

Solar energy in Brazil: which are the barriers and opportunities for women professionals in the field?

MARCH 2021

ABOUT CFF

The C40 Cities Finance Facility (CFF) is a collaboration between C40 Cities Climate Leadership Group and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. The CFF supports cities in developing and emerging economies to develop finance-ready projects aiming at reducing emissions to limit the global temperature rise to 1.5°C and strengthen resilience against the impacts of a warming climate. The CFF is funded by the German Federal Ministry for Economic Cooperation and Development (BMZ), the Children's Investment Fund Foundation (CIFF), the Government of the United Kingdom and the United States Agency for International Development (USAID).

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Brazil, 2021.

FOREWORD

Energy plays an essential role in the lives of women and men despite their different interests, needs and capacities to act. Energy policy, however, is generally formulated in a way that is considered gender-neutral. However, women's engagement in the energy sector is more limited than that of men, for reasons ranging from their different roles in society, to unequal access to the benefits of these technologies.² In Brazil, the energy sector is one of the worst in gender equality³, and the barriers leading to women's non-engagement in the sector imply considerable economic losses, since besides being professionals in the field, women represent a large audience of renewable energy users.

In this context, the New Urban Agenda • affirms the relevance of developing age and gender-sensitive policies and projects across all sectors in improving urban living conditions for our society. According to the Inter-American Development Bank, "evidence suggests that where there is relative equality between men and women, economies tend to grow faster, the poor lift themselves out of poverty at higher rates, and household welfare is improved". 5 This is because by accessing additional resources, women invest relatively more than men in food, health, and education for their children, reducing the intergenerational transmission of poverty. Aware of this reality, national and international financial institutions have been developing their own guidelines for gender equity and preponderantly valuing initiatives aligned to this perspective when evaluating proposals that seek financing.

The solar energy sector presents considerable opportunities for economic and social development, with environmental benefits as well. However, it will be essential to ensure the promotion of gender equality, since, in addition to being predominantly male, the professional environment is still very unequal. According to the International Renewable Energy Agency (Irena), ⁷ women hold only 32% of renewable energy jobs worldwide. The low representation of women is a reality, especially when analyzing the participation of women in the areas of Science, Technology, Engineering and Mathematics (STEM), both at the technical level and in decision-making positions and other decision-making spaces.

In Brazil, besides being predominantly male, the sector is still very much permeated by prejudice. According to a 2019 survey by the Brazilian Women's Network in Solar Energy (Mesol), 64% of professionals in the sector have heard sexist comments and 49% have suffered discrimination in the workplace for being a woman. •

According to data from the Brazilian Institute of Geography and Statistics (IBGE), 51.8% of the Brazilian population is comprised of women, and they are also the majority with a higher education.⁹ Contradictorily, despite having more years of study, women make, on average, 77.7% of the salary of men 10. In engineering, only 39% of the jobs are held by women, and in the exact sciences, this number falls to 32%. Considering the group of researchers in engineering, only 29% are women ".

However, research shows that a diverse workforce promotes not only better results in terms of increased creativity and innovation potential, but also better decision-making and greater economic benefits. ¹² Therefore, considering gender diversity and inclusion is crucial in the national and global energy transition process.»

However, the "Curitiba more Energy" H and "Solário Carioca" projects gender analyses, supported by the C40 Cities Finance Facility, found gender disaggregated information, studies, and data in the energy sector to be lacking, making it difficult to understand the challenges, interests, and needs of professionals working in the field.

CLANCY; FEENSTRA (2019): <u>https://www.europarl.europa.eu/RegData/etudes/STUD/2019/608867/IPOL_STU(2019)608867_EN.pdf</u>
 NELSON; KURIAKOSE (2017): <u>https://www.climateinvestmentfunds.org/sites/cif_enc/files/gender_and_re_digital.pdf</u>
 FALCÃO et al. (2019): <u>https://www.researchgate.net/publication/334163137_ENERGY_GENDER_An_assessment_on_gender_equality_in_the_energy_</u>

PACCAO et al. (2019): <u>https://www.researcngate.net/publication/33416313/_ENERGY_GENDER_An_assessment_on_gender_equa</u>
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 ONU HABITAT (2019)
 BID; FMI (2017, p. 12)
 BETTI; BOING (2020a, 2020b).
 TIRENA (2019): <u>https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Gender_perspective_2019.pdf</u>
 OLIVEIRA et al. (2020).
 IBGE (2019a): <u>https://biblioteca.ibge.gov.br/visualizacao/livros/liv101707_informativo.pdf</u>
 IBGE (2019b): <u>https://educa.ibge.gov.br/jovens/conheca-o-brasil/populacao/18314-trabalho-e-rendimento.html 11 BOLZANI (2017).</u>

 ¹⁹ BOLZANI (2017).
 ¹⁹ BOLZANI (2017).
 ¹² GWNET (2019): <u>https://www.globalwomennet.org/women-for-sustainable-energy/</u>
 ¹⁹ MARTINEZ; STEPHENS (2016)
 ¹⁹ BETT; BOING (2020a).
 ¹⁵ BETTI; BOING (2020b).

Therefore, in order to achieve a better understanding of the barriers to female participation and representation, their interests and needs for the transformation of the solar energy sector into a more equal and attractive environment for women professionals, the C40 Cities Finance Facility, in partnership with Mesol, prepared this study.

A first in the country, this report analyzes gender issues in the Brazilian solar energy sector and is directed at the people working in the sector: decision makers, entrepreneurs, public policy makers, and other professionals.

The C40 Cities Finance Facility (CFF) supports cities in developing and emerging countries to develop low-carbon, resilient and financially sustainable infrastructure projects. It is funded by the German Ministry for Development and Economic Cooperation (BMZ), the British Department for Business, Energy and Industrial Strategy (Beis), the United States Agency for International Development (USAID) and the Children's Investment Fund Foundation (CIFF). The program is implemented through a partnership between the C40 Cities Climate Leadership Group (C40) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. In Brazil, four cities belong to the C40 group: Rio de Janeiro (RJ), São Paulo (SP), Curitiba (PR) and Salvador (BA).

As for Mesol, it is a national non-profit organization founded in 2019 to make women visible in the scientific, technological, business and industrial fields, and to promote actions that encourage the incoming and retention of women in the field. Mesol has been inspiring change for gender equity in the solar energy sector by connecting, supporting, promoting and inspiring women to actively act in the Brazilian process of energy transition.

The study was coordinated and executed by Mesol and the German-Brazilian Chamber of Commerce and Industry in Rio de Janeiro (AHK-RJ) and had institutional support from the Institute for the Development of Alternative Energies in Latin America (Ideal) and the Center for Research and Training in Solar Energy of the Universidade Federal de Santa Catarina (Fotovoltaica-UFSC).

Cis and transgender women working with solar energy in the country comprise this research's target group. The information was collected using two methodologies: data collection from professionals employed in the solar sector - specifically those available in the Annual Social Information Report (Rais) -, and primary data from women who work directly or indirectly in the solar energy sector, via the application of an online survey, with the participation of 251 respondents.

The data and information collected provided a better understanding of what are the barriers for women to enter and remain in the sector, as well as their interests and development needs. From these results, recommendations were elaborated to address the issues, aiming at strengthening female participation and the transformation of the solar energy sector into a more just, respectful, and equitable environment for all people.

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BOX LIST

Box 1: Background and definitions related to solar energy

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LIST OF ACRONYMS

Abens	Brazilian Association for Solar Energy
Absolar	Brazilian Association of Photovoltaic Solar Energy
AHK-RJ	German-Brazilian Chamber of Commerce and Industry in Rio de Janeiro
Aneel	Brazilian Electricity Regulating Agency
Antra	National Association of Transvestites and Transsexuals
Beis	British Department for Business, Energy and Industrial Strategy
IDB	Inter-American Development Bank
BMZ	German Ministry of Development and Economic Cooperation
BNDES	National Bank for Economic and Social Development
CFF	C40 Cities Finance Facility
CIFF	Children's Investment Fund Foundation
CNPJ	National Registry of Legal Entities
CSP	Concentrated Solar Power
Fotovoltaica-UFSC	Center for Research and Training in Solar Energy at the Universidade Federal de Santa Catarina
CG	Centralized Generation
GCF	Green Climate Fund
DG	Distributed Generation
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GW	Gigawatt
IBGE	Brazilian Institute of Geography and Statistics
Ideal	Institute for the Development of Alternative Energies in Latin America
MHDI	Municipal Human Development Index
Ipea	Institute for Applied Economic Research
Irena	International Renewable Energy Agency
KW	Kilowatt
Mesol	Brazilian Women's Network in Solar Energy
MW	Megawatt
O&M	Operation and Maintenance
NGO	Non-Governmental Organization
PV	Photovoltaics
UN	United Nations
Rais	Annual Social Information Report
REN	Normative Resolution
STEM	Science, Technology, Engineering, and Mathematics
UNFPA	United Nations Population Fund
USAID	United States Agency for International Development
WEPs	Women's Empowerment Principles

EXECUTIVE SUMMARY

According to the International Renewable Energy Agency (Irena), women hold only 32% of the jobs related to renewable energy in the world. The sector is expected to generate up to 42 million jobs globally by 2050. The low representation of women is a reality, especially when analyzing the participation of women in the areas of Science, Technology, Engineering and Mathematics (STEM), both at the technical level and in decision-making positions and other decision-making spaces.

Solar energy, in turn, is the most prominent renewable energy sector, both nationally and internationally, when compared to other renewable energy sectors. In Brazil, it has generated over R\$38 billion in business from 2012 to 2020, creating over 224,000 job positions according to the Brazilian Solar Energy Association (Absolar). However, the gender analysis performed by the "Curitiba more Energy" and "Solário Carioca" projects, supported by the C40 Cities Finance Facility, found that, in Brazil, the sector lacks disaggregated gender information, studies and data.

Thus, in order to provide reliable, quality information that is easy to comprehend, about the challenges for the incoming and retention of women in the solar energy sector in Brazil, as well as their needs and interests with regard to their professional development, C40 Cities Finance Facility, in partnership with Mesol, elaborated this study.

The report analyzes gender issues in the Brazilian solar energy sector based on secondary data made available in the Annual Social Information Report (Rais) and on the answers of 251 women to an online survey made available to female workers in the sector through Mesol social media networks and those of its partners.

Themes of health and safety, with focus on gender violence and parenting, economic opportunities, education, training, and access to information; as well as representation, participation in decision-making spaces, and female leadership in the sector were defined to guide this study. This choice emerged from the policies and recommendations for the preparation of a gender analyses from institutions that finance projects in the sector, such as the manual on Mainstreaming Gender in Green Climate Fund Projects of the Green Climate Fund (GCF), the IDB's Política Operativa Sobre Igualdad de Género en el Desarrollo, and the BNDES' Policy for Gender Equity and Valuing Diversity.



Photo: Mesol Network

Regarding the profile of female workers in the sector, it is contended that the female workforce is slightly younger than the male workforce. Nearly 60% of the women were between the ages of 25 and 39 years old in 2019. The high participation of young people may evidence that many women at the early stages of their career are choosing to follow a career path in renewable and solar energy. It is also observed that women tend to have a higher education level than men in the sector. However, in spite of having the same profile as the men in regards to education and experience, men earn, on average, 31% more than their female counterparts.

