

Gender And Corporate Practices In The Solar Photovoltaic Sector: A Critical Look At Rede MESol Awardees

Gabriela Martins Flores¹, Renata Mansuelo Alves Domingos², Ingrid de Paula Marques¹,
Barbara Gomes Pereira³ e Aline Cristiane Pan⁴

¹ Universidade Federal do Rio Grande do Sul, Porto Alegre (Brasil)

² Universidade Federal de Santa Catarina, Florianópolis (Brasil)

³ Centro Federal de Educação Tecnológica Celso Suckow da Fonseca, Santo Estevão (Brasil)

⁴ Universidade Federal do Rio Grande do Sul, Tramandaí (Brasil)

Abstract

This study empirically examines companies in the photovoltaic solar energy sector that have notable gender equity initiatives. To this end, it focuses on Brazilian companies selected through the 2023 and 2024 calls for proposals by the Brazilian Network of Women in Solar Energy, comparing their initiatives against gender-related indicators in the photovoltaic solar energy sector. These indicators include: the proportion of women in decision-making positions; income; time allocated to paid and unpaid work; self-reported satisfaction levels; legal instruments and gender-related guidelines; educational attainment; energy consumption; the Gender Development Index (GDI); and the number of awards received. The findings reveal that only a minority of companies stand out for implementing effective gender equity practices. Furthermore, the study observes a predominance of approaches based on predominantly quantitative and structural indicators, which do not always capture the subjective and intersectional dimensions of gender inequalities within the photovoltaic solar energy sector.

Keywords: Gender indicators, Gender Equity, Photovoltaic Solar Energy, Indicators, Gender Networks

1. Introduction

Climate change has triggered urban concerns, particularly regarding carbon emissions. The energy transition can be considered a response to this urban challenge, as the replacement of conventional fossil fuel-based energy generation with sustainable technologies offers a pathway to rapidly reduce carbon emissions (IRENA, 2020). This debate intersects with the concept of sustainable development, which seeks to meet the needs of the present generation without compromising the ability of future generations to meet their own needs, while also aiming to address and prevent future environmental issues.

In this context, the United Nations (UN) proposed the 2030 Agenda, a global action plan comprising 17 Sustainable Development Goals (SDGs). The SDGs represent a global call to eradicate poverty and protect the environment and climate, thereby ensuring peace and prosperity worldwide (UN Brazil, 2015).

Given the sustainable development framework, this article focuses the discussion on the relationship between renewable energy, specifically photovoltaic solar energy, and gender equality. SDG 5 addresses gender equality, with the goal of “achieving gender equality and empowering all women and girls” (UN Brazil, 2015). It comprises nine targets: ending gender discrimination (5.1); eliminating violence against women (5.2); eliminating harmful practices against women (5.3); recognizing and valuing unpaid care and domestic work (5.4); “ensuring women’s full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic, and public life” (5.5); ensuring universal access to sexual and reproductive health and rights (5.6); ensuring women’s equal rights to economic resources, access to and control over property, financial services, and natural resources (5.a); “enhancing the use of enabling technology, in particular information and communications technology, to promote the empowerment of women” (5.b); and “adopting and strengthening sound policies and enforceable legislation for the promotion

of gender equality and the empowerment of all women and girls at all levels” (5.c) (UN Brazil, 2015). SDG 7 aims to “ensure access to affordable, reliable, sustainable, and modern energy for all” (UN Brazil, 2015).

In addition to being a central goal of sustainable development, gender equality is essential in addressing the challenges posed by climate change and, consequently, the need for transformations in the energy sector. This is the case “not only because women are disproportionately affected by climate change, but also because they possess valuable perspectives, experience, and knowledge to contribute to building community and national resilience” (IRENA, 2020, p.9).

In the Brazilian context, women represent 51.48% of the population, amounting to approximately 104.5 million female residents (IBGE, 2022). In the scientific research sector, women authored 72% of Brazilian publications between 2014 and 2017; however, the number of women publishing remains lower than that of men (49%). In engineering fields, this figure drops to 24% between 2018 and 2022 (Elsevier; Agência Bori, 2024).

