IRENA
International Renewable Energy Agency

# SOLAR PV
# A GENDER PERSPECTIVE

IRENA
International Renewable Energy Agency

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## ABOUT IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future and serves as the principal platform for international co-operation, a centre of excellence, and a repository of knowledge on policy, technology, resources and financing related to renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.

**www.irena.org**

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## DISCLAIMER

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# About the Gender Perspective Series

The Gender Perspective series is an integral part of IRENA's extensive research work on the effects of renewable energy deployment during energy transitions. The initial focus on employment creation and skills was expanded over time to cover other socio-economic elements such as gross domestic product, broader measures of welfare, local economic value creation, improved livelihoods and gender-differentiated impacts.

IRENA has explored opportunities to improve the gender balance in the global energy transformation, first by deploying a gender lens in most of the agency's publications dealing with the socio-economics of the energy transition, and second by researching ways to maximise the socio-economic dividends of gender mainstreaming in stand-alone reports. Some of the highlights of the latter category of work are mentioned below.

- In 2017, IRENA, Bloomberg New Energy Finance and the Clean Energy Business Council published a joint brief that reported the results of a regional survey of the Middle East and North Africa region.
- In 2019, the first global report dedicated to gender in renewable energy was published. *Renewable Energy: A Gender Perspective* examined the question of gender equity across various renewable energy technologies. It was one of the most extensive surveys conducted on gender in renewable energy to date. Building on a ground-breaking survey of employees, companies and institutions, the study found that much remained to be done to boost women's participation and allow their talents to be fully utilised. It revealed that 32% of the renewable energy workforce were women and highlighted substantial opportunities for a better gender balance in the global energy transformation.
- In early 2020, a new publication focused on the wind energy sector. Based on a survey of around a thousand individuals and organisations, it tracked the presence of women in the wind energy value chain and examined gender-inclusive policies and perceptions of gender bias in the industry. A key finding was that the share of women in the wind industry's workforce (21%) remained substantially below the average for all renewables.

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The present report evaluates the role of women in the solar PV industry using the largest sample of global responses on solar PV energy and gender gathered to date. Based on our survey of some 1 300 individuals and organisations, it reports the share of women in the industry (40%), highlights the barriers and opportunities within the sector, and flags the similarities and differences between the solar PV workforce and the previously analysed sectors.

**Assessing gender equity in renewable energy**

**Analyses of local capacities**

**Studies of access context**

**Annual reviews of employment in renewables**

These and other reports can be downloaded from www.irena.org/Publications.

# KEY FINDINGS

- The solar photovoltaic (PV) sector is the largest employer within the renewable energy sector, accounting for some **4.3 million jobs in 2021 – one-third of all renewable energy jobs**.

- The solar PV sub-sector will remain the largest source of employment in an energy transition pathway consistent with the Paris Climate Agreement, accounting for almost **14 million jobs by 2030 – 37% of the total for the renewable energy sector**.

- The share of women working in full-time positions in the **solar PV industry is 40%**. This is almost double the share in the wind industry (21%) and the oil and gas sector (22%). The solar PV industry also compares well with the 32% share across the entire renewable energy landscape.

- Most women in solar PV are employed in **administrative jobs**, where they account for **58%** of the workforce. They are not as well represented in **technical positions not related to science, technology, engineering and mathematics** (STEM), where they hold only around **38%** of the jobs. Examples of such positions include lawyers or procurement experts. Their share in **STEM positions** is even lower: just **32% of the total**. Meanwhile, driven in part by off-grid solar PV deployments, women account for **35% of other non-technical positions** (*e.g.* marketing, sales, distribution, and product assembly and installation).

- Regarding leadership positions, women hold **30% of managerial jobs** and barely **13% of senior management posts** in the solar PV industry.

- Solar PV **manufacturing** does best in employing women, with a **47%** share. **Service providers** and **developers** follow with **39%** and **37%**, respectively. It is harder for women to find a job as a **solar PV installer**, an activity in which women account for barely **12%** of the total.

- Women face challenges to entry, retention and advancement in the solar PV workforce. The most prominent barriers are perceptions of gender roles, lack of fair and transparent policies, and cultural and social norms that shape behaviour.