A negative bias towards women in technical careers such as STEM can also be observed, such careers grouping together the fields of science, technology, engineering and mathematics. Only 4.8% of women followed such careers in 2019, compared to 8.4% of men. Women tend to hold higher-level positions, but in other areas, such as business administration, for example.

When directly asked about possible barriers and challenges to enter and remain in the sector, almost all of them (92%) indicated the existence of such barriers and challenges. Male chauvinism and prejudice were widely and explicitly mentioned, as well as the lack of credibility in the quality of the work developed by women, particularly in regard to the STEM areas.

Having access to information and opportunities is another barrier to women's professional development. At the same time, the fact that they are a minority in the industry does not contribute to the expanding of their experiences and their exchange of information, which would allow them to support each other.

The participation of women in leadership positions is limited, especially in higher positions, such as director or executive positions, making it difficult for important issues to be debated and addressed, which contributes to the replication of inequalities.

Keeping a balance between personal and family life, particularly regarding the care for sons and daughters is also a barrier, since most of the responsibilities for home and family care fall on women. Thus, being or becoming a mother is recognized as a barrier by half of the mothers in the sector.

Gender violence and racial inequality are very strong and widespread issues in Brazil, resulting in major barriers also for women in the sector, since 57% of the professionals have already suffered some type of violence and 71.7% have already been discriminated against in their professional environment.

More professional training, greater equality of opportunity and credibility in relation to their work is what women most want or need to develop professionally in the solar energy sector. They also pay attention to the need to involve the male public in training courses and other spaces and actions aimed at discussing and promoting gender equality in the sector.

Given this context and taking into account that one out of every three organizations in the sector develops no actions towards gender equality, diversity, and/or race equality, recommendations were made. Among the main recommendations, we highlight the incentive given to organizations in the sector to adhere to actions and programs for gender and race equality, as well as the creation of policies and actions that fight gender violence. The need to develop programs and actions that offer equal conditions to female workers during pregnancy, breastfeeding, and maternity was reinforced. We also encouraged the development of training programs in the technical, business management, leadership, and entrepreneurial areas, preferably taught by other women. Encouraging the participation of black, low-income, transgender, and other female-led minorities will make the sector more inclusive and diverse.

By making data and recommendations available, the goal is to include the gender agenda in the Brazilian solar energy sector and raise the awareness of its main players to the subject. The diversification of the Brazilian energy matrix needs to go hand in hand with the expansion of gender and racial diversity in order for the renewable energy sector to take advantage of its full potential for growth and innovation, not only in solar energy sector.

SOLAR ENERGY AND GENDER 1

Solar Energy in Brazil 1.1

The quality of the air we breathe, the food we eat, and the structural safety of the buildings in which we live and work are some examples of the many impacts that climate change is having on contemporary society. Since the energy sector is responsible for the emission of two-thirds of greenhouse gases,¹⁶ working towards the energy transition (Box 1) may be one of the most significant manners to mitigate these impacts.

The increased adoption of renewable energy sources - associated with energy efficiency measures is one of the main aspects of the energy transition process. In the electricity sector, the installed capacity of renewable energies in the world has been growing and becoming more prominent in recent years, reaching its highest growth in 2019 with the addition of 200 GW installed capacity. 7 More than half (115 GW) of the renewable energy installed capacity refers to the solar photovoltaic (PV) source (Box 1), which is the renewable energy source that has added the most installed capacity in the sector since 2016. *

In 2019, solar PV energy added 627 GW of installed capacity worldwide. China leads the ranking of countries with the most cumulative installed capacity, having added 205 GW in 2019, followed by the United States (75 GW), Japan (62 GW), Germany (49 GW) and India (42 GW). ¹⁹ In Brazil, the global trend is reproduced, and the development of the solar PV energy sector has also gained a lot of prominence in recent years. Especially since 2012, when the Brazilian Electricity Regulatory Agency (Aneel) published Normative Resolution REN 482/2012, which established the general conditions for distributed generation and applied the virtual net-metering scheme in the country (Box 1).

Since then, the installed capacity of solar PV energy has been growing exponentially in the country, notably from the year 2017 onwards, as shown in Figure 1. In 2019, installed capacity practically doubled compared to the previous year, growing from 2.4 GW to 4.5 GW. By 2020, that figure jumped to 7.5 GW, representing a 64% growth even in a pandemic year of global crisis. Overall, since 2012, the solar PV source was responsible for generating over R\$ 38 billion in business and creating more than 224,000 job positions up to 2020.20



Figure 1: Growth of the installed capacity

On a global scale, the solar PV energy sector is the renewable energy sector that has created the greatest number of job positions since 2016, generating approximately 3.8 million jobs in 2019. ²¹ By 2050, renewable energy is expected to generate up to 42 million jobs worldwide.²² These figures highlight how promising the sector seems for those men and women who would like to pursue a career in this field.

It is necessary to ensure that the development and growth of the sector happens in a fair, diverse, and inclusive manner. Women have much to offer as professionals in the energy sector, especially in times of change. Research shows that a diverse workforce promotes not only better results in terms of increased creativity and innovation potential, but also better decision-making and greater economic benefits.²³ Therefore, considering gender diversity and inclusion is crucial to the national and global energy transition process. 24

¹⁶ IPCC (2018): <u>https://www.ipcc.ch/sr15/</u>

¹⁸ IPCC (2018): https://www.ipcc.cn/srib/ 7 REN21 (2020): https://www.ren21.net/wp-content/uploads/2019/05/ gsr_2020_full_report_en.pdf
¹⁸ REN21 (2020): https://www.ren21.net/wp-content/uploads/2019/05/ gsr_2020_full_report_en.pdf
¹⁹ REN21 (2020): https://www.ren21.net/wp-content/uploads/2019/05/ gsr_2020_full_report_en.pdf gsr_2020_full_report_en.pdf ²⁰ ABSOLAR (29/01/2021): http://www.absolar.org.br/n

 ²¹ IRENA (2020a): https://www.irena.org/-/media/Files/IRENA/Agency/ Publication/2020/Sep/IRENA_RE_Jobs_2020.pdf
 ²² IRENA (2020b): https://www.irena.org/-/media/Files/IRENA/Agency/ Publication/2020/Apr/IRENA_Global_Renewables_Outlook_2020.pdf
 ²³ GWNET (2019): https://www.globalwomennet.org/women-for-sustainable-energy/

energy/ ²⁴ MARTINEZ; STEPHENS (2016).

Box 1: Background and definitions related to solar energy

What does energy transition mean?

Energy transition is the process of transforming the fossil-based energy sector to zero carbon. This process aims at reducing energy-related CO₂ emissions in order to limit climate change. The complexity, uncertainties, and ambiguities of this process encompass both technical-economic-environmental and social aspects.²⁵

Solar Energy

Solar energy can be used for two main purposes: heating and electricity production. To heat fluids water is the most common - and environments through solar thermal energy, and to produce electricity from solar irradiation. In the latter case, the two most common technologies are photovoltaic, which deals with the conversion of solar radiation directly into electricity, and helio-thermal (or concentrated, better known by its acronym CSP, Concentrated Solar Power) in which a fluid is heated using the sun's energy to produce steam and generate electricity).²⁶

Centralized Generation (CG)

This refers to the production of energy in large power plants, generally far from the points of consumption. In CG, the energy produced is transmitted over great distances by means of transmission lines until it reaches the consumer units.

Distributed Generation (DG)

Refers to small and medium-sized systems for the production of renewable energy or qualified cogeneration, connected to the electric grid and distributed to the local network. In Brazil, under current regulations, DG systems may have an installed capacity of up to 5 MW (microgeneration with power of up to 75 kW and mini-generation greater than 75 kW and smaller than 5 MW).

What is the virtual net-metering scheme and how does it work?

The virtual net-metering scheme stablished by REN 482/2012 boosted the growth of the solar PV energy sector in the country.

How does it work?

The virtual net-metering scheme allows individuals and legal entities (known as prosumers, because they produce and consume) to produce their own energy and receive credits on their electricity bill. Each kWh exported to the grid generates a credit of one kWh of energy that will be discounted (in the equivalent R\$/kWh) from the electricity bill of the consumer unit associated with that DG system. The energy credit can be used for a period of up to 5 years (60 months).

Out of the technologies associated with renewable energy that can be used in a DG system (solar PV, wind, hydro and cogeneration), PV was the most adopted one, representing about 90% of the DG installations in the country. One of the great advantages of solar PV technology is its modularity, making it possible to integrate PV modules to the roofs and buildings' architecture. Furthermore, the drop in prices for this technology has made it increasingly attractive and financially viable in recent years. cada vez mais atrativa e financeiramente viável nos últimos anos.

 ²⁵ MONTERO; SERNA; ALLENDE (2020).
 ²⁶ INTITUTO E+ TRANSIÇÃO ENERGÉTICA (2020): https://www.emaisenergia.org/wp-content/uploads/2020/12/ECartilhaTransicaoEnergetica-1.pdf

1.2 Gender Scenario in Brazil

With a population of 209.5 million, comprised mostly of black people (56.2%) ²⁷ and women (51.8%), Brazil is the largest country in South America in terms of population and area, having global economic and political influence. ²⁸ Its Human Development Index (HDI) of 0.778 includes the country in the high human development bracket; however, the contradictions portrayed by its indicators bear the mark of deep social inequality.

People who declare themselves as white, on average, live longer (76.6 years) than their black counterparts (73.7 years). ³⁹ They are also the majority among those who complete higher education programs (25.9% of women and 12% of men) and earn the highest salaries. ³⁰ With the gender cutout, the inequalities get deeper. When analyzing income by skin color and gender, a study produced by the Institute for Applied Economic Research (Ipea), in partnership with UN Women, found that although black women's income increased the most between 1995 and 2015 (80%), and white men's increased the least (11%), the pay scale has been the same over twenty years, between 1995 and 2015, with black women having the worst salaries in the labor market, according to Figure 2.³¹



Figure 2: Average monthly income in the main job of the employed population aged 16 years or older, by sex and color/race - Brazil, 1995 to 2015.

In the educational field, women stand out in relation to men by having, on average, more years of schooling and education. According to the IBGE, the percentage of men between the ages of 25 and 44 years old who finished college in 2018 was 15.6%, while the percentage of women in the same age group reached 21.5%. From a racial-ethnic perspective this difference is also noticeable with white women having completed more years of education than white men, and black women, than black men.³² However, this advantage does not reflect in the professional field.

A survey conducted by Catho, a Brazilian online recruitment company, compared the income of men and women according to their occupation, as well as according to their educational level. The study concluded that, in 2020, women in leadership positions, such as managers and directors, in private companies, earned on average 23% less than men. Salary inequality applied to all hierarchical levels, except for the position of assistant. In relation

³⁰ ONU MULHERES, IPEA (2017): <u>https://www.ipea.gov.br/portal/images/stories/PDFs/170306_apresentacao_retrato.pdf</u> ³¹ ONU MULHERES, IPEA (2017): <u>https://www.ipea.gov.br/portal/images/stories/PDFs/170306_apresentacao_retrato.pdf</u>

²⁷ The Brazilian Institute of Geography and Statistics researches the color or race of the Brazilian population based on self-declaration, considering the following options: white, black, brown, indigenous, or yellow. The denomination "black" includes the entire brown and black population.

