less challenging assignments, or being perceived as less competent than their male counterparts.
B12	Gender Bias in Recruitment	Gender bias in recruitment processes can limit women's access to opportunities in the energy sector. Implementing gender-balanced selection panels and bias-free recruitment processes can help address this barrier.
B13	Stakeholder Coordination & Collaboration	Limited coordination and collaboration between stakeholders, such as energy companies, academia, and research institutions, can hinder the implementation of gender-fair organisational structures. Facilitating knowledge-sharing and best practices exchange among these stakeholders can help overcome this barrier.

Business Measures		
Number	Measure	Measure Explanation
M1	Professional Development, Mentoring and Support	Mentoring, sponsorship, and career development programmes are vital in aiding women to reach their career aspirations. These initiatives provide access to networks, resources, and experienced leadership guidance, enhancing skills, confidence, and preparation for leadership roles. Training, coaching, and mentoring further equip women for success and advancement.
M2	Leadership Accountability	Leaders should be held accountable for promoting gender equality in their organisations. They should ensure that women are represented in all areas of the organisation and that they have the same opportunities and resources as men. Leaders should also ensure that women are included in decision-making processes and that their voices are heard.
M3	Gender Equality through Inclusive Policies	Inclusive policies and gender-neutral recruitment practices promote women's representation and equal opportunities in both organisations and the energy sector. This includes flexible work arrangements, anti-discrimination policies, gender-neutral job ads, application procedures, and hiring decisions.
M4	Flexible Work Arrangements	Flexible work arrangements like part-time, job sharing, and telecommuting enable women to balance careers and family without neglecting responsibilities. Job sharing, particularly in management roles, enhances skills, confidence, and leadership readiness for women.
M5	Women's Empowerment through Collaboration	Women-centric networking events foster connections, resource-sharing, and skill enhancement. These events boost women's confidence and leadership qualification. Cross-company collaboration promotes women's representation and equal opportunities in the energy sector through mentoring, sponsorship programmes, and joint gender equality initiatives.

M6	Gender Equality Awareness Training	Training measures to raise awareness about gender equality can help leaders and employees become aware of the importance of gender equality and learn how they can contribute to creating an inclusive and fair work environment.
M7	Monitoring of Gender Equality based on Indicators	Monitoring gender equality based on indicators can help companies and organisations measure and evaluate their progress in promoting gender equality. This includes indicators such as the percentage of women in leadership positions, the percentage of women in technical professions, and the gender pay gap.
M8	Analysis of Gender Pay Gaps	Analysing gender pay gaps can help companies and organisations identify wage differences between women and men and take action to reduce these differences.
M9	Cooperation with Education System	Cooperation with education system stakeholders can help attract more girls and women to the energy sector. Companies can, for example, visit schools and universities to inform girls and women about career opportunities in the energy sector and encourage them to be interested in technical professions.
M10	Self-Imposed Women’s Quotas in Leadership	Self-imposed quotas for the share of women in decision-making bodies can help ensure that women are represented in all areas of the organisation and that they have the same opportunities and resources as men. These quotas can help ensure that women are included in decision-making processes and that their voices are heard.
M11	Establishing a Gender Equality Position	The establishment of a position with responsibility for gender equality can help companies and organisations coordinate and monitor their efforts to promote gender equality. This position can help make gender equality an important issue in the organisation and take action to promote gender equality.

Application Field: Higher Education

Higher Education Structural Barriers		
Number	Barrier	Barrier Explanation
B14	Family Responsibilities and Career Choices	The availability and social acceptance of care facilities, along with supportive policies like parental leave and flexible work arrangements, play a pivotal role in shaping women's career choices. To address the gender gap, it's crucial to advocate for policies that promote work-life balance and equalise care responsibilities between genders. Women often shoulder the majority of care work, hindering their access to full-time employment and career growth. To mitigate this challenge, expanding care services for both children and the elderly, and encouraging equitable sharing of care responsibilities between men and women, is essential.
B15	Education System Barriers	Systematic barriers and biases in education systems can deter girls from pursuing STEM education. More open education systems that allow students to decide their specialisation later can increase the appeal of STEM fields to a broader range of students, including girls. Implementing mandatory gender mainstreaming in educational institutions is also crucial to promote equal opportunities for all genders and ensure inclusive educational environments.
B16	Professionalisation	The efforts an organisation makes, or can make, to recruit women and the resources available are crucial factors in promoting gender diversity. This includes the level of professionalism within the organisation, which is measured by the efforts and resources invested in the HR area to promote gender equality. Offering opportunities for upskilling, recognising transferrable skills from degrees not directly related, and facilitating re-entry into the workforce through skill development programmes can greatly contribute to increasing gender diversity.