Female participation plays a crucial role in promoting environmental quality, especially when linked to economic growth, technological innovation, and the use of clean energy sources. Studies indicate that women are more likely to support investments in sustainable energy, and their presence in the workforce significantly contributes to advancements in the field (Jie et al., 2023).

The photovoltaic solar energy sector accounts for “44% of the total renewable energy workforce worldwide” (IRENA; ILO, 2024, p.10). Economic empowerment is a particularly effective means for women to gain greater control over their own lives. However, women are still frequently overlooked, undervalued, and unpaid, which prevents them from realizing their full economic potential. Without their full engagement, inclusive growth remains unattainable. Nevertheless, gender equality continues to be the greatest human rights challenge of all time [...] (IRENA, 2022, p.9).

The Brazilian energy sector still exhibits low gender representation and remains one of the segments with the highest levels of inequality in this regard (Falcão et al., 2019; Oliveira et al., 2020). “The proportion of women working full-time in the photovoltaic solar energy sector is 40%” (IRENA, 2022, p.8); however, the majority of these positions are in administrative roles, which account for 58% of the workforce. “Regarding leadership positions, women hold 30% of managerial roles and only 13% of senior management positions in the photovoltaic solar energy sector” (IRENA, 2022, p.8).

In this context, the Brazilian Network of Women in Solar Energy (MESol) contributes to progress in the intersection between photovoltaic solar energy and gender equality. Founded in 2019, MESol is a Brazilian non-profit organization that aims to “highlight women in the scientific, technological, business, and industrial fields, as well as promote actions that encourage their inclusion and retention in the photovoltaic solar energy (PV) sector” (Pan et al., 2024, p.1).

[...] The MESol Network has organized and participated in various activities that bring gender equity to the forefront, aiming to raise awareness among stakeholders in the sector about the importance of addressing this issue. Specifically, MESol is composed of women with scientific and technical backgrounds who research, teach, and work with solar energy conversion applications. Its mission is to connect, support, and inspire women to actively engage in Brazil’s energy diversification and transition process (Pan et al., 2022, p.2).

Performance indicators, whether qualitative or quantitative, are used to assess progress toward established goals and objectives, with the purpose of measuring advancements in the promotion of gender equality and the empowerment of women and girls across different sectors of society (Fortuin, 1988). “Gender indicators are used to measure a company’s progress in pursuing gender equity, through the monitoring and evaluation of established goals and objectives” (Pan et al., 2024, p.5).

Accordingly, the present study aims to evaluate the presence of gender indicators in Brazilian private companies selected through MESol’s 2023 and 2024 calls for proposals, respectively titled “Measures to Promote Gender Equality, Diversity, and Inclusion within Companies in the Solar Energy Sector: What Initiatives Exist in Brazil?” and “Diversity and Gender Equity Projects in Decarbonization and Just Energy Transition Initiatives.” These initiatives are analyzed in relation to the indicators that shape the gender debate within the photovoltaic solar energy sector.

2. Methodology

This study adopts a comparative methodology to analyze the initiatives of Brazilian companies selected through the 2023 and 2024 calls for proposals by the Brazilian Network of Women in Solar Energy (MESol), in relation to gender indicators within the photovoltaic solar energy sector.

2.1. Characterization of the Study Area

The Brazilian Network of Women in Solar Energy (MESol) is a sociopolitical movement that has been actively working to mitigate gender inequalities in the Brazilian energy sector, particularly within the solar energy domain. Established through the collaboration of women researchers, professionals, and entrepreneurs, the network's central purpose is to contribute to an energy transition that is also socially just and inclusive.