 ²⁸ IBGE (2019a): https://biblioteca.ibge.gov.br/visualizacao/livros/liv101707_informativo.pdf
 ²⁹ IPEA, PNUD, FJP (2019): <u>http://repositorio.ipea.gov.br/visualizacao/livros/liv101707_informativo.pdf</u>
 ²⁹ IPEA, ONCJ %ADDIdices%20componentes%20no%20per%C3%ADodo.pdf
 ²⁰ ONCJ %ADDIdices%20componentes%20no%20per%C3%ADodo.pdf
 ²⁰ ONCJ %ADDIdices%20componentes%20no%20per%C3%ADodo.pdf
 ²⁰ ONCJ %ADDIdices%20componentes%20no%20per%C3%ADodo.pdf
 ²⁰ ONCJ %ADDIdices%20componentes%20no%20per%C3%ADodo.pdf

 ³¹ ONU MULHERES, IPEA (2017): https://www.ipea.gov.br/portal/images/stories/PDFs/170306_apresentacao_retrato.pdf
 ³² IBGE (2018): https://agenciadenoticias.ibge.gov.br/media/com_mediaibge/arquivos/9d6f4faeda1f1fb7532be7a9240cc233.pdf

³³ G1 (15/10/2020): https://g1.globo.com/economia/concursos-e-emprego/noticia/2020/10/15/mulheres-em-cargos-de-lideranca-ganham-em-media-23percenta-menos-que-homens-aponta-pesquisa.ghtml

to educational levels, the biggest salary difference is among professionals with post-graduation/specialization, who get paid salaries up to 47% lower than their male counterparts. ³³

In addition to having less access to financial resources, women face greater difficulties in taking job opportunities equally, since they are the ones primarily responsible for the domestic chores and the care of children, the elderly, and sick family members. According to IBGE, in 2019, considering only the employed population in the country, women devoted 18.5 hours per week to people's care and household chores, 76% more hours than men (10.4 hours per week).³⁴

Despite the challenges for professional advancement, the presence of women in leadership positions has grown over the years. In a survey based on data from the Annual Social Information Report (Rais), the number of women aged 30 to 49 holding managerial positions rose from 32.3% to 39.2% between 2003 and 2017, and of female directors, from 31.9% to 42.4% in the same period. ³⁵ Black women, however, held only 1.6% of the managerial positions, and made up 0.4% of the executive staff of companies in 2016, as cited in a publication prepared by the Inter-American Development Bank (IDB) and the Ethos Institute. ³⁶ Such data is indicative that Brazil is still far from achieving gender and race equity in the labor market.

Regarding parenthood, Brazilian women are having fewer children and becoming mothers later in life. They have, on average, 1.7 children, a rate considered lower than the population replacement rate of 2.1 children, according to a study presented by the United Nations Population Fund (UNFPA). Although the number of children varies according to factors such as race/color, level of education, income and place of residence, this drop has been observed in all regions of the country, social strata, as well as among younger women.³⁷ In turn, the fertility rate of women over 30 has been increasing, indicating a trend in this direction: according to the IBGE, in 2019, children born from mothers aged 30 years or older accounted for 37.4% of the total births in the country, whereas, in 1999, this percentage was of only 23.7%. ³⁸

Maternity leave was established in Brazil under the 1988 Constitution and its length varies between 120 and 180 days, depending on the institution's policy. Paternity leave, on the other hand, is only five to twenty days, which shows that men still live with social representations and pressures that often identify them only as breadwinners and disregard other dimensions of fatherhood. Also, for the first five months after birth, the mother cannot be fired without due cause, while there is no legislation ensuring paternal stability.³⁹ However, a significant number of women who become mothers leave or lose their jobs after this period. A study conducted by the Getúlio Vargas Foundation using data from the Ministry of Labor found that 50% of the women whose career path was analyzed were no longer employed a year after their maternity leave started. The study also identified that the lower the level of education, the lower the chances of remaining in the job. Moreover, while there is a drop in female participation in the labor market with the presence of a small child in the family, the same is not true for men. 40

Gender-based violence is another aspect that influences the life dynamics of girls and women and can be understood as any type of aggression against a person in a situation of vulnerability due to their gender identity or sexual orientation. However, according to the World Health Organization (2017), 35% of women have experienced physical or sexual violence in their lifetime. Since women are the most affected by gender-based violence, the following definition for the concept has been used in this study:

> [...] expression used to refer to the various acts carried out against women as a way of subjecting them to physical, sexual and psychological suffering. These include the various forms of threats, not only in the intra-family sphere, but also covering their social participation in general, with emphasis on their work relations, characterized mainly by the imposition or intended imposition of a subordination and control of the male gender over the female. 41

In Brazil, a significant number of women are subjected daily to some form of violence, both in public and private spaces, femicide being the most severe expression of such violence. Despite the legislation against gender-specific violence in Brazil, the statistics are alarming, resulting in a perverse highlighting of the country as the fifth highest femicide rate in the world.42

 ³⁴ IBGE (2020): https://agenciadenoticias.ibge.gov.br/media/com_mediaibge/arquivos/579f8cb956b0677de8dfc870215f3951.pdf
 ³⁵ FOLHA DE SÃO PAULO (03/03/2019): https://www1.folha.uol.com.br/mercado/2019/03/aumenta-a-participacao-de-mulheres-em-cargos-de-chefia.shtml
 ³⁶ BID; INSTITUTO ETHOS (2016) https://www3.ethos.org.br/wp-content/uploads/2016/05/Perfil_Social_Tacial_Genero_500empresas.pdf
 ³⁷ UNFPA (2018): https://brazil.unfpa.org/sites/default/files/pub-pdf/swop_brasil_web.pdf
 ³⁸ AGÊNCIA BRASIL (09/12/2020): https://agenciabrasil.ebc.com.br/genros/direito.doc12/2cai-numero-de-pessoas-nascidas-e-registradas-no-brasil-em-2019
 ³⁶ ANDITO UNEDLO (05 (12/000): https://dambito.indic.com.br/genros/direito.doc12/2cai-numero-de-pessoas-nascidas-e-registradas-no-brasil-em-2019

 ³⁹ ÂMBITO JURÍDICO (05/11/2019): <u>https://ambitojuridico.com.br/cadernos/direito-do-trabalho/estabilidade-provisoria-paterna/</u>
 ⁴⁰ NEXO (11/09/2017) <u>https://www.nexojornal.com.br/expresso/2017/09/07/Por-que-50-das-brasileiras-saem-do-trabalho-ap%C3%B3s-a-licen%C3%A7a-</u>

maternidade

 ⁴¹ SOUZA (2007, p. 35).
 ⁴² AGÊNCIA BRASIL (27/08/2017): <u>https://agenciabrasil.ebc.com.br/direitos-humanos/noticia/2017-08/taxa-de-feminicidios-no-brasil-e-quinta-maior-do-mundo</u>

In a decade, from 2007 to 2017, women homicide rates increased by 30.7% in the country, according to the Atlas of Violence, the largest growth being among black women, who accounted for 66% of all women murdered in Brazil in 2017.43

Cases of violence directed at transgender individuals are also expressive and impactful in Brazil, which ranks as the most transphobic country in the world. That, in turn, results in an average life expectancy for transgender people of only 35 years. The Dossier on Murders and Violence Against Brazilian Transgender People, prepared in 2019 by the National Association of Transvestites and Transsexuals (Antra) denounces that, since 2008, Brazil has been the country that kills the most transsexuals (out of a total 74 countries surveyed) with the vast majority (97.7%) being transgender women. 44

Still in regards to gender violence, women's professional development is greatly impacted by these situations. A survey conducted by the LinkedIn platform in partnership with Think Eva, in 2020, concluded that 47% of Brazilian women have experienced harassment at work, and one in six has resigned after the event. Yet, only 5% asked for help from the Human Resources department of the company they worked for, considering that in the perception of 78% of the women surveyed, the aggressor usually goes unpunished.⁴⁵ Moreover, when we observe the statistics relating to women victims of domestic violence, we observe that they stay in the same job for shorter periods than other women, skipping more workdays and reportedly having less concentration, which increases their chances of being fired.46

Discrimination and other forms of violence also make it difficult for trans women to access the labor market. According to the UN's Trans Pages document, "they are discriminated against in the selection processes, being left behind in the recruitment stages because of their gender identity". * Although most of them have a low education level and little professional experience and qualification as a result of prejudice and negative stereotypes attributed to them, many others have professional experience and advanced levels of education and professional qualification, and are therefore able to perform professional activities accordingly, but are not always given the opportunity to do so. 48

1.3 The Importance of Gender Equality in the Solar **Energy Sector**

The renewable energy sector workforce has a gender gap with women representing only 32% of the industry, according to the Irena survey. * Consequently, the invisibility of women in the industry discourages girls from studying science and/or engineering.

Studies show that school-age girls are convinced that ability in STEM fields is a male quality. In addition, the role played by social norm in shaping the notions of what are the desirable or viable jobs for men and women affects their confidence and, in many cases, results in employer discrimination, making it difficult for them to get the initial job offers or subsequent promotions. ³⁰

According to another gender survey in the energy sector ¹⁰, findings show that in the European Union the proportion of women working in the industry is of about 20%. Most of them work in non-technical areas, such as administration and public relations. In addition, the proportion of women in management positions in the sector

⁴³ IPEA; FÓRUM BRASILEIRO DE SEGURANÇA PÚBLICA (2019): <u>https://www.ipea.gov.br/portal/images/stories/PDFs/relatorio_institucional/190605_atlas_da_</u> violencia_2019.pdf

⁴⁴ BENEVIDES, B. G.; NOGUEIRA, S. N. B. (2020): https://antrabrasil.files.wordpress.com/2020/01/dossic3aa-dos-assassinatos-e-da-violc3aancia-contra-pessoastrans-em-2019.pdf

⁴⁵ THINK EVA; LINKEDIN (2020): <u>https://thinkeva.com.br/pesquisas/assedio-no-contexto-do-mundo-corporativo/</u> ⁴⁶ ESTADO DE DIREITO (06/02/2020): <u>http://estadodedir</u> eito.com.br/maria-da-penha-vai-ao-trabalho-mulhere vitimas-de-violencia-e-sindicatos-o-que-umacoisa-tem-a-ver-com-outra/

 ⁴⁷ ONU (p. 41, 2019): http://aliancalgbti.org.br/wp-content/uploads/2020/08/16.-ONUBR-Cartilha-P%C3%A1ginas-Trans.pdf
 ⁴⁸ ONU (2019): http://aliancalgbti.org.br/wp-content/uploads/2020/08/16.-ONUBR-Cartilha-P%C3%A1ginas-Trans.pdf
 ⁴⁹ IRENA (2019): https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Gender_perspective_2019.pdf
 ⁵⁰ FALCAO, et al. (2019): https://www.researchgate.net/publication/334163137_ENERGY_GENDER_An_assessment_on_gender_equality_in_the_energy_

sector_in_Brazil ⁵¹ BETTI; BOING (2020a, 2020b).
 ⁵² EPBR (11/25/2018). Mulheres na energia: Por enquanto somos estatística.