- In the context of expanding access to energy women also face challenges, but **off-grid solar PV** offers plenty of opportunities, especially in consultation and planning, construction, and operation, as well as through the development of productive uses enabled by the availability of decentralised energy solutions.

- Measures to eliminate barriers are critical. Addressing the complex issues women face will require raising **gender awareness**; improving national policies and **removing restrictive laws**; establishing better **workplace practices, policies, and regulations**; and forming **networks** and systems to support **training** and **mentorship**.

- Improving women's representation in solar PV needs to be part of a broader objective: **diversifying the workforce as a whole** so it includes everyone's vision, talents and skills. This means not only women, but also all other minority groups.

# Introduction

Economic empowerment is a particularly effective means for women to gain more control over their own lives. Yet women are still frequently ignored, undervalued and unpaid, preventing them from fulfilling their full economic potential. Without their full engagement, inclusive growth is unattainable. Yet gender equality remains the greatest human rights challenge of all time (Ban, 2016), and the COVID-19 pandemic appears to have made matters worse.[1]

Gender equality is essential because it is an intrinsic human right and a core development objective.[2] It is also a critical *instrument* for development. It increases productivity and improves the welfare of families and children while exerting positive effects on GDP per capita. Furthermore, climate change and gender equality are inextricably linked. Strategies and programmes to address the effects of climate change must include the participation, experiences and voices of women, not only because they are disproportionately affected by climate change, but also because they have valuable points of view, experience and knowledge to contribute to building community and national resilience (Williams, 2021).

Energy sourced from renewables and efficiency in the use of that energy are the keys to decarbonising all end uses, massively cutting carbon emissions and helping to mitigate climate change (IRENA, 2022). The energy transition can boost economic development, create jobs and significantly improve welfare. In fact, the global renewable energy labour market is estimated to have grown to around 12.7 million jobs in 2021 and is estimated to nearly quadruple by 2050 if a holistic policy framework can be put in place (IRENA, 2021a; 2022; IRENA and ILO, 2022).

The solar photovoltaic (PV) sector is the largest employer within the renewable energy field, accounting for some 4.3 million jobs (IRENA and ILO, 2022). Large-scale solar facilities feed power to the grid, while small, off-grid solar applications offer much-needed access to electricity in remote and energy-poor communities (IRENA, 2021a). In IRENA's energy transition scenario, solar PV will remain the largest driver of job growth in renewable energy, becoming the source of 14 million jobs by 2030 along a pathway consistent with the Paris Climate Agreement (IRENA, 2021a; 2022). In other words, its job creation potential all along the value chain (from project planning to decommissioning) is immense.