MESol's actions have been consolidated around three fundamental pillars: promoting gender equity in the energy sector; expanding women's participation across various spheres of the solar energy value chain and decision-making processes; and strengthening initiatives for education, leadership, and visibility of women in spaces traditionally marked by low female representation. Additionally, MESol has played a key role in raising awareness among strategic stakeholders in the sector to foster dialogue on diversity and inclusion. Among its awareness-raising initiatives, two stand out: the “Selo + Mulheres na Energia” and the “Elas Conectam” event.

The + Women in Energy Seal is a research project funded by the National Council for Scientific and Technological Development (CNPq), under the Ministry of Science and Technology (MCTI) (Universal Call 2023, Project No. 420295/2023-2). The initiative is carried out in partnership with the Federal University of Rio Grande do Sul (UFRGS), the Federal University of Santa Catarina (UFSC), the Pontifical Catholic University of Rio Grande do Sul (PUCRS), and the MESol Network. The project aims to develop a comprehensive and effective methodology for evaluating and certifying a gender equality seal for companies in the energy sector, with the goal of promoting gender equity within organizations. It seeks to identify and recognize best practices in inclusion and diversity, while encouraging the adoption of policies and practices that promote equal opportunities and the appreciation of all genders in the workplace (Pan et al., 2024).

“Elas Conectam” is a public event held during the Intersolar South America trade fair. In 2023 and 2024, MESol provided a space through a public call for proposals, inviting energy sector companies to present their organizational practices related to diversity and inclusion. The objective of the call was to highlight best practices in gender equity and diversity within solar energy companies, encouraging organizations to share their activities, policies, actions, and projects to inspire other participants at the fair.

2.2. Methodological Procedures

The selection process for the companies was conducted through the evaluation of three (3) initiatives. The primary target audience of these calls for proposals consisted of private sector companies operating directly or indirectly within the solar energy industry, which were either involved in or had implemented measures and/or actions aimed at promoting gender equality, diversity, and inclusion within their organizations.

To select the winning companies, three main dimensions were analyzed: quantitative indicators, qualitative evidence, and the potential of the initiatives. The submissions revealed that the finalist initiatives presented explicit data, such as the number of women directly involved, percentages of female participation, or outcomes related to training programs. These indicators were primarily associated with training and capacity-building programs, demonstrating the companies' commitment to increasing the presence of women in technical and leadership roles.

2.3. Selection of Companies for Comparative Study

The conditions for company registration and selection were as follows: being a company operating in Brazil, having core activities within the solar energy sector, and having implemented or initiated a relevant initiative within the past five years. Regarding the evaluation process, all submitted applications underwent an eliminatory selection phase, which involved the assessment of the information provided through a standardized form by a specialized jury panel. This panel selected the winning initiatives, while the remaining submissions were not retained.

The evaluation considered the intentionality, consistency, and impact of the initiatives, as well as the duration

of the practices adopted, emphasizing the organizations' sustained commitment to the themes. The selected companies demonstrated significant contributions to Sustainable Development Goal (SDG) 5 – Gender Equality – and SDG 7 – Affordable and Clean Energy.

2.4. Selection of Gender Indicators in the Solar Energy Sector

This study compared the actions of the five highest-rated companies from the 2023 and 2024 calls for proposals by the MESol Network with nine global indicators. As a starting point for this analysis (Fig. 1), gender inequality was identified, indicating a gap in gender equity within companies—namely, an unequal distribution of opportunities between men and women.