Available at: https://epbr.com.br/mulheres-na-energia-por-enquanto-somos-estatistica/ > Last access at: 02/01/2021



Photo: Mesol Network

is significantly lower than that of its male counterparts. On the Latin American continent and in the Caribbean, women also occupy about 20% of positions in the sector. However, on the advisory boards or presidency of companies, this percentage drops to 7%. 52

In the Brazilian energy sector, according to a study conducted by the British Embassy in Brazil, the representation of women in management positions is also low with 11% of female participation in executive boards, 12% in boards of directors and 18% in supervisory boards. According to that study, the energy sector is one of the worst in gender equality in the country.33

According to another gender study in the energy sector,⁵⁴ the literature recognizes the central role of women as the driving force behind the energy transition to a low-carbon matrix. Furthermore, women entrepreneurs tend to better consider women's needs and interests when designing strategies to transform the energy system, which may improve energy access for female-headed households.

Diversity in the workplace can provide several benefits, such as innovation, creativity, increased productivity, and more collaboration. 55 Additionally, companies with more women on their boards are more likely to proactively invest in renewable energy and reduce carbon emissions across the value chain, and countries with higher female parliamentary representation are more likely to seek to reduce their carbon dioxide emissions. 56

While it is understood that there is a gap in female participation in the domestic and global energy sectors, there is also limited accurate data and information in this regard. Moreover, indicators need to be improved so that strategies can be based on reliable data and progress can be measured. 57

This study is the first, at the national level, seeking to collect gender disaggregated data and to identify the barriers faced by women in the solar energy sector in Brazil in order to develop proposals to overcome them.

⁵³ FALCÃO, et al. (2019): <u>https://www.researchgate.net/publication/334163137_ENERGY_GENDER_An_assessment_on_gender_equality_in_the_energy_sector_in_Brazil</u>
 ⁵⁴ BETTI; BOING (2020a, 2020b).
 ⁵⁵ BETTI; BOING (2020a, 2020b).
 ⁵⁶ MARTINEZ; STEPHENS (2016) <u>https://www.tandfonline.com/doi/pdf/10.1080/15487733.2016.11908149?needAccess=true</u>
 ⁵⁷ GWNET (2019). Women for Sustainable Energy: Strategies to Foster Women's Talent for Transformational Change

IDENTIFYING GENDER GAPS IN THE 2 SOLAR ENERGY SECTOR

In order to carry out the gender analysis, this study aimed at identifying the context and the bottlenecks for the incoming and retention of women in the solar energy sector in Brazil, as well as their needs and interests regarding their professional development.

To that end, the following categories of analysis were used: i) health and safety, with a focus on gender violence and parenting; ii) economic opportunities; iii) education, training and access to information; and iv) representation, participation in decision-making spaces, and female leadership in the sector.³⁸ To define these themes, gender policies were analyzed, as well as recommendations from institutions that finance projects in the sector, such as the manual on Mainstreaming Gender in Green Climate Fund Projects» of the Green Climate Fund (GCF), the Operational Policy on Gender Equality in Development[®] of the IDB, and the Policy for Gender Equity and Valuing Diversity® of the BNDES.

The study's target group were cis and transgender women who work directly or indirectly with solar energy in the country. The information was collected based on two approaches: survey of the secondary data available in the Annual Social Information Report (Rais) based on the Brazilian Classification of Occupations (CBO) and primary data collected through the application of an online survey.

The data collected from the Rais database, considered one of the main sources of information on the Brazilian formal labor market, has allowed the drawing of a profile of formally registered female participation in the solar energy sector in Brazil, especially in the private sector, as presented in section 2.1 Gender overview in the solar energy sector - secondary data.

It should be noted that this study relied on secondary data from Rais to address the gender dimension in the Brazilian solar sector. Therefore, it presents limitations inherent to this methodology, which resulted from using a database that was not designed specifically for the research query.

The data analysis provided by Rais was carried out based on the National Registry of Legal Entities (CNPJs) registry numbers collected from the Ideal Institute[∞] database (3,077 companies), the list of CNPJs belonging to the members of the Brazilian Solar Energy Association (Absolar) (550 companies) and an additional 38 companies identified as leaders in the solar energy sector in Brazil. Since solar PV energy is the solar energy segment undergoing the most development in the country in comparison to other segments (such as thermal and CSP), it has been understood that, according to the sample of CNPJs assessed from the Rais database, it characterizes the domestic working force who is active in the PV sector.



58 BETTI; BOING (2020a, 2020b)

⁵⁹ GCF (2017): <u>https://www.greenclimate.fund/document/mainstreaming-gender-green-climate-fund-projects</u>

BID (2010): http://idbdocsiadb.org/wsdocs/getdocument.aspx?docnum=35428394
 BNDES (s/d): https://www.bndes.gov.br/wps/portal/site/home/quem-somos/responsabilidade-social-e-ambiental/o-que-nos-orienta/politicas/politica-genero
 AMÉRICA DO SOL (s/d): http://www.americadosol.org/fornecedores/

Photo: Mesol Network

However, it is worth noting that, although the filling out of the Rais is mandatory, not all of the identified companies were found in its database. This is due to potential filling errors in the CNPJs numbers, or because they have become inactive at the Federal Revenue service only five years after failing to declare the Rais, and many companies are shut down before this period.

Therefore, the CNPJs registry sample used in the research encompassed a total of 1,268 companies for the period between 2012 - the year of publication of Normative Resolution 482/2012, establishing Distributed Generation in the country, becoming one of the main drivers for the development of solar PV technology - to 2019, the last year available in the database up to the time of this research.

The online survey directed at female workers in the solar energy sector in Brazil was structured with open and close-ended questions that were defined based on the aforementioned categories of analysis, aiming at identifying the profile of the respondents. The main purpose of this survey was to obtain gualitative information regarding the perception of the women themselves about their challenges, interests, and needs for entering and remaining in the sector.

This information adds to the quantitative analysis of the sector carried out using Rais data.

The survey was made available and disseminated through the Mesol social media and by partners in the sector, such as Ideal Institute, the Brazil-Germany Chamber of Commerce and Industry (AHK), Fotovoltaica-UFSC, Brazilian Solar Energy Association (Abens), Brazilian Photovoltaic Solar Energy Association (Absolar), and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

The survey was open to respondents for a ten--day period in January 2021. A total of 368 responses were obtained, of which 251 (68%) were complete. Only complete responses were computed and analyzed. The results from the close-ended questions were turned into charts (graphics), and those from the open questions were submitted to content analysis with the creation of categories from the repeating themes.49 Later, they were tabulated and presented graphically. The data collected through the guestionnaire is presented in section 2.2 Profile and perception of women working in the brazilian solar energy sector primary data.

Gender Overview in the Solar Energy Sector -2.1 **Secondary Data**

Pursuant to a study of the working force in the solar energy sector productive chain in Brazil, e it is observed that companies employ mostly men - around 68% in the average period from 2012 to 2019 compared to 32% of women, an inequality that is in line with international standards.⁶⁶ Furthermore, there is a downward trend in female participation, as shown in Figure 3, reaching 28% by the end of 2019.



Figure 3: Participation by gender in the solar energy sector in Brazil: 2012-2019.

Source: Study of the workforce in the productive chain of the solar energy sector in Brazil prepared by GIZ (2021).

ef The study prepared by GIZ (2021) on the labor force in the production chain of the solar energy sector, applied the same method using the Rais database and sample of CNP3 applied in this research to characterize the labor force of the solar sector in Brazil. For this reason, the results from that study are directly comparable to the results of this report. ⁶⁵ IRENA (2019): <u>https://www.irena.org/publications/2019/Jan/Renewable-Energy-A-Gender-Perspective</u>

⁶³ BARDIN (2011)

By observing the significant growth of the solar PV sector in Brazil, especially from 2016 onwards (Figure 1), and according to market studies and projections, 46.97 it can be noted that, during this period, the sector has opened up many opportunities to generate new jobs in the solar energy industry in the country. The projections expect the sector to generate a grand total of 377,000 jobs in Brazil by the end of 2021, which will be distributed throughout the entire industry production chain.⁴⁰ These data and projections combined with Figure 3 show that the hiring drive in this period showed a male bias.

This study on the workforce in the productive chain of the Brazilian solar energy sector,⁶⁰ also identified that the hirings in the sector for the year 2019 were mostly related to the installation of PV systems. This conclusion, combined with the significant increase in the installed power capacity of solar PV energy in the country, may justify why the recent hirings in the sector have had a more male bias. According to international literature, women tend to occupy more administrative positions in the energy sector than technical ones.^{10,71}

As for female participation according to the country's regions in the period between 2012-2019, according to the sample used in this study, it is observed that, historically, the Southern region has a higher participation of women in hiring (38.9% average), followed by the Southeastern region (33.2%), as presented in Figure 4. In all regions (with the exception of the Northern region), the percentage of women active in solar energy companies has decreased between 2017 and 2019.





A significant drop in female participation in the South and Southeast regions in 2019 is noticeable, even though these were the regions with the highest workforce participation in the sector's productive chain that year² and the regions that historically installed the most distributed solar PV systems in the country.⁷³

In 2019, the Northern region outperformed the Southern and Southeastern regions, being the region that employed the most women in the sector, even though it ranked second as the region to employ the least amount of people in the country. The Midwest region ranked first, according to the sample of companies analyzed.74

The fact that the hirings in recent years have showed a male bias may be a factor in justifying this change in pattern in regional hiring in 2019, since many more men may have been hired in comparison to women, especially in the South and Southeast regions that year.

As for the age distribution, the age pyramids (Figure 5) show that, for both genders, the distribution of working people is mostly in the 30 to 34 years of age group (around 18% (men) and 20% (women) in 2019).

An interesting fact is that the age distribution of

 ⁶⁶ IRENA (2020a): <u>https://www.irena.org/publications/2020/Sep/Renewable-Energy-and-Jobs-Annual-Review-2020</u>
 ⁶⁷ ABSOLAR (09/01/2021): <u>http://www.absolar.org.br/noticia/noticias-externas/setor-fotovoltaico-gerou-mais-de-86-mil-empregos-no-brasil-em-2020.html</u>
 ⁶⁸ PORTAL SOLAR (13/01/2021): <u>https://www.portalsolar.com.br/blog-solar/energia-solar/energia-solar-vai-gerar-mais-de-147-mil-empregos-no-brasil-em-2021-</u> projeta-absolar.html

⁶⁹ GIZ (2021).

⁷⁰ IRENA (2019): https://www.irena.org/publications/2019/Jan/Renewable-Energy-A-Gender-Perspective ⁷¹ GWNET (2019): <u>https://www.globalwomennet.org/women-for-sustainable-energy/</u>

⁷² GIZ (2021)

⁷³ ANEEL (2021): http://www2.aneel.gov.br/scg/gd/GD_Estadual.asp

women shows a younger trend than that of men, as the base of the age pyramid for women is wider, and this fact is even more remarkable in 2016 and 2012. Indeed, in 2012 almost half of the women employed in the industry, according to the sample, were between the ages of 25 and 34 years old. Over time, the pyramids have become more similar, suggesting that no new women in the 25 to 34 age group have entered the industry.





Source: Elaborated from Rais database

According to the sample analyzed, in the year 2019 the female workforce in the solar energy sector tended to have a higher level of education than the male workforce (Table 1). Women were found to have completed higher education levels at a higher rate than the average rate of this study global sample (45.4% vs. 35%), and the lower education ranges at a lower rate than average rates. On the other hand, the male workforce tended to have completed only a high school education (55.4%).35%). Os homens, em sua maioria, tendem a apresentar apenas o ensino médio completo (55,4%).



Figure 6: Educational levels and gender in the industry for the year 2019.

Source: Online survey applied to women in the sector (2021).