B17	Inclusive Corporate Culture	To retain women in STEM careers, addressing the marginalising work culture and lack of support is essential. Organisations must prioritise fostering an inclusive corporate culture that values diversity and provides equal opportunities for all employees, regardless of gender. By doing so, they can create a supportive work environment where women feel included and empowered, ultimately promoting greater gender diversity and equality within the company.
B18	Gender Stereotypes and Societal Expectations	Societal norms and gender stereotypes discourage women from pursuing STEM careers, hindering inclusivity. Similarly, expectations around traditional gender roles contribute to labor market gender disparities. Addressing these issues, promoting an inclusive image of STEM, and challenging gender stereotypes are essential steps to attract and retain more women in these fields and create a more equitable labor market.
B19	Access to and Quality of STEM Education	Although girls generally have access to STEM education, there are systematic barriers and biases that can deter them from pursuing it. Encouraging more open education systems that allow students to decide their specialisation later can increase the appeal of STEM fields to a broader range of students, including girls.
B20	Lack of Female Role Models and Mentors	The underrepresentation of women in STEM fields can lead to a lack of role models and mentors for young women considering careers in these areas. Increasing the visibility of successful women in STEM and providing mentorship opportunities can help inspire and support more women to enter and persist in these fields.
B21	Gender Bias in the Workplace	Women in STEM fields often face gender bias, which can result in higher turnover intention and discourage them from pursuing careers in the energy sector. Addressing gender bias through inclusive policies, training, and awareness-raising initiatives can help create a more supportive work environment for women.
B22	Permeability of Careers	The permeability of careers within companies is a crucial factor in promoting gender diversity. Companies that require a broader range of professional degrees have the potential to draw from a larger pool of female professionals, considering the underrepresentation of women in STEM fields compared to the humanities. By creating more flexible and interconnected career paths, organisations can facilitate the upward mobility and growth of female professionals, enhancing gender diversity within the workforce.
B23	Limited Networking Opportunities	This barrier can arise from factors such as a lack of access to industry events, conferences, mentorship programs, or networking platforms that predominantly cater to men. As a result, women may have fewer opportunities to establish relationships, seek career advice, or access valuable resources that can help them progress in their careers.
B24	Institutional Biases in Education	Systematic barriers and biases in education systems can deter girls from pursuing STEM education. More open education systems that allow students to decide their specialisation later and implementing mandatory gender mainstreaming in educational institutions can promote equal opportunities for all genders and ensure inclusive educational environments.
B25	Career Development and Flexibility	Rigidly separated career paths and limited development opportunities within organisations can hinder women's advancement in STEM fields. Creating more flexible and interconnected career paths and offering opportunities for upskilling and re-entry into the workforce can facilitate the growth and retention of female professionals in STEM.

Higher Education Measures		
Number	Measure	Measure Explanation
M12	Public Awareness Campaigns	Implement public awareness campaigns to challenge gender stereotypes and promote a more inclusive image of STEM fields.
M13	Encourage Female Media Representation	Encourage media representation of women in STEM roles to normalise their presence in these fields.
M14	Gender-Sensitive Curricula in Schools	Introduce gender-sensitive curricula in schools to foster an early interest in STEM subjects among girls.
M15	Mandatory Gender Mainstreaming in Education	Implement mandatory gender mainstreaming in educational institutions to promote equal opportunities for all genders and ensure inclusive educational environments.
M16	Mentorship Programmes	Establish mentorship programmes that connect female students with women working in STEM fields.
M17	Outreach Activities of Female Professionals	Encourage female STEM professionals to engage in outreach activities, such as school visits and career fairs, to inspire young girls.
M18	Inclusive Policies and Training	Implement inclusive policies, training, and awareness-raising initiatives to address gender bias and create a more supportive work environment for women.
M19	Expand Care Provision	Expand care provision for children and elderly, making it easier for women to balance work and family responsibilities.
M20	Showcase Women's Energy Achievements	Encourage energy companies to showcase diverse role models and success stories, highlighting the achievements of women in various roles within the sector.
M21	Cross-University Networks	Establish cross-university networks to facilitate mutual learning of higher education institutions about the promotion of women STEM talent and successful cooperation formats with industry.
M22	Collaboration between Education and Industry	Foster collaborations between educational institutions and the energy industry, creating opportunities for internships, research projects, and job placements.
M23	Advocating for Family-Friendly Policies	Advocate for policies supporting parental leave and flexible working arrangements in the energy sector, promote a culture of work-life balance within the energy industry, and emphasising the importance of mental health and well-being.
M24	Support Working Parents	Encourage energy companies to provide on-site childcare facilities or subsidies for childcare services.
M25	Flexible Career Paths	Encourage energy companies to create more flexible and interconnected career paths, allowing for upward mobility and growth of female professionals.