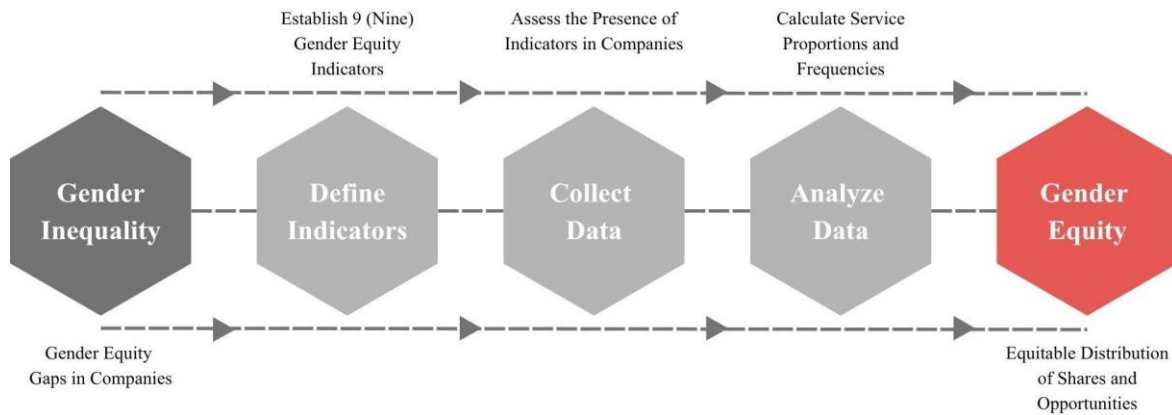


Figure 1: Steps for Evaluating the Methodology of the + Women in Energy Seal

This study is based on a literature review focused on gender-sensitive performance indicators (Fig. 2), conducted as part of the research project approved by CNPq, “CNPq/MCTI Call No. 10/2023 – Track A – Emerging Groups” (Pan, 2024). The review identified nine (9) relevant indicators for assessing gender equity actions in the sector. These are: Proportion of Women in Decision-making Spaces, Gender Pay Equity (income), Time Devoted to Paid and Unpaid Work, Self-reported Satisfaction Levels, Legal Instruments and Gender Guidelines, Educational Attainment, Energy Consumption, Gender Development Index (GDI), and Number of Awards Received. Each indicator was coded binarily (1 = present; 0 = absent) based on the information provided by the companies.