As for the growth to managerial positions, an interesting phenomenon was observed: there is a positive bias regarding the incoming of women into management positions (6.9% for women against 5.3% for men, according to Table 2), but a negative bias for executive positions - only 0.7% of them will take over such positions, in comparison to 0.9% of the total sample (Table 3). Although small, this bias is significant from the statistical point of view, at 99% significance, i.e., the chance that there is no bias is less than 1%.

Table 1: Management positions and gender in the solar sector for the year 2019.

Position	Female	Male	Total
Managers (excluding directors)	ing directors) 6.90%		5.80%
Other	93.10%	94.70%	94.20%

Source: Elaborated from Rais database.

Table 2: Board positions and gender in the solar sector for the year 2019.

Position	Female	Male	Total
Director (excluding managers)	0.70%	0.90%	0.90%
Other	99.30%	99.10%	99.10%

Source: Elaborated from Rais database.

To the extent of the sample provided in this study, women seem to face a barrier to achieving higher and less numerous positions, such as executive positions in the companies. Whilst management positions, more numerous and lower positioned in the hierarchical level, tend to be more easily accessed by them. A more in-depth study to better understand this phenomenon is required.

Regarding career descriptions, Table 3 shows a negative bias for women in STEM careers, as only 4.8% of them were pursuing such careers in 2019, compared to 8.4% of men and 7.4% of the total.

Table 3: STEM careers and gender in the solar sector for 2019

Professional Careers	Female	Male	Total
STEM Careers	4.80%	8.40%	7.40%
Other	95.20%	91.60%	92.60%

Source: Elaborado a partir dos dados da Rais de empresas do setor solar.

However, when comparing with occupations other than STEM careers, the bias found was positive for these careers, as can be seen in Table 4.

Table 4: Other higher level occupations and gender in the industry for the year 2019

Occupations	Female	Male	Total
Other higher-level professions (except STEM careers)	19.30%	7.20%	10.60%
Other	80.70%	92.80%	89.40%

Source: Elaborated from Rais data of companies in the solar sector.

While 7.2% of men and 10.6% of the total study sample are engaged in these higher-level occupations, this percentage is 19.3% among women. These figures show that women tend to work in higher level occupations in companies in general, but not in STEM areas, which are still dominated by men. As in other studies concerning the Brazilian economy, the earnings and distribution of average wages in the solar sector show that women earn less than men (Table 6). The gross differentials are the simple percentage difference between men and women, based on women's wages. Theses differentials start in the range of 23-24% and end in the range of 10-12%. It should be noted that men's wages remain relatively unchanged throughout the period, while women's wages grow a little, which helps to explain the reduction in the differential.





Source: Elaborated from Rais database

The conditional differentials come from an econometric model that is estimated year by year where the logarithm for wages is regressed as a function of educational attainment, age, age squared, length of employment, and gender. The coefficient of the gender variable is of particular interest because it will show the difference in wages between men and women if both individuals have the same educational level and the same age.

Table 6 shows that the conditional differentials are larger than the unconditional ones. One possible explanation is that women are more educated than men in our sample; so, if men had the same education as women, the gross differential would be even larger.

Conditional differentials also fall throughout the years, starting the series at 34.9% - that is, a man with the same education and same age as a woman earned 34.9% more in 2012 - and closing at 28.2% in 2019, showing an overall average of 31%. Whether this is a consistent trend remains to be identified. However, it is noticeable that men tend to have higher salaries, despite the fact that women have higher educational levels.

It is important to point out that the salary averages disaggregated by gender, as presented in Table 6, are directly linked to the sample of companies used in the research and do not necessarily reflect the reality of the sector. According to the research on the workforce of the productive chain of the Brazilian solar energy sector,⁷⁸ based on the same sample of this study, only 8% of the companies analyzed were large companies with an average of about 400 employees and with an average salary above R\$ 6.000,00. The vast majority of the companies evaluated were small companies with about 12 employees who earned an average salary of R\$ 2.500,00 in 201.

Conclusions

Women are a minority in the solar sector in Brazil - 32% on a historical average, which is in line with international patterns. However, this share has been shrinking since 2016. Especially between 2016 and 2019, indicating the expansion of men's participation in the sector. The majority of the female workforce is slightly younger than the male workforce. Almost 60% of women were between the ages of 25 and 39 in 2019.

The female 32% participation hides some regional heterogeneity. Historically, the Southern region is the region that employs the most women (38.9%), followed by the Southeastern region (33.2%). The region that least employs women is the Midwestern region (16.1%).

Female workforces tend to have a higher education than that of its male counterparts in the Brazilian solar energy sector. The proportion of women with an undergraduate degree was 45.4% in 2019, compared to 30.7% of men. In turn, the proportions of completed high school education were 47.3% for women and 55.4% for men.

As for the rise to directory boards and management positions by women, as far as the sample of this study allows concluding, there seems to be a barrier towards women for the higher and fewer directorship positions in companies.

There is a negative bias toward women in STEM careers. Only 4.8% of women were pursuing such careers in 2019 (compared to 8.4% of men and 7.4% of the total). On the other hand, women tend to pursue other careers that require higher education, such as legal careers, applied social sciences, media, and others, to a significantly greater extent than men.

Men tend to earn an average 31% more than women, even when they have the same educational levels, age, and length of employment

Women are a minority in the solar sector in Brazil - 32% on a historical average, which is in line with international patterns.



Photo: Mesol Network

2.2 Profile and perception of women working in the Brazilian Solar Energy sector - Primary Data

This section presents primary data collected from 251 female professionals who work directly or indirectly in the solar energy sector who spontaneously responded to the online survey designed to identify the main barriers, interests and needs for their entrance and retention in the sector. Some questions allowed multiple answers, so the sum of some results exceeds 100%.

2.2.1 Profile description

AAbout half of the respondents present a young profile, as 50.6% of them are between the ages of 18 and 30, 27.5% are between the ages of 31 and 40, 16% are between the ages of 41 and 50, and the remaining 6% are over 51 years old (Figure 6). The younger age profile differs somewhat from the age profile identified in the characterization of the formalized solar sector as presented in SECTION 2.1. It is possible that the online survey reached younger respondents due to the fact that it was disseminated primarily on social media such as Instagram, Facebook, LinkedIn, WhatsApp and Mailing.



Figure 8: Age range of women in the solar energy sector.

Source: Online survey applied to women in the sector (2021).

However, beyond that, the high participation of young people in the industry may evidence that many women starting their careers are choosing to follow the career path towards to the renewable and solar energy industry.

Regarding the diversity of gender identification and skin color, only two (0.8%) of the 251 respondents considered themselves to be transgender women, i.e., they were not born female but identify themselves as a woman. The other 99.2% identify themselves as a cisgender, i.e., they were born female and identify themselves as a woman.

As for skin color, the vast majority of respondents (68.9%) self-declared themselves as white women, while 24.7% as brown. Only 4.8% self-declared as black women, 1.2% as yellow, and 0.4% as indigenous (Figure 7).

The high participation of young people in the industry may evidence that many women starting their careers are choosing to follow the career path towards to the renewable and solar energy industry



Figure 9: Self-declaration (classification according to IBGE) of women in the solar energy sector.

Source: Online survey applied to women in the sector (2021).

In relation to the state of residence, with 19.9% of respondents, São Paulo is the state with the most respondents followed by Santa Catarina, with 11.6% of the respondents, Rio Grande do Sul with 10.4%, and the Federal District, Paraná, and Rio de Janeiro with 8.8% each. None of the respondents resides in Acre, Roraima, Tocantins, Maranhão, or Sergipe (Figure 8).

Observing this numbers by region (Figure 9), it can be noticed that the great majority of the respondents are located in the Southeast and South regions of the country, accounting for 38% and 31% respectively; 16% of them are in the Midwest, 10% in the Northeast, and 7% in the North. This regional distribution of female participation may be a reflection of the regional growth of the solar PV energy sector in distributed generation in Brazil - which has outgrown centralized generation since 2020. The Southeast and South regions have installed the most distributed solar PV energy in the country cumulatively from 2012 to 2021, adding 37% and 23%, respectively, to the total installed capacity in the country. Next come the Northeast (19%), Midwest (17%) and North (5%). These numbers may also explain why female participation in the sector in the North is lower than in other regions.



Figure 10: States of the country where women in the solar sector live.

Source: Questionnaire applied to women in the sector (2021).



Figure 11: Regions where women in the solar sector live.

Source: Online survey applied to women in the sector (2021).

As for the sector in which these women work, the vast majority of them work in the private sector (71.3%). Another 11.2% work in educational institutions and 5.2% in the third sector (such as associations, foundations, and NGOs). A few are active in the government (2.8%), in international organizations (2.8%), or in government run companies (2.4%). Only 2% said they were not active at the time they responded the survey and 2.4% of respondents selected the option 'Other' (Figure 10).



Figure 12: Regions of the country where women in the solar sector live.

Most of the respondents (43.4%) said they belonged to the formal labor market as employees with a signed contract. Another 27.5% said they were entrepreneurs, 10% said they had a research grant, 7.6% said they were interns, 4.8% said they were public employees, and another 4.8% said they were currently unemployed. Of the total, 7.2% of the respondents selected the option 'Other', having mentioned their employment relationships as legal entities, freelancers, consultants and service providers, for example (Figure 11).

Almost half of the survey respondents (47.8%) said they work in the technical area of the company/institution. Another 47.1% work in another area, such as Administrative, Academic/Teaching, Commercial, Communication/ Marketing, and Legal (Figure 12).

Source: Questionnaire applied to women in the sector (2021).

⁷⁶ The categories Commercial and Communication/Marketing were not presented as options in the original survey. However, they were areas of activity that were often cited in the 'Other' category and for this reason are presented here as independent categories.



Figure 13: Sectors in solar energy that women work. .

Source: Online survey applied to women in the sector (2021).

Figure 14: Areas of the companies/institutions that women in the solar industry are active in.



Source: Online survey applied to women in the sector (2021).

A large portion of the respondents (63.8%) are newcomers to the industry and said they have been in solar energy for up to 3 years. Another 21.5% have been active for 4 to 6 years and 9.6% have been active for 7 to 10 years. Only 5.2% of the respondents have been in the industry for more than 10 years (Figure 13). The fact that the vast majority of respondents started their career in the industry in the last six years coincides with the recent growth in the development of the solar PV energy sector, which has been growing exponentially in the country since the publication of REN 482 in 2012.

 77 The sum of the percentages exceeds 100%, since the question allowed more than one answer option to be chosen.



Figure 15: Time women have been working in the solar energy sector.

Source: Online survey applied to women in the sector (2021).

Indeed, 90% of the respondents said they were active in solar PV energy. Another portion (30.7%) said they work with energy efficiency associated with solar PV energy. Only 4.4% of the respondents work with solar thermal energy and 2.4% work with concentrated solar energy. Also, 6.4% of the respondents are active in other areas such as micro and mini grids, energy storage and electro mobility (Figure 14).



Figure 16: Area of activity of women in the solar energy sector.⁷⁸

Source: Online survey applied to women in the sector (2021).

The fact that the vast majority of respondents started their career in the industry in the last six years coincides with the recent growth in the development of the solar PV energy sector, which has been growing exponentially in the country since the publication of REN 482 in 2012.



Photo: Mesol Network

⁷⁸ The sum of the percentages exceeds 100%, since the question allowed more than one answer option to be chosen.