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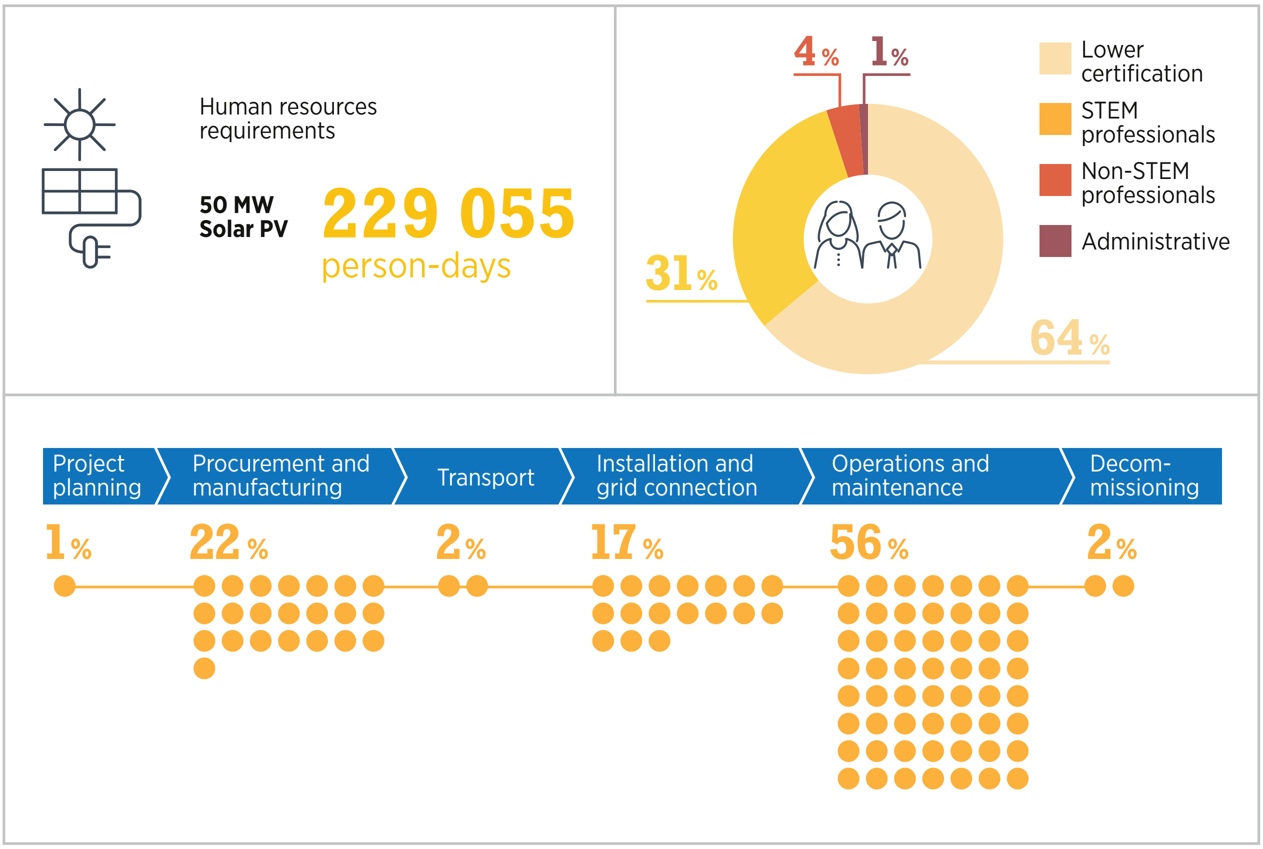
[1] *Women suffer disproportionately from economic shocks and restrictions such as those induced by COVID-19, in part because nearly 60% of women work in the informal economy. Additionally, women have played a disproportionate role in responding to the virus (frontline healthcare workers and providers of home care). Moreover, school closures have accentuated women's already disproportionate burden of childcare (United Nations, n.d.).*

[2] *Gender equality is the fifth of the Sustainable Development Goals established by the United Nations in 2015.*

For a typical 50 MW solar PV facility, about 230 000 person-days are required for project planning, manufacturing, construction, installation, and operations and maintenance. That works out to a year's work for 885 people for a single large-scale facility. Solar PV offers employment prospects for people with a wide range of experiences and occupations. There is demand for individuals with training in the STEM fields (science, technology, engineering and mathematics) and with high-level qualifications in non-STEM fields (such as lawyers), as well as people with lower formal skills (such as construction) who could be leveraged from different industries with minimum training (see Figure I.1). The low threshold of skills required for many of these jobs opens doors to employment for many people. Policy makers need then to match skills demand and facilitate the supply of an adequate workforce through active labour market policies; and when possible, create new job opportunities by leveraging capabilities of the female half of the workforce (IRENA, 2016).

**Figure I.1** Labour requirements along the value chain and occupational patterns for workers in solar PV



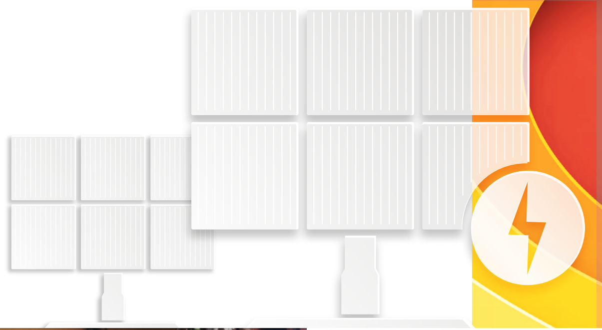
Source: Based on IRENA (2016).

Note: New data and analysis are forthcoming, but the fundamental skills patterns are unlikely to shift dramatically, even as automation exerts a greater impact.