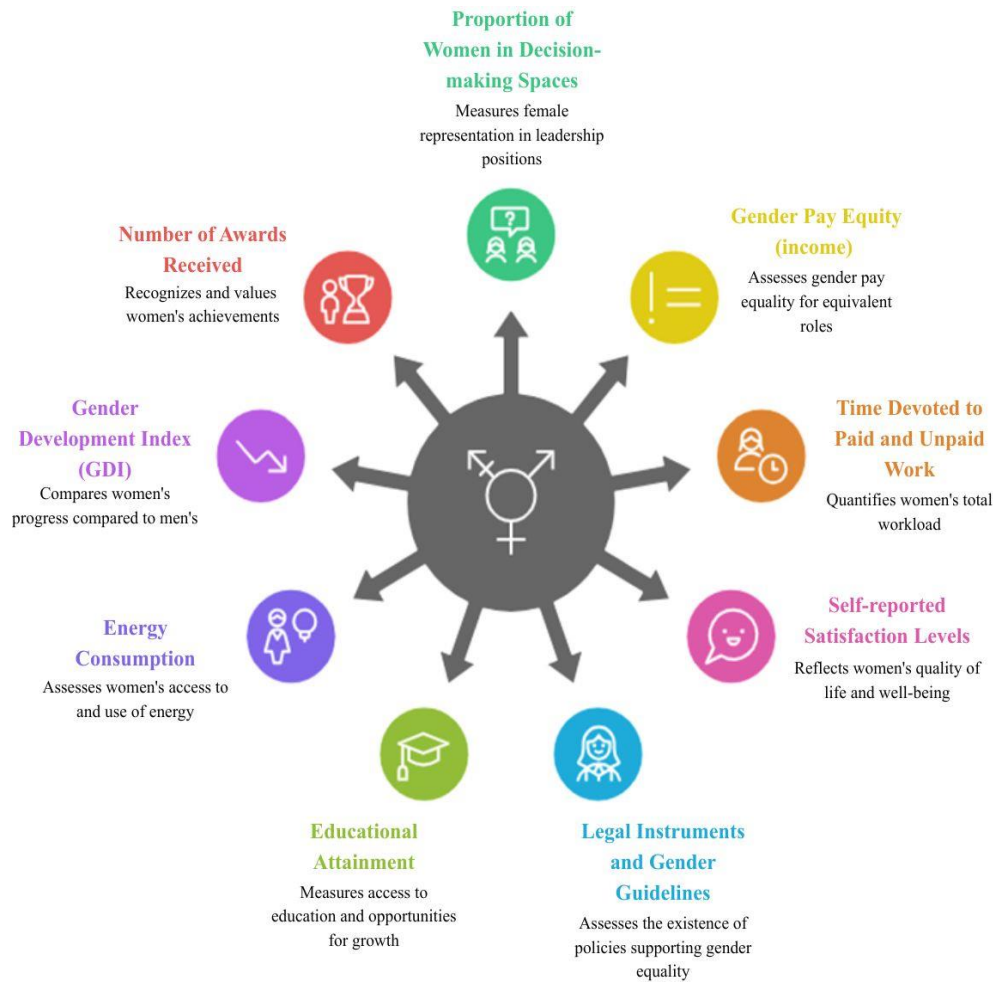


Figure 2: Quantitative Indicators Used to Evaluate Companies in the Photovoltaic Solar Energy Sector

The first indicator refers to the Proportion of Women in Decision-making Spaces (Pascale et al., 2016; Clansy & Mohlakoana, 2020), and is directly associated with SDG 5.5, which aims to ensure women's participation and equality in leadership positions. As a quantitative performance indicator, it was prominently featured in several scientific documents during the literature review and, therefore, receives the greatest emphasis in this study due to its recurrence and high citation frequency in academic publications. Notably, this indicator has been the focus of studies such as those by Pueyo et al. (2020), Fraune (2015), Mininni (2022), Pascale et al. (2016), Clansy & Mohlakoana (2020), Ryan (2014), Atahau et al. (2021), and Mang-Benza (2021).

The second indicator concerns Gender Pay Equity (income) (Pascale et al., 2016), which refers to equal pay for equal work across genders, as well as access to financial resources. It is directly related to SDG 5.a, which addresses equal rights for women regarding economic resources. This indicator has been discussed in studies such as Pascale et al. (2016), Atahau et al. (2021), Cicowiez et al. (2022), and Manfred et al. (2015).

The third quantitative indicator is Time Devoted to Paid and Unpaid Work (Heuër, 2017; Ding et al., 2019; Cicowiez et al., 2022), which refers to activities beyond formal employment that women perform in comparison to men. It enables an understanding of the time women dedicate to additional work responsibilities.

The fourth indicator is Self-reported Satisfaction Levels (Arachchi & Managi, 2021). From a qualitative perspective, this indicator relates to quality of life, well-being, and individual professional fulfillment. It offers a subjective dimension that is often overlooked by other quantitative indicators, thereby revealing the working conditions experienced by women.

The fifth indicator refers to Legal Instruments and Gender Guidelines (Clansy & Mohlakoana, 2020; Ryan, 2014). This indicator allows for the assessment of the existence of legal frameworks that promote gender equity and energy access. The sixth indicator, Educational Attainment, reflects the opportunities for women to pursue education, professional qualification, and career advancement. The seventh indicator is Energy Consumption,

which has received attention in studies such as those by Ding et al. (2019) and Arachchi & Managi (2021).

The eighth performance indicator is the Gender Development Index (GDI), which aims to assess disparities between men and women in terms of human development (Njoh et al., 2022). This index is based on the Human Development Index (HDI) and its parameters of health, education, and income (UNDP, 2025). The final indicator is the Number of Awards Received (Heuër, 2017).

Subsequently, the proportion of indicators met by each company and the frequency of compliance per indicator were calculated, allowing for the identification of patterns and gaps. This comparative approach enabled a clearer visualization of the results and enhanced the understanding of how initiatives are distributed and aligned with gender equity goals.