2.2.2 Education

A total 42% of the respondents said they had completed their higher education, 27.1% had some kind of specialization, 15.9% had a master's degree, and 4.8% had a doctorate, as presented in Figure 15. Four percent of them said they had completed high school and 3.2% had attended a technical high school. Only 2.4% have a post-doctorate and none stated that they had no formal education or elementary schooling.

Almost half of the women (42.6%) have at least an undergraduate degree and 50.2% have some kind of specialization or post-graduation (master's, doctorate or post-doctorate). This high representation of high education may justify the majority of white women in the sector.



Figure 17: Education level of women in the solar energy sector.

Source: Online survey applied to women in the sector (2021).

Nearly 60% (59.4%) of the participants with a higher education have degrees in Architecture, Engineering and related fields. The Social Sciences and Humanities category was the second most chosen by respondents, but well below the first, adding up to 18.7% of the participants. The remaining 16.8% of the respondents have degrees in areas such as Mathematics/Statistics and related areas, Chemistry/Physics and related areas, Computer/ Communication Sciences and related areas, Legal Sciences, Biological Sciences/Health and related areas, Communication and related areas (Figure 16).



Figure 18: Educational background of women in the solar energy sector.

Source: Online survey applied to women in the sector (2021).

2.2.3 Representation and participation in decisionmaking and leadership spaces

DAmong the female respondents, 49% hold leadership positions in companies and other institutions in the sec-

tor (Figure 17). Out of the majority of this percentages, 23.5%, are managers, department or sector heads, coordinators or supervisors; 20.3% are in higher positions, in the executive positions of the organizations; and 5.2% occupy other leadership positions.



Figure 19:Percentage of women in leadership positions in companies/institutions in the solar energy sector.

Source: Online survey applied to women in the sector (2021).

When the employment relationship of women in leadership positions is analyzed, it shows that the majority of directors are owners of their own company (84.3%), and a smaller number are employees (11.8%), unlike what happens among department heads, managers, and other intermediate hierarchical positions (Figure 18).





Source: Online survey applied to women in the sector (2021).

These data seem to reaffirm what was pointed out by the information collected from Rais, which indicate a possible barrier for women to access the highest executive positions in corporations, since there are few female directors as employees of companies and other organizations. The information regarding motherhood, among those who occupy leadership positions in the sector, can also help in this understanding. Among the female directors, the majority (56.9%) are mothers, while this percentage is 42.4% among managers and other leaders, including those who are pregnant (Figure 19). Since, as presented in section 1.2, half of the women leave or lose their jobs within one year of starting their maternity leave in Brazil, there may be a relationship between motherhood and the significant amount of female directors who undertake entrepreneurship by opening their own business.





The interest in taking on leadership positions, however, is present in 76.6% of the women who do not currently hold such positions, while another 16.4% cannot say if they would like to occupy such positions and only 7% state that they do not wish to do so (Figure 20).





These data show that, despite the low representation of women in leadership positions being one of the barriers to both their incoming and remaining in the sector, as will be seen in section 2.2.7, there is an interest of most of the women who are not in leadership positions to go on to reach them.

Source: Online survey applied to women in the sector (2021).

Source: Online survey applied to women in the sector (2021).

2.2.4 Health and Safety: Parenthood

Motherhood is a reality for 36.7% of the women in the sector who answered the questionnaire. In addition, 1.2% of respondents are pregnant (Figure 21). The survey reached a younger audience, moreover, there is a trend towards an increasing age of women becoming mothers in Brazil, as disclosed in section 1.2, and this may have influenced this result.





Among the mothers, most (46.7%) are between the ages of 36 and 45, while 21.7% are as old as 35 years old, and 31.5% are 46 or older (Figure 22). Of those who are pregnant, two are between the ages of 26 and 30 and one is between the ages of 36 and 40 years old.





The great majority of the mothers respondents, 86% have up to two children: 43% have one child and the same proportion (43%), two children. Also, 7% have three children, 4% have four or more children, and 2% did not answer this question. When their kids age range is analyzed, it is observed that the minority is up to two years old, a significant number of 3 to 7 year-olds (32.6%) and more than 18 year-olds (30.43%) (Figure 23).

Source: Online survey applied to women in the sector (2021).

Source: Online survey applied to women in the sector (2021).



Figure 25: Age range of the children of women in the solar energy sector.

Source: Online survey applied to women in the sector (2021).

When asked if they have faced or are facing any professional barriers due to being a mother or becoming a mother, most of the respondents said yes: 56.5% of those who are already mothers and all those who are pregnant (Figure 24).





Source: Online survey applied to women in the sector (2021).

2.2.5 Health and Safety: Gender Violence

Gender-based violence is a strong means of perpetuating inequality in Brazil, as discussed in section 1.2. The data collected in the survey indicates that in the solar energy sector the violence factor also represents something to overcome. Most women (57%) said they have already suffered some type of violence as professionals of the sector in the different spaces in which they work - companies, institutions, universities, events, meetings - with emphasis on psychological violence,²⁹ which represents 47.4% of the total of situations experienced by the respondents (Figure 25). Another 15.5% experienced situations of moral violence, 10% sexual violence, 1.6% physical violence, and 0.8% other types of violence. There is also a number of women, 8%, who could not identify if they had already experienced some situation of violence in the workplace.

Most women (57%) said they have already suffered some type of violence as professionals of the sector in the different spaces in which they work, and 71.7% have already been discriminated.

⁷⁹ Psychological violence: any conduct that causes emotional damage and diminished self-esteem or that harms and disturbs their full development: threat, embarrassment, humiliation, insult, etc. Moral violence: any conduct that constitutes slander, defamation or insult. Sexual violence: any conduct of a sexual nature without consent, through intimidation, threat, coercion, blackmail, bribery, manipulation or the use of force: from any type of touch that causes discomfort, such as kissing, hugging, caressing, to rape. Physical violence: any conduct that offends its integrity or bodily health. Source: BRASIL (2006); BRASIL (2011). Note: these definitions were included with the response options to the question about gender violence.

Figure 27: Percentage and type of violence that women of the sector have already faced in their different working environments (company, institution, university, events, meetings, etc). **



Source: Online survey applied to women in the sector (2021).

Furthermore, when looking specifically at discrimination in the professional work environment,^{at} 71.7% have experienced discrimination and only 21.5% claim never having experienced it (Figure 26). Among the reasons for discrimination, "because I am a woman" stands out, with 64.1% of affirmative answers, and 7.2% "because I am a mother," highlighting the existence of gender-based discrimination in the sector. Age discrimination (30.3%), economic origin (10.4%), and regional origin (8%) were also frequent among the respondents. Likewise, discrimination due to clothing style, sexual orientation, skin color, religion or spirituality, in addition to others, were also reported, but to a lesser degree.



Figure 28: Type of discriminations faced by women. **

⁸⁰ The sum of the percentages exceeds 100%, since the question allowed more than one answer option to be chosen.

^{an} Any distinction, exclusion or preference that has the effect of destroying or altering equality of opportunity or treatment in matters of employment or occupation. Source: BRASIL (2019).

Source: Online survey applied to women in the sector (2021).

⁸² The sum of the percentages exceeds 100%, since the question allowed more than one answer option to be chosen.

Among those who have experienced discrimination, harassment, or other forms of violence, the majority (65.8%) perceived it, but did not feel safe enough to report it or to make a formal complaint, as shown in Figure 27. Only a minority (9.6%) reported feeling safe to do so. The statement of one of the respondents indicates that impunity and the normalization of violence may be one of the reasons for the feelings of insecurity towards reporting it: "I complained, and nothing happened. I don't report anymore, they told us that 'this is what men are like'."

There are also cases where women were unable to identify the situations of violence they went through at the time they occurred, as well as those who stated that they dealt with the situation in other ways, such as those who took a stand and argued directly with the aggressor.



Figure 29: When a woman suffers violence, does she feel safe to report it?"

Despite gender violence being a very present reality in the Brazilian labor market and in the industry, a significant amount (41%) of the respondents' workplaces do not have policies or actions to fight that violence (Image 28). Furthermore, 22.7% of the respondents do not know if there are any actions towards that issue within the organizations they are linked to. Among the most frequently mentioned actions to fight gender violence in the organizations in the sector is the existence of a Code of Conduct (19.9%), a hotline (16.7%), and projects and/ or other actions to fight harassment in the workplace (11.6%).



Figure 30: In the company/institution where the women work, is there any policy or action to combat gender violence? ⁸⁴

Source: Online survey applied to women in the sector (2021).

⁸³ The sum of the percentages exceeds 100%, since the question allowed more than one answer option to be chosen. ⁸⁴ The sum of the percentages exceeds 100%, since the question allowed more than one answer option to be chosen.

Source: Online survey applied to women in the sector (2021).

2.2.6 Perception about the professional environment

The survey assessed the existence of policies and actions aimed at gender equity in companies and institutions in the sector. According to the respondents, one out of three organizations has no action in favor of gender equality (31.1%).

Of those that mentioned there was some action or policy, the most cited were actions towards balancing work and family life, with flexible working hours, the possibility of working from home, among other practices in only one out of three institutions (35.9%); followed by actions that develop measures for equal access to leadership positions and/or equal participation of men and women in decision-making spaces, in one out of four institutions (23.1%) (Figure 29). Only one in ten institutions have actions or policies to raise the staff's awareness on gender equality (13.2%) and or to promote gender, diversity and/or race equity (12.4%). For 14.3% of respondents the question was not applicable, as in the case of those who are self-employed.

One out of three organizations has no action in favor of gender equality (31.1%)

Figure 31: In the company/institution in the solar energy sector that women work, there are:[∞]



Source: Online survey applied to women in the sector (2021).

In addition, the respondents were asked to indicate, on a scale from zero to one hundred, the degree of importance of some actions promoting gender equity for the improvement of their professional environment (Figure 30). The most important were the promotion of equal participation of women in leadership positions and/or in decision-making spaces in the professional environment (94 points); followed by policies or actions to fight gender violence (91 points); flexible working hours, as well as the possibility of working from home for mothers, fathers, and caregivers of other family members (90 points); support for mothers to continue breastfeeding after the end of maternity leave and training or internal awareness actions for the teams about gender equality (both with 89 points); and, finally, the extension of the maternity leave (74 points).

The most important were the promotion of equal participation of women in leadership positions and/ or in decision-making spaces in the professional environment.

⁸⁵ The sum of the percentages exceeds 100%, since the question allowed more than one answer option to be chosen.

Figure 32: How important do women in the solar energy sector consider it to have the listed items in their professional environment (0, not important at all, and 100, very important).



Source: Online survey applied to women in the sector (2021).

With the exception of the extension of paternity leave, all the other items were rated quite highly. This result, however, is not indicative for the non-implementation of such a measure, but rather of the importance of making professionals in the sector aware of the shared benefits that could be gained from an extended paternity leave, such as the reduction of the burden on women in the care of children, the strengthening of the bond between fathers and children, and a more balanced division of domestic chores, among others.