The under-representation of women in the energy sector is well known. Men vastly outnumber women in the oil and gas industry, with women accounting for barely 22% of sectoral employment. Renewable energy does better than traditional energy, with women occupying 32% of jobs (IRENA, 2019). The takeaway is that renewable energy, as a younger and more dynamic sector, represents an opportunity for change. The expanding solar PV industry offers long-term and challenging career opportunities in both on-grid and off-grid contexts, with real potential for women as construction managers, technicians, electricians, plumbers, sales representatives, installers, human resource managers and marketers, among others (IRENA, 2016).

If the solar industry fails to incorporate more women, it will be missing out on the talent pool that women represent as well as the opportunity to create a better working environment for all employees, as having more women in the workplace improves the organisational culture, resulting in better employee engagement and retention (Clerkin, 2017).

**Chapter 1** of the present report outlines the share of women in the solar PV workforce. **Chapter 2** examines the barriers women face. It is followed by a close look at women living and working in the off-grid context. **Chapter 3** surveys the role that decentralised solar PV can play in empowering women, particularly in areas with low electrification rates. **Chapter 4** discusses the path towards a more diverse solar PV workforce.



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# 1

# Women in the solar PV workforce

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# 01

This chapter discusses the main findings of IRENA's online survey of nearly 300 organisations. It analyses women in the solar PV workforce by role, region, activity and organisation size. Interestingly, the results show no significant differences between off-grid and on-grid employment of women; therefore the results are considered similar for women in both contexts.[3]

## 1.1 Narrowing the data gap on gender in the solar energy sector: IRENA's survey

Echoing previous methodologies used by IRENA, the report is based on the results of a global survey directed at organisations and individuals working in the solar PV sub-sector. The study outlines quantitative insights derived from the organisations' responses, and qualitative insights on the barriers to entry, retention and advancement based on individual responses. Drawing on both sets of findings, the report also suggests policy solutions.

Initially planned for 2020, the survey was postponed due to the global health crisis, as some construction and other key activities along the solar PV value chain suffered delays or disruptions from the lockdown measures imposed by countries around the world (IRENA, 2020b). The survey was available online from 8 March 2021 (coinciding with International Women's Day) to 31 December 2021. It was widely publicised through IRENA distribution channels and further disseminated in the newsletters, mailing lists, etc. of various partner organisations.

**1 283**
responses

**294**
organisations

**989**
individuals

**123**
countries

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[3] *As noted in IRENA's previous gender surveys, online surveys have limitations. While they offer an easy, convenient, and inexpensive means of data collection, online surveys commonly suffer from methodological limitations, including the fact that the population to which they are distributed is technologically aware and educated and thus self-selected. There could also be geographical imbalances, that is, higher participation rates in some countries than in others, or self-selection bias, given those choosing to participate may not be a full representation of the population. While these limitations cannot be eliminated, IRENA is committed to increasing collaboration and partnership with different organisations for further analysis, aiming to reach broader audiences.*


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Participation was worldwide, with individuals and organisations from 123 countries completing the survey

Online surveys have limitations. While they offer an easy, convenient and inexpensive means of data collection, they commonly suffer from methodological limitations, including the fact that the population to which they are distributed is technologically aware and educated – and thus self-selected and therefore not a full representation of the population. There could also be geographical imbalances; that is, higher participation rates in some countries than others.

Respondents could choose to complete the survey either as individuals or as representatives of their employers (*i.e.* on behalf of organisations).

- From **individuals**, information was collected about perceptions of the main barriers and challenges to attracting and retaining women in the workforce, as well as suggestions for potential solutions to some of these problems.
- From representatives of **organisations**, the survey asked for more quantitative information about the gender distribution in the organisation's workforce and the policies and measures used to support greater gender diversity.[4] Answering these questions accurately requires some knowledge of the relevant staff statistics, so respondents were encouraged to consult with their human resources department to complete this part of the questionnaire.

A total of 1 283 organisations and individuals completed the questionnaire (294 organisations and 989 individuals). The survey was made available in Arabic, Chinese, English, Italian, Portuguese and Spanish.

**Geographical and regional distribution.** Participation was worldwide, with individuals and organisations from 123 countries replying (see Figure 1.1). Unlike previous IRENA surveys, responses were not dominated by replies from Europe and North America. In particular, a relatively high proportion of replies (26% among organisations, 31% among individuals) came from the Asia-Pacific region, where a great deal of solar energy development is taking place. Figure 1.2 shows the regional distribution of responses.