3. Results and discussion

3.1. Tables Regarding the Selection of Companies from MESol's Calls for Proposals

In the 2023 call, a total of seven applications were received, of which six companies were selected for the next phase, and subsequently, three were classified as finalists. In the 2024 call, six applications were registered, and three companies were selected as finalists. The finalist companies stood out for their training initiatives, internal policies, harassment prevention measures, and promotion of female leadership. A strong potential for monitoring and measuring the impact of these actions was identified, along with possibilities for scalability and replication. Additionally, the presence of strategic partnerships was a notable aspect of the initiatives.

A comparative analysis of the proposals received over the two years revealed that, in 2023, the three selected organizations presented initiatives focused on structuring internal programs and monitoring metrics. In contrast, the 2024 proposals placed greater emphasis on practical implementation, with indicators of direct involvement of women, actions related to climate justice, and references to results already achieved.

3.2. Comparative Analysis of Gender Indicators and Selected Companies

Table 1 presents the results of this comparison between the selected indicators and the Brazilian companies in the photovoltaic solar energy sector that have gained prominence for their gender-related initiatives.

Table 1: Comparative Table of Gender Indicators in the Photovoltaic Solar Energy Sector and Brazilian Companies Selected in the Public Calls of 2023 and 2024 Promoted by the MESol Network

Companies		Company A	Company B	Company C	Company D	Company E
1	Proportion of Women in Decision-making Spaces	1	1	1	0	1
2	Gender Pay Equity (income)	1	0	0	0	0
3	Time Devoted to Paid and Unpaid Work	0	0	1	0	0
4	Self-reported Satisfaction Levels	0	0	0	0	0
5	Legal Instruments and Gender Guidelines	1	1	1	0	1
6	Educational Attainment	1	1	1	1	1
7	Energy Consumption	0	0	0	0	0
8	Gender Development Index (GDI)	0	0	0	0	0
9	Number of Awards Received	1	0	1	0	0

In summary, within the comparative study, four companies stand out for initiatives that enable and ensure women's participation in decision-making spaces, assuming leadership positions (Indicator 1); only one company stands out for salary-related initiatives (Indicator 2); only one company addresses the initiative corresponding to Indicator 3; no company mentioned the initiative corresponding to Indicator 4 in the MESol call; the percentage of companies in the comparative study that address the initiative corresponding to Indicator 5 is 80%; all companies adopt the initiative corresponding to Indicator 6; none of the companies in the call mention initiatives related to reduced energy consumption as a result of women in leadership positions (Indicator 7); no company addresses the GDI as an initiative (Indicator 8); Indicator 9 is addressed in the comparative study by two companies. These results are illustrated in Figure. 3.