2.2.7 Economic Opportunities

When asked about possible barriers or challenges to getting into the solar energy sector, and thus taking advantage of the opportunities offered by this growing sector, only 6.4% of the women said there were no barriers or challenges and 0.8% could not give an opinion (Figure 31). ∞ The others (92.8%) indicated a number of factors, highlighting male chauvinism and prejudice, * explicitly mentioned, as well as the lack of credibility in the quality of work developed by women, ** especially when it comes to the STEM areas, which together represent 39.1% of the responses. This demonstrates the influence of gender norm in shaping the notion of what are desirable jobs for men and women, resulting in major inequalities for the incoming of girls and women in careers related to the development of the sector. Responses that exemplify such barriers were:

"It is an extremely hostile area for women, there is a very explicit gender inequality. Entering a company or academia requires standing up for yourself every second and that becomes exhausting making one wanting to leave for other areas that better shelter a woman's position."

"We still face prejudice! More than once, I have arrived at the client to present the solution and I have heard that women don't add anything technically, that they only discuss technical issues with men."

¹⁰ Male charvinism is a prejudice, expressed by opinions and attitudes, which opposes the equality of rights between genders, favoring the male gender over the female. A sexist person is one who believes that men and women have distinct roles in society, that a woman cannot or should not behave and have the

same rights as a man, or who judges women as inferior to men in physical, intellectual and/or social aspects. Source: POLITIZE (2019). ⁸⁸ Despite understanding that several barriers can be attributed to sexist thoughts and attitudes, such as the lack of credibility in women's work, few opportunities to enter the sector, low number of women leaders in the sector, the difficulty in reconciling family and professional life, the unequal remuneration, e different categories of analysis created aiming for a deeper analysis. In the category "male chauvinism / prejudice" were inserted especially the answers that brought such words explicitly in their content, without details that would allow further specification of the barrier found.

⁸⁶ This corresponds to 5.2% of the answers, since the same participant could indicate more than one barrier/challenge per answer.

It is important to emphasize that both this question and the other questions analyzed in this section were derived from open-ended questions posed to professionals in the industry. Therefore, the barriers and challenges listed emerged from the answers themselves, identified based on the themes were the most recurrent.

Male chauvinism / prejudice 20%	n / Few opportunities to enter the sector 10% 9.1%		Few opportunities to enter the sector 10%		ficient vledge / mation / ing		
Lack of credibility / recognition / respect							
19.1%	Nc 4.8	one %		Lack of to ente sector 4.2%	incentive r the		
Predominantly male sector	Haras gend discri 2.4	ssment / er violence / imination %	Low repre of wo leade	sentation omen as rs	Self-confidence and/or self- determination		
15.5%	Oth 2.7%	er %	2.7% Conci and p 2.7%		2.7% Conciliate matern and professional 2.7%		2.7% nity / personal life

Figure 33: Women's main barriers/challenges to entering the solar energy sector in the country.

Unequal / low pay0.9%Sector in development / yet unknown in the country0.9%Limited resources / funding0.9%Limitations to travel / go to the field0.6%I cannot say0.6%

Source: Online survey applied to women in the sector (2021).

Male predominance in the sector was also mentioned in a significant amount of responses (15.5%) and used as justification for other barriers, especially those related to prejudice, credibility, and work recognition:

"The entire engineering sector is much more male than female. Within solar, direct contact with electricians is challenging. Holding a management position, making myself heard and respected is not an easy job. Besides the work group, because we often deal with contracts with significant amounts, when presenting a proposal to the client we can only pass on credibility and reliability when accompanied by a male colleague."

Insufficient professional training is perceived as a barrier by 9.1% of women. Even though their level of education is higher than that of men, according to RAIS data (section 2.1), which may indicate that women feel more insecure than that they are, in fact, insufficiently trained. Moreover, not receiving incentives for entry, not only in the industry, but before that, incentives to take courses in the STEM area, may help explain the inequalities in this field of work:

"There is still a considerable difference between men and women who opt for STEM courses, which are the gateway to this market. It is necessary not only to encourage young women to enter university, but also provide support for them to remain and finish these courses."

The low representation of female leaders in the sector, the balancing of personal and family life - especially regarding the care of sons and daughters -, factors related to self-confidence and personal determination were also mentioned, with each representing 2.7% of the answers. In addition, in 2.4% of the answers, situations of gender violence were mentioned as barriers to entry in the sector, often even before reaching the labor market:

"[...] Women suffer discrimination and harassment from professors at the University. To graduate is already a victory and brings scars. After graduating, the woman needs to learn how to heal these scars at the same time as she needs to constantly prove herself. [...]"

The need for further development of the industry, lack of resources for research, for training, as well as for entrepreneurship and salary inequality, as well as the fact that some salaries are low, were also mentioned as barriers, although less mentioned.

Among the "others" category, there were quite varied answers, ranging from the economic and political situation in Brazil to those who consider the barriers and challenges to be the same as those found in other areas of engineering.

To find out if there is a change in the barriers and challenges to remaining in the sector, this question was posed to the survey respondents. To the exception of the category "lack of flexible schedules", the others categories were very similar to those listed in the question about entering the sector, with a change in the order of importance. The lack of credibility and recognition, along with sexism and prejudice, continue to be the most mentioned barriers, with 39.6% of the answers (Figure 32). Such factors also influence the lack of opportunities for growth and career advancement, which ranked third as a barrier, mentioned by 11.3% of the women, as exemplified by this professional:

"Standing up for ourselves every day and showing that we are as capable and competent as any man in the area makes us want to give up, because it is unfair that we have to do this every day. To reach leadership positions is even more complicated, respect and salary inequality are very present." Figure 34: Main barriers/challenges for women to remain in the solar energy sector in the country.

Lack of credibility / recognition / respect 23.9%	Predominantly male sector 6.9%		Ack of credibility / cognition / respect 8.9% Predominantly male sector 6.9% 5.3%			/
Male chauvinism / prejudice	Reconcile maternity / personal and professional life 5.3%		Insufficient knowledge / information / training 5.3%		: / n /	
16%	Lack of incentive to continue in the career 4.1%	Self-confidence and/or	3.1%	None 3.8% %! E		
Few career advancement opportunities	Other 2.5%	tion of ers Limited re funding		/ in	Harassment/ gender violence/ discrimination 1.9%	
11.3%	Low representation of women as leaders 2.5%			2.8% Limited resources / ^{funding} 1.3%		
Inflexibility of schedules 0.90%						

Source: Online survey applied to women in the sector (2021).

I cannot say

The need for professional training seems to interfere more in entering the market than in remaining in it, since fewer women mentioned it as a barrier (5.3%). As to the inequality of salaries and the need to balance their personal and professional lives, also with 5.3% of the answers each, the opposite is true, with greater impacts of these for the retention of women in the sector, as exemplified below:

0.90%

"The 'maternity issue' is perhaps the biggest barrier for women to remain in the solar energy sector in the country, but not only in this sector."

"Women are on double duty (work and family). We need to establish a link with the solar market through entities that fight for the sector in defense of women."

Among the other factors, the fact that the sector is not fully developed in the country stands out, which seems to influence more the retention than the entrance of women in solar energy, totaling 2.8% of the answers. It is also noteworthy that only 4.8% of the women stated that there were no barriers for them to remain in the sector, and 1.2% could not give an opinion.

In addition to the barriers and challenges, the respondents were asked about what they want or need to develop professionally in the sector. The answers point to demands for more professional training (38.1% of the answers), aimed at improving the technical and managerial capacity of companies, and the development of leadership and entrepreneurial skills (Figure 33).

Information and professional training 38.1%	nd aining	
	Incentive to insertion and permanence in the sector 5.1%	Network of relationships and cooperation 4.8%
Equal opportunities 18.6%	Gender sensitive work environment and dynamics 3.5%	Greater leadership and participation in decision-making spaces 3.8%
	Financial resources 3.8%	Other 1% Social and environmental impact projects 1%

Figure 35: Women's demands and needs for professional development in the solar energy sector in the country.

More self-confidence / determination0.6%I cannot say0.3%

Source: Online survey applied to women in the sector (2021).

Greater equality in opportunities is a wish for a significant number of women (18.6% of the answers), which presupposes a greater opening of the market to hire women. Equal possibilities for career progression, as well as pay that is fair and equivalent to that of men were aspects that were also mentioned in the answers. Such measures depend, especially, on giving credibility to the work of women in the sector, the third most frequently mentioned demand (9.6% of the answers).

The interest in strengthening networking and cooperation among professionals in the sector (4.8% of the answers), as well as the involvement in projects that have a socio-environmental impact (1%), appear as an unprecedented contribution of this question to the study, being exemplified by the answers that follow:

"A STRONG SUPPORT NETWORK"

"DISCUSSION GROUPS, STUDIES AND COLLABORATION."

"I WANT TO DEVELOP A PROJECT IN THE AMAZON RAINFOREST, BIG DREAM! BRINGING LIGHT TO INDIGENOUS PEOPLE."

"PROFESSIONALIZE GIRLS. MAYBE IN VILLAGES AND SLUMS."

In addition, a response classified as "other", and that deserves to be highlighted, attends to "that the spaces that are being conquered have the participation of the traditional male audience, so that we don't keep talking only among ourselves," indicating the need to attract men from the sector to the networks, trainings and other spaces and actions aimed at debating and promoting gender equality in solar energy.



Photo: Mesol Network

Conclusions

The **profile** of the respondents in the survey is largely young, with 50.6% of them in the 18 to 30 years old bracket. The great majority (68.9%) declared themselves as white, and 38% of them live in the Southeast region and another 31% in the South region of the country. The only states not reached by the survey were Acre, Roraima, Tocantins, Maranhão, and Sergipe. As for the sector in which the respondents work, the great majority of them work in the private sector (71.3%) and say they are in the formal labor market as employees with a signed contract (43.2%).

Almost half of the respondents (47.8%) said they work in the technical area of the company/institution they are part of, and most of them (59.4%) have degrees in Engineering, Architecture and related areas.

The solar PV sector was the most prominent, since a large portion of the respondents work with solar photovoltaic energy. Only 4.4% of the respondents said they work with solar thermal energy and 2.4% with concentrated solar energy.

Regarding **education**, almost half of the women (42.6%) have at least an undergraduate degree and 50.2% have some kind of specialization or post-grad studies (masters, doctorate or post-doctorate). This high representation of higher education may justify the large participation of white female respondents.

Almost half of the survey participants hold **leadership** positions, 49%. However, among those who occupy executive positions (20.3%) the vast majority (84.3%) are owners of their own company, and a smaller number are formal employees (11.8%). Such data is in line with the information collected from Rais: the possible existence of a barrier for women to access executive positions, since there are few female directors as employees of companies other than those they own. Motherhood may have driven part of these women to become "entrepreneurs by necessity", since 56.9% of the directors are mothers and it is significant the number of women who leave or lose their jobs in Brazil when they become mothers.

Motherhood is a reality for 36.7% of the survey participants, a result that may have been influenced by the fact that the survey reached a younger audience and by the tendency for an increasing motherhood age among women in Brazil. Most of the mothers in the sector are between the ages of 36 and 45 (46.7%) and have up to two children (86%). The number of children aged 3 to 7 years old is significant (32.6%) and over 18 years old (30.4%). Still, more than half of the mothers state that they have faced professional barriers for being a mother or for becoming a mother. **Gender violence** is a challenge to be overcome also in the solar energy sector: 57% of the respondents have already suffered some kind of violence as a professional in the sector, especially psychological violence, which represents 47.4% of all situations. In addition, 71.7% have been discriminated against in their professional environment, with evidence of discrimination based on gender. Most of those who have experienced discrimination, harassment or other forms of violence noticed them, 65.8%, but did not feel safe enough to report it or to make a formal complaint. Despite this context, 41% of the organizations in the sector do not have policies or actions aimed at fighting gender violence.