Given that most solar PV jobs are located in Asia-Pacific (around 80% of the global total), followed by Europe and North America (12%), Africa (5%), and Latin America and the Caribbean (3%), responses were adjusted. Weights were used to calculate global averages, so that the results would more accurately reflect the regional distribution of employment in the sector.

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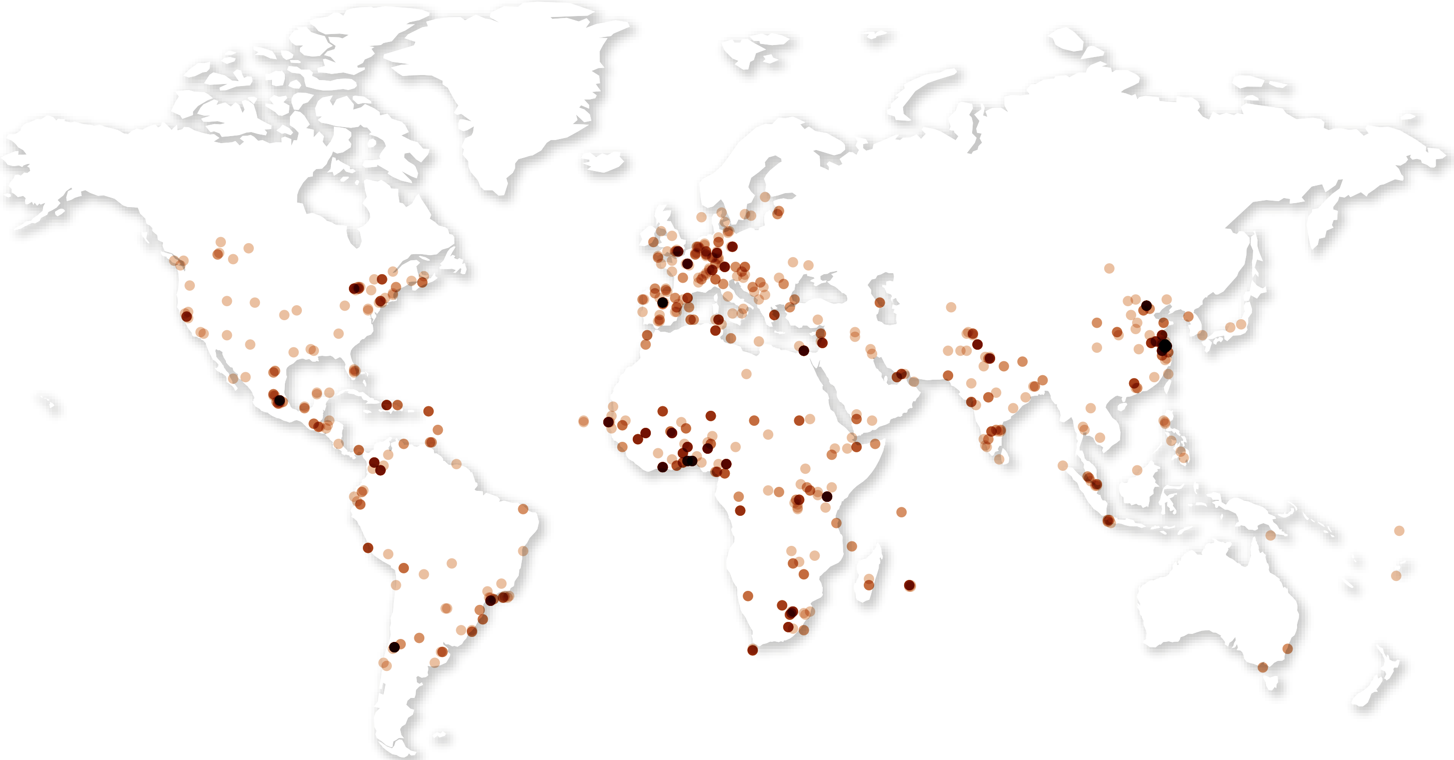
[4] *For the purpose of this report gender refers to women and men. "Other" was also offered as an additional choice for respondents. However, only six individuals identified themselves as such, not a sufficiently significant number to warrant aggregating their answers into a separate category.*