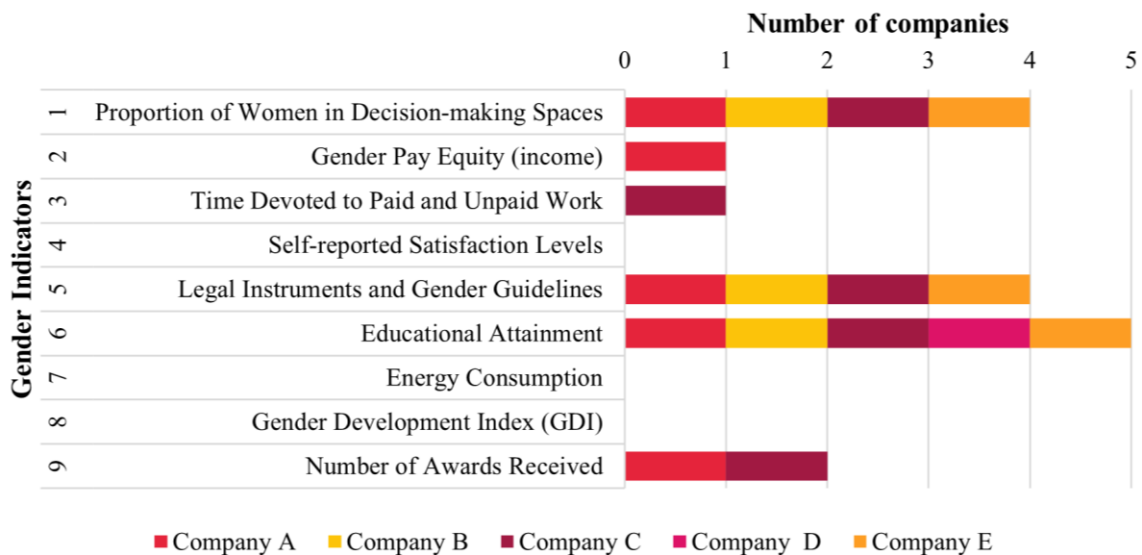


Figure 3: Distribution of Gender Equality Indicators Among Companies Selected in MESol Calls for Proposals

The results reveal a concentration of initiatives in quantitative indicators, particularly those related to female presence in leadership positions (Indicator 1), the adoption of Legal Instruments and Gender Guidelines (Indicator 5), and Educational Attainment (Indicator 6), while qualitative dimensions such as Self-reported Satisfaction Levels (Indicator 4) and the Gender Development Index (Indicator 8) remain absent. This gap suggests that companies prioritize more tangible and easily measurable metrics over subjective aspects that could uncover deeper structural inequalities. Furthermore, the comparative analysis between 2023 and 2024 indicates progress in diversifying initiatives, with greater emphasis on practical actions and strategic partnerships in the second year, although there is still limited integration of intersectional indicators and broader social impact measures.

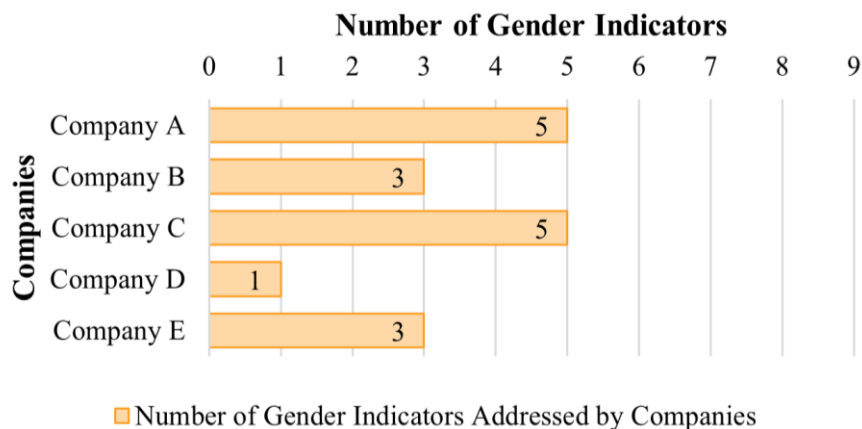


Figure 4: Number of Gender Equity Indicators Addressed by Companies Selected in MESol Calls for Proposals

Figure 4 illustrates the number of indicators addressed by the companies. In summary, the results of the comparative study reveal that Companies A and C are notably the most committed to gender-related initiatives, covering five indicators. However, this result represents only 55.55% of the total number of indicators considered in the study, highlighting that even companies with prominent initiatives still lack certain approaches to achieve full gender equity. Companies B and D address only three indicators, corresponding to one-third ($\frac{1}{3}$) of the total indicators included in this study. Company D addresses only one indicator (11.11%).

Company A, through its gender initiatives in 2023, demonstrated an increase in female representation in the photovoltaic solar energy sector from 11% to 40% within just four years, highlighting its significant role in advancing the debate and efforts toward gender equity. Additionally, the company adopted a policy of prioritizing women in hiring processes for solar energy projects. It also implemented initiatives aimed at personal and professional growth for women, including talent programs and mentorship to qualify and promote women into leadership positions. In alignment with the SDGs, the company advocates for the use of clean and renewable energy as a long-term sustainability commitment. Finally, Company A received the Social ESG Award and was honored with the “Solar Deal of the Year” (Americas) award, recognizing the success of its gender equity program. Thus, Company A addresses 5 out of 9 indicators, representing 55.55% in this study.