Application field: Policy

Policy Structural Barriers		
Number	Barrier	Barrier Explanation
B26	Lack of Career Advancement Support	Limited mentorship and sponsorship opportunities for women in the energy sector can impede career growth and networking prospects. The absence of adequate support for career advancement further restricts opportunities for skill development and networking, perpetuating gender inequality within the industry. Overcoming these barriers is crucial for achieving a more balanced and equal professional landscape.
B27	Insufficient Support for Parents	Inadequate childcare facilities, services, and insufficient parental leave policies present challenges for women in balancing work and family responsibilities. These issues can elevate turnover rates and perpetuate gender inequality within the industry. Women often find themselves at a crossroads, having to choose between their careers and family duties. Addressing these challenges is vital for fostering a more equitable and supportive work environment.
B28	Early Specialisation in Education Systems	Early specialisation in education systems can limit the ability of women to explore different fields and career paths, potentially leading to a lack of diversity in the energy sector. Women may be discouraged from pursuing careers in the energy sector if they are not exposed to the field early on in their education or if they are encouraged to specialise in other areas.
B29	Access to and Quality of STEM Education	Limited access to and poor quality of STEM education can limit the ability of women to develop the skills necessary to work in the energy sector. This can perpetuate gender inequality in the industry, as women may not have the same opportunities to develop the skills and knowledge necessary to succeed in STEM fields.
B30	Intersectionality Exacerbates Gender Inequality	Gender stereotypes and societal expectations can hinder women from entering specific career paths within the energy sector, fostering gender inequality. Women may shy away from traditionally male-dominated roles, like engineering or operations, due to societal norms and stereotypes. Moreover, intersectional inequalities tied to race, ethnicity, and socioeconomic status compound gender disparities in the energy field. Marginalised women encounter additional barriers like discrimination and limited access to education and training, further constraining diversity and perpetuating gender inequality in the industry.
B31	Women Underrepresentation in STEM	Women are underrepresented in STEM fields, which limits their ability to work and thrive in these areas. This can perpetuate gender inequality in the energy sector, as STEM fields are critical to the development and implementation of new technologies and innovations in the industry. The lack of diversity in STEM fields can also lead to a lack of diversity in the energy sector as a whole, limiting the perspectives and experiences that are brought to the table.
B32	Permeability of Careers	Rigidly separated career paths in areas such as research and development, production, sales, and administration can hinder women's advancement. By creating more flexible and interconnected career paths, organisations can facilitate the upward mobility and growth of female professionals.
B33	Corporate Culture	The corporate culture of a company can have a significant impact on the exclusion of women. If women are a minority in a company, they are more likely to experience a marginalising work culture.

B34	Limited Coordination & Collaboration	Inadequate collaboration and knowledge-sharing among energy companies, academia, and research institutions can hinder the development and implementation of effective gender equality policies and practices.
B35	Lack of Gender-Responsive Procurement	The absence of procurement policies that prioritise gender diversity in EU-funded projects can limit the opportunities for women-owned businesses and female professionals in the energy sector.
B36	Failing to Enforce Equal Treatment	Weak enforcement mechanisms for gender equality laws can result in inadequate progress towards gender balance in the energy sector.
B37	Limited Flexible Work Arrangements	Inflexible work options and rigid schedules pose challenges for women in managing both their professional roles and personal responsibilities. This struggle can result in higher turnover rates, perpetuating gender inequality. Women are often compelled to choose between their careers and personal duties, underlining the need to address these work-life balance challenges for a more equitable industry.
B38	Gender Bias in Recruitment and Promotion	Women often face discrimination and bias during recruitment and promotion, which can hinder their career advancement in the energy sector.

Policy Measures		
Number	Measure	Measure Explanation
M26	Collaborations with Universities	Collaborate with regional and national universities to recruit female graduates from STEM-related fields, increasing the pool of female professionals available for EU-funded projects and procurement in the energy sector.
M27	Equality Policies and Gender Quotas	Address intersecting inequalities through comprehensive packages of measures, including equal opportunity policies, harassment prevention, and gender quotas.
M28	Equality Monitoring and Imposing Sanctions	Regularly monitor equality figures and impose sanctions for non-compliance with gender quotas to ensure progress towards gender diversity in EU-funded projects and procurement.
M29	Encourage Inclusive Corporate Culture	Encourage organisations to create an inclusive corporate culture that values diversity and provides equal opportunities for all employees, irrespective of gender.
M30	Encourage Flexible Career Paths	Encourage organisations to develop more flexible and interconnected career paths, facilitating the upward mobility and growth of female professionals.
M31	Encourage Recognition of Transferable Skills	Encourage organisations to recognise transferable skills from degrees not directly related to the energy sector, allowing for a broader range of professional degrees to be considered.
M32	Facilitate Upskilling and Re-entry	Provide opportunities for upskilling and re-entry into the workforce through skill development programmes, contributing to increased gender diversity in the energy sector.
M33	Campaigns Challenging Gender Stereotypes	Launch campaigns to challenge gender stereotypes and promote a more inclusive image of STEM careers, targeting both students and the general public. These campaigns can showcase successful women in the energy sector and emphasise the importance of gender diversity in the industry.
M34	Mentorship Programmes	Establish mentorship programmes that connect female students with female professionals in the energy sector, providing guidance and support for career development.

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