**Figure 1.1** Geographical distribution of survey respondents

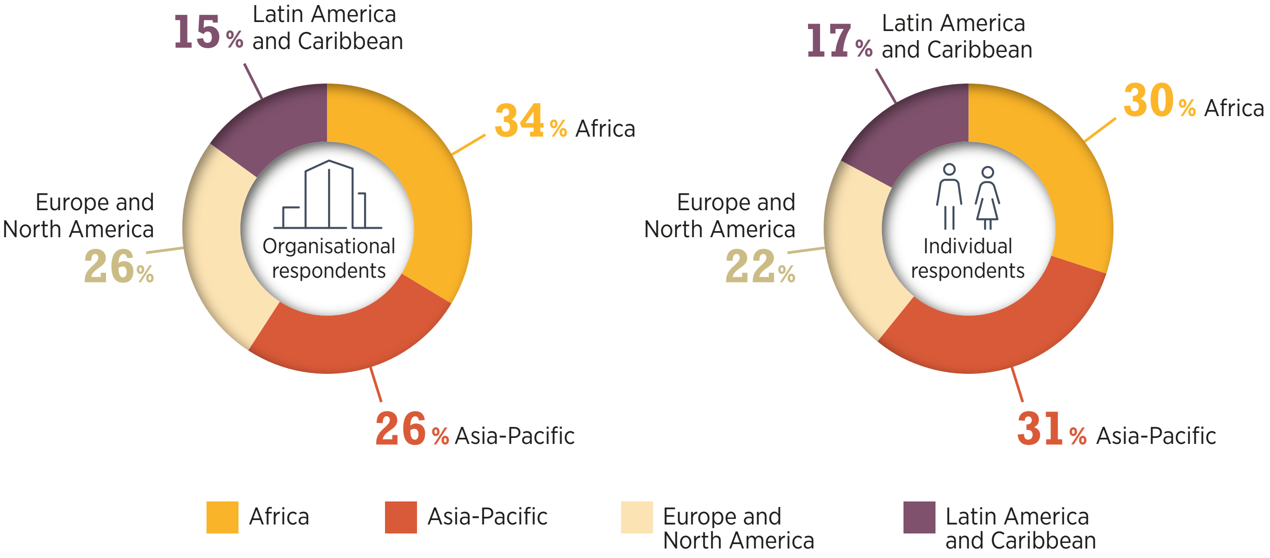


Note: Baseline map data ©2022 Google, overlaid with data points from the survey.

Disclaimer: This map is provided for illustration purposes only. Any boundaries and names shown do not imply any endorsement or acceptance by IRENA.

Source: IRENA online solar PV survey, 2021.

**Figure 1.2** Distribution of survey respondents by region



Source: IRENA online solar PV survey, 2021.

**Activity distribution.** Figure 1.3 shows the distribution of respondents by main activity, which refers to the functions of companies and other organisations that may relate to segments of the solar PV value chain. For the purposes of this report, this includes project developers; solar panel installers; manufacturers (of solar panels, components, or other solar devices); service providers (including finance, insurance, research and trade associations); and others. The latter included a wide range of activities (mostly technical and engineering activities, often involving the application of solar power outside the energy sector).

Responses were quite evenly distributed across the various activities and are thus likely to represent the views of a broad selection of organisations and individuals active in the sector. However, as in previous surveys, manufacturers were possibly under-represented in the sample against their contribution to employment in the sector as a whole.