Company C appears as a highlight in both 2023 and 2024 under MESol’s selection criteria. Its distinction, compared to other companies, lies in Indicator 3 concerning time devoted to paid and unpaid work. Its initiative—a women’s committee—aims to improve quality of life, particularly regarding support for children or dependents in health-related matters. Although not directly addressing domestic workload indicators, this initiative is highly relevant to the fight for gender equity. Regarding Indicator 9, the company did not receive awards but earned recognition through seals such as “Women-Friendly Company” and “Early Childhood-Friendly Company,” as well as the “Human Rights and Diversity” seal from the São Paulo City Hall, which were considered equivalent to awards in this context. Thus, Company C also addresses 5 out of 9 indicators, representing 55.55% in this study.

Company B, in 2023, achieved 33.33% of the indicators mentioned, addressing only Indicators 1 (proportion of women in decision-making spaces), 5 (legal instruments and gender guidelines), and 6 (educational attainment in its initiatives). Similarly, Company E, in 2024, consolidated its efforts around the same indicators.

Conversely, Company D achieved the lowest number of indicators through its gender equity initiatives in the photovoltaic solar energy sector. It represents a partnership between a solar energy company and a training institution. With limited scope, it addresses only Indicator 6, through a program aimed at training women in technical courses via a selection process. Interestingly, women selected for this program have a high likelihood of being hired by the company. Finally, Company E addresses Indicators 1, 5, and 6, but stands out primarily for having a female CEO in a leadership position.

It is important to highlight the absence of initiatives related to self-reported satisfaction levels and the GDI, which demonstrates a neglect of qualitative indicators that generally reveal needs and structural gender inequalities in the photovoltaic solar energy sector. Furthermore, no materials were found that link sustainability to energy consumption in relation to measures implemented by women in leadership positions. These findings underscore the limited engagement of companies in the fight for gender equity in the labor market, focusing on quantitative indicators while largely neglecting qualitative ones.

The predominance of quantitative indicators reflects a global trend already noted by Clancy and Mohlakoana (2020), who emphasize the challenges organizations face in incorporating qualitative metrics into evaluation processes. While this approach is relevant for monitoring structural progress, it limits the understanding of women’s lived experiences in the sector, particularly regarding workplace quality, well-being, and work-life balance. The absence of indicators such as satisfaction levels and GDI reinforces the need for more comprehensive methodologies capable of capturing subjective and intersectional dimensions, which are essential for a just and inclusive energy transition.

4. Final considerations

The results of this study highlight significant progress but also reveal substantial gaps in promoting gender

equity within the photovoltaic solar energy sector. The quantitative analysis showed that, on average, companies meet only 33% of the nine indicators assessed, with notable emphasis on female representation in leadership positions (80%) and educational attainment (100%). Conversely, qualitative indicators such as self-reported satisfaction levels and the Gender Development Index (GDI) were not addressed by any of the companies analyzed, reinforcing the predominance of structural metrics over subjective and intersectional dimensions.

The comparison between the 2023 and 2024 calls indicates an evolution toward more applied practices and strategic partnerships, although integration of indicators measuring social impact and well-being remains limited. This trend confirms the need for more comprehensive methodologies capable of capturing not only numerical representation but also the quality of women's experiences in the sector.

It is recommended that companies in the solar energy sector expand their strategies beyond numerical representation by incorporating qualitative and intersectional indicators that allow for evaluating the effectiveness of gender equity policies. MESol, in turn, can play a strategic role by proposing standardized methodologies for impact measurement, including metrics related to satisfaction, well-being, and human development. Furthermore, public policies and regulatory incentives can encourage the adoption of these practices, ensuring that Brazil's energy transition is not only about energy but also socially just.

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