One out of three organizations in the sector has no action **in favor of gender equality** (31.1%), according to the participants. Among the actions developed, the ones that help balance work and family life stand out, existing in one out of three institutions in the sector (35.9%) and measures for equal access to leadership positions and/or equal participation of men and women in decision-making spaces, in one out of four institutions (23.1%). Only one in ten institutions has actions or policies to raise the staff's awareness on gender equality (13.2%) and/or to promote gender equity, diversity and/or race equity (12.4%).

92.8% of the women state that they face **barriers and/or challenges** to get into the sector, and 94% to remain there. The biggest barriers are male chauvinism and prejudice, explicitly mentioned, as well as the lack of credibility in the quality of the work developed by women, especially when it comes to STEM areas, as the main barriers mentioned. This shows the influence of gender norm in the shaping of the notion of what are desirable jobs for men and women, resulting in major inequalities.

More professional training, more equal opportunities, and credibility about their work is what women **most want or need to develop professionally in solar energy.** They also pay attention to the need to involve the male audience in training courses and other spaces and actions aimed at discussing and promoting gender equality in the sector.

3 RECOMMENDATIONS FOR MEASURES TO PROMOTE GENDER EQUALITY IN THE SECTOR

The smaller and disproportionate participation of women, as well as the discrimination and different inequalities faced by them demand efforts to support the incoming, retention, and continuous development of women, and consequently, of the solar energy sector in Brazil.

To that end, based on the results of this study, recommendations were made for the promotion of gender equality, the strengthening of female participation, and the consequent development of the sector as a whole.

The following table presents existing barriers, strategies to address them, and some of their possible positive impacts.

Recommendations for promoting gender equality in the solar energy sector in Brazil					
Summary of findings on barriers and interests of female professionals for entering and remaining in the solar energy industry		Strategies and actions	Main impacts		
	Poor access to information and opportunities in the sector. Interest in strengthening networking and cooperation among women in the sector.	Create an online platform to connect women who work in the sector and disseminate mentoring programs, events, exchanges, notices, scholarships and projects that contribute to the participation of women in the sector in different Brazilian regions.	Identifying, recognizing and connecting women to each other and to other professionals in the sector will provide networking and more access to opportunities in the solar energy sector.		
ırmation	High demand for professional training in the areas of business management, leadership, entrepreneurship and technical skills.	Prouide specific training for women, especially taught by other women, from short to long-term courses through online platforms and/or in person.	Training of women by other women increases the degree of learning. Increasing professional qualifications will favor the development of the sector.		
access to info	Poor diversity of gender and race/color identities in the sector.	Develop and/or support training programs for the incoming and development of black women, transgender and other minorities in the sector.	The incentive to the incoming of black women, transgender and other minorities will contribute to social inclusion and diversification of the sector.		
ation, training, c	Poor male participation in actions to raise awareness about gender issues.	Encourage the participation of male audiences in training courses and other actions aimed at discussing and promoting gender equality in the sector. Raise male public awareness to issues related to their gender, such as healthy masculinity.	Male participation in gender- related actions can raise their awareness and make them allies in the strengthening of women's activities in the sector, as well as reducing male chauvinism and prejudice.		
Educati	Lack of data and information disaggregated by gender, gender identity, race/color, age, regionality, etc.	Raise awareness and guide the entire sector towards having the data and information they collect to be always disaggregated by gender, race/color, etc. Carry out other research on gender inequalities also with professional men of the sector, aiming at identifying their perceptions and comparing them with the point of view of women. Know the specificities of participation and gender issues in each region of the country, based on geographically directed research, and disseminate these results in a physical and/or digital booklet prepared jointly by women representatives from each region.	Collecting data and information disaggregated by gender will contribute to the understanding of how the sector is configured. This will identify the potentials and challenges to be overcome to make it a more fair, respectful, and equal environment for all people.		

Summary of findings on barriers and interests of female professionals for entering and remaining in the solar energy industry		Strategies and actions	Main impacts
Economic opportunities	Male chauvinism and pre- judice due to the stereotype and implicit bias regarding what are considered to be male and female careers. Lack of credibility and recog- nition of the quality of work of female professionals in the solar energy sector.	Encourage organizations in the sector to join gender equity programs, such as UN Women's Empowerment Platform of Principles (WEPs). Hold events to discuss and raise awareness about the issue and widely disseminate the results of this study in the public and private sectors of the industry.	Eliminating the bias and stereotype that the sector is "male" will reduce the male chauvinism and prejudice that hinder the development of professional women. Increasing the visibility, recog- nition, and credibility of women professionals who work in solar energy will favor the development of the sector itself. Promoting debate on the subject and presenting the results of rese- arch like this can raise awareness, form partnerships, and join efforts to advance the reduction of bar- riers against women.
	Poor participation of women in technical careers, such as STEM careers.	Carry out and/or support actions, events and annual cam- paigns regarding female participation and awareness about gender equality in primary, secondary and higher education, as well as in public and private institutions in the sector. Develop awareness-raising materials such as booklets, videos, podcasts, games, pages on social media, etc., according to each audience and objective.	Marketing the sector as a space to be occupied also by women will contribute to the elimination of stereotypes, attracting more girls to STEM careers.
	Poor female participation in areas of the sector that require primary and secon- dary education.	Identify in the productive chain in which areas women with less education can and would be interested in working, aiming to train and/or attract these professionals.	The participation of women in dif- ferent areas will make solar energy more inclusive and diverse.
	Women's salaries are lower than men's, even with equal characteristics, such as educational level and experience.	Carry out surveys to identify the reasons for salary inequality between men and women aiming at developing mechanisms to eliminate it, such as career plans with equal salaries and opportunities.	Equalizing salaries will make the sector fairer and more attractive to women.
Participation, representation, leadership	Poor female participation in leadership positions and/or decision-making spaces in solar energy. Female interest in occupying leadership positions and spaces.	Investigate the reasons and discuss the issue of gender unbalance in the occupation of leadership positions and/or in decision-making spaces in the different professional environ- ments in the sector. Carry out campaigns to deconstruct gender stereotypes. Develop and/or support specific programs, such as trainee and mentoring programs for women to rise to management and executive positions and develop leadership.	Achieving equal representation of women in management, executi- ve and leadership positions will enable important issues for women professionals to be debated and addressed, promoting the transfor- mation of the solar sector.

Summary of findings on barriers and interests of female professionals for entering and remaining in the solar energy industry		Strategies and actions	Main impacts
Health, well-being, and fighting against violence	Gender-based violence, such as psychological violence, discrimination, and sexual harassment, is a major bar- rier against women in the solar energy sector as well. There are few actions and projects to fight gender-ba- sed violence and promote gender, diversity, and/or race equity in public and private institutions in the sector.	Offer information and advice to women, as well as to public and private institutions to confront gender violence. Encourage institutions to create policies to fight against violence, reporting channels, groups, and other means of support. Carry out awareness campaigns, with the production of informative short videos about types of gender violence to be widely disseminated on social media, aimed at all genders.	Raising awareness about different types of gender-based violence and providing safety for women will make the solar energy industry a more equitable and fairer environ- ment.
Health and well-being: parenting	It is more difficult for women than for men to balance personal and family life, especially when it comes to childcare, since most of the responsibilities for the home and relatives fall on women. Being or becoming a mother means a barrier against women in the sector. The actions and projects that favor parenthood in the sector's institutions are insufficient.	Offer equal conditions to women workers during pregnancy, breastfeeding, maternity, and when they need to take care of family members. Examples are flexible working hours; possibi- lity of working from home; caregivers and child recreation in events and fairs in order to allow the participation of women with small children. Equalizing maternity and paternity leaves. To not consider the maternity leave a time for mothers when accounting for productivity indicators in public competitions, participation in invitations to bid or temporal curricular evaluation for companies. In the selection tools where the title time is considered as a criterion for submission, add an extra year for each maternity or paternity leave.	Making it possible to balance women's personal and professional lives will favor the retention and development of professionals, with a consequent increase in their well- -being and that of their children.

4 FINAL CONSIDERATIONS

The development and growth of solar energy in Brazil has benefited not only the environment, but also the economy, with the inclusion of new jobs. However, the data collected in this study demonstrated that men and women have been unequally appropriating these opportunities.

The analysis of information from 1,268 companies in the Brazilian solar sector, collected via Rais, allowed the drafting of a profile description of formalized female participation, especially in the private sector, and revealed that women are a minority, with 32% in the historical average. This participation has been decreasing since 2016, reaching 28% in 2019, evidencing that the boost in hiring in the sector in this period had a male bias. It was also possible to observe that gender inequality is especially evident in STEM careers.

Pay gaps are a reality in the solar energy sector as well, with men earning on average 31% more than women over the period 2012 to 2019, even in situations of equal educational level, age, and length of employment. In addition, there seems to be a barrier for women to reach higher positions, such as those in executive positions in organizations, making it difficult for important issues for professionals in the sector to be discussed and addressed, which contributes to the reproduction of inequalities.

The online survey applied to female workers in the Brazilian solar energy sector, on the other hand, was responded by 251 women and made it possible to understand in a deeper way the barriers to their participation and representation, as well as their interests and needs for the transformation of the solar energy sector into a more egalitarian and attractive environment for them.

Almost all of them (more than 92%) indicated the existence of barriers and challenges to enter and remain in the sector, which indicates the need and urgency of actions to change this scenario. The biggest barriers mentioned are linked to structural male chauvinism and its consequences, such as a lack of credibility in the quality of the work developed by them- especially when it comes to the technical area.

Data raised shows that gender violence and racial inequality are strong and widespread issues in Brazil, resulting in major barriers for women: 57% of the professionals in the sector who answered the questionnaire have already suffered some kind of violence, especially psychological violence (47.4%). In addition, 71.7% have already been discriminated against in their professional environment, especially for gender reasons. Moreover, although Brazil is composed mostly of black people (56.2%), only 29.5% of the women in the sector who answered the survey are black (black or brown). This result may be indicative of racial inequality in the sector, as well as of gaps in the research, by not accessing its diversity.

The recommendations inserted at the end of this study aim to promote the gender agenda within the organizations of the sector, in order to strengthen the participation of women. They were guided by the themes highlighted in the research and by the barriers and interests that emerged. For an effective change, however, it is necessary to extend the actions beyond the female audience, ensuring the participation of men in the sector in the spaces and actions aimed at promoting gender equality.

Gender analyses such as the one developed in this study are increasingly in demand. National and international funding institutions have started to demand gender studies to subsidize their decisions regarding the viability of investment in certain projects, which demonstrates a global effort in relation to the theme.

Thus, by proposing to analyze structural gender inequalities in depth, the solar energy sector shows it is at the forefront of the issue and has the potential to inspire changes throughout the Brazilian energy sector. To be able to follow the evolutions in this theme, however, it is necessary that class entities, research institutions, and other organizations in the sector, especially in solar, start collecting gender disaggregated data in all their registers, surveys, and research. Without data, there is no visibility, and without visibility it becomes difficult to establish priorities for action.

The diversification of the Brazilian energy matrix needs to go hand in hand with the expansion of gender and race diversity in order for the sector- not only in solar energy but also in renewable energy - to take advantage of its full potential for growth and innovation.

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Execution:



Partner In Energy Transition



Institucional support:





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