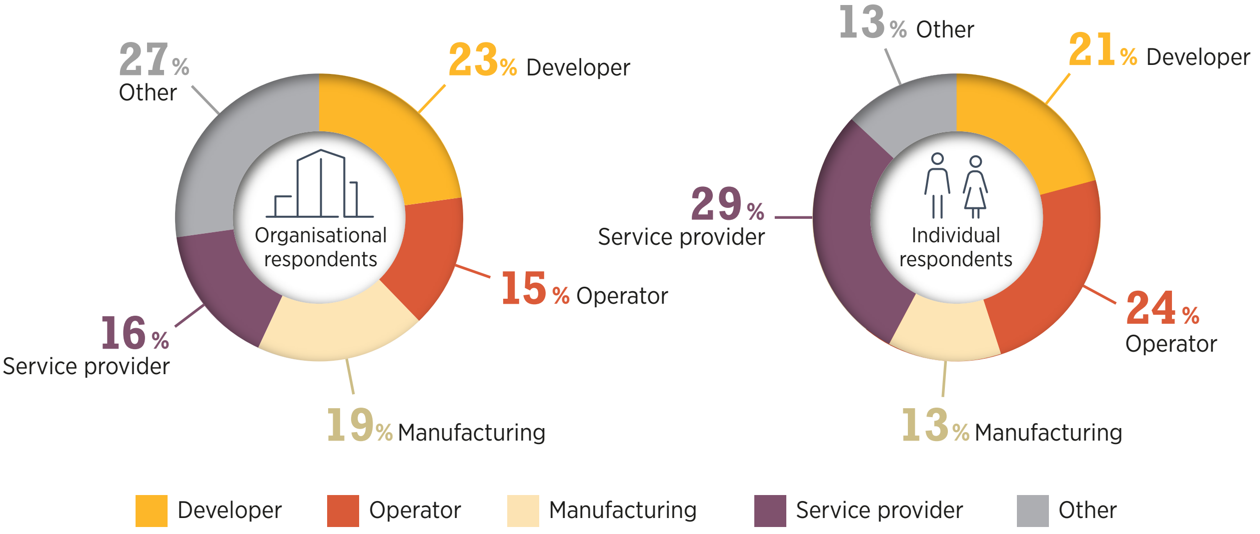
To account for the fact that many organisations have business activity outside solar PV (including a range of renewable energy technologies), the survey asked both organisations and individuals to specify the proportion of their activity related to solar energy. Responses were used as an additional weighting factor in the calculation of global averages and totals.

**On-grid, off-grid, or both.** Individuals and organisations were asked to indicate whether they work in on-grid solar PV, off-grid, or both (given the overlap in several segments of the value chain). Among both organisations and individuals, 35% of respondents specified they were working in an on-grid setting, roughly 20% in off-grid, and the reminder (around 45%) in both contexts.

**Employer size.** With respect to entities' size, more than half of the responses from organisations and almost half of the individual responses came from the two smallest size classes: organisations employing fewer than 20 people or between 21 and 50 people (see Figure 1.4). While it is possible that a relatively high share of employment in the solar sub-sector is in small organisations (given the importance of distributed deployments), the distribution of responses for solar contrasts strongly with the previous wind energy employment survey (where half of the individual responses came from people working in organisations employing more than 1 000 people).

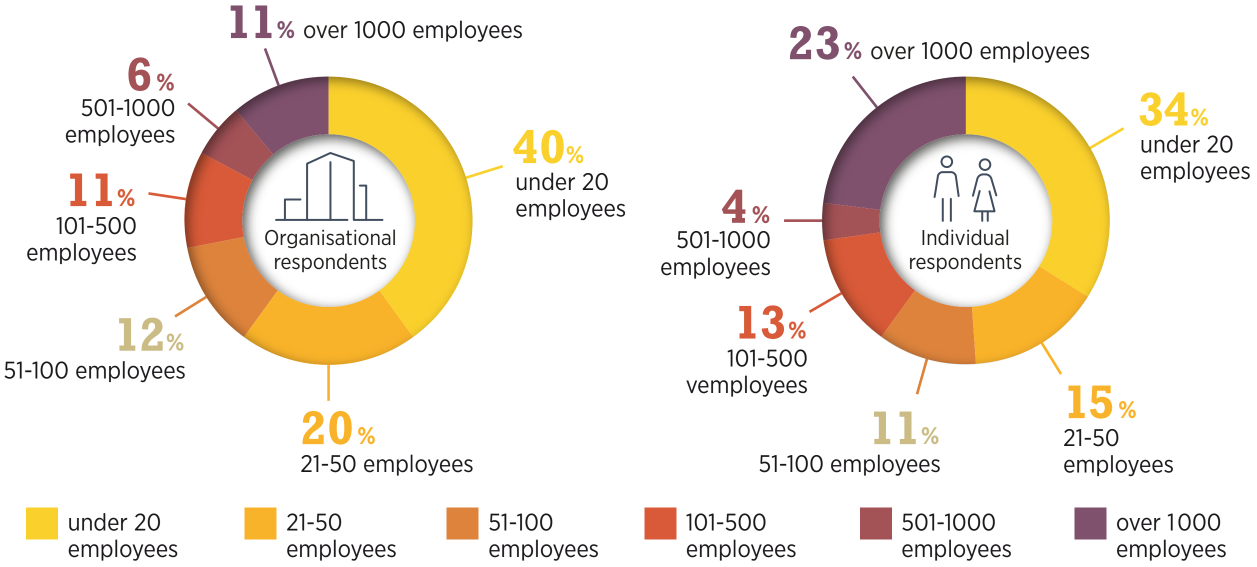
The size of an organisation is an important variable for the calculation of global averages for two reasons. First, answers may differ significantly among respondents from organisations of

**Figure 1.3** Distribution of survey respondents by main activity



Source: IRENA online solar PV survey, 2021.

**Figure 1.4** Distribution of survey respondents by organisation size



Source: IRENA online solar PV survey, 2021.

different sizes. Second, and more important, size is a crucial variable for the interpretation of responses from organisations, where each reply must be treated as though it represents several employees in the sector. The lack of information about the true size distribution of organisations working in solar PV remains a challenge for scaling up survey results to produce reliable population estimates, particularly with respect to the weight that should be given to replies from large organisations responding to the survey.

**Survey participation by women and men.** Women and men were fairly evenly balanced among respondents, with a 54% share for women and 46% for men.

**Survey participation by educational achievement.** The level of education of male and female respondents was similar, with that of women being slightly higher (see Table 1.1). The survey included a question on the educational status of the individual respondents, as the composition of respondents by background could influence survey results. The distribution of educational status indicates that 86% of respondents had a university degree and 42% had a masters or doctoral degree.

Individuals with lower levels of education are poorly represented in the sample compared with those holding a tertiary degree. The under-representation of less-educated employees can affect the analysis. As noted earlier, online surveys are at risk of several types of bias. However, as this survey is focused on a single sector for which more information is available about the population of interest (employees in the sector), it was possible to adjust responses to reflect the distribution of characteristics in the underlying population.

Women and men were fairly evenly balanced among respondents, with a **54% share for women** and 46% for men

The following sections discuss the results of the analysis. Some of the results confirm previous findings from IRENA's work while others offer valuable additional insights. Section 1.2 is a quantitative analysis of the share of women in the solar PV energy sector, broken down by role, region, activity and organisation size. Box 1.1 defines key terms used.

**Table 1.1** Sex and educational status of individuals responding to the survey

| | Highest level of education | | | | | All replies<br>🟥 Women<br>🟦 Men |
|---|---|---|---|---|---|---|
| **Subjects** | High school | Diploma | Bachelor's | Master's | Doctoral | |
| **STEM qualifications** | | | | | | |
| Males | 3% | 7% | 21% | 11% | 3% | **46%** |
| Females | 10% | 6% | 20% | 16% | 2% | **54%** |
| All respondents | **13%** | **13%** | **41%** | **27%** | **6%** | **100%** |
| **Non-STEM qualifications** | | | | | | |
| Males | 12% | 7% | 18% | 6% | 2% | **46%** |
| Females | 16% | 5% | 20% | 13% | - | **54%** |
| All respondents | **29%** | **12%** | **39%** | **19%** | **2%** | **100%** |
| **Highest level of either qualification** | | | | | | |
| Males | 2% | 6% | 21% | 13% | 4% | **46%** |
| Females | 3% | 4% | 22% | 23% | 2% | **54%** |
| All respondents | **5%** | **10%** | **44%** | **36%** | **6%** | **100%** |

Note: Diploma includes technical certificates, such as vocational training in a technical field.

Source: IRENA online solar PV survey, 2021.

### Box 1.1 Glossary of terms

**Role.** For the purpose of this report, the roles of solar PV sub-sector employees fall into the following categories: administration, STEM (science, technology, engineering and mathematics), other technical (non-STEM, such as lawyers), and other non-technical (*e.g.* marketing, sales, distribution, product assembly, installation), management and senior management. Some of the categories may overlap. A person with a STEM degree, for instance, may rise into a management or senior management role.

**Region.** The regions considered are Africa, Asia-Pacific, Europe and North America, and Latin America and the Caribbean, including Mexico.

**Activity.** Activity refers to the functions of organisations in the solar PV value chain. For this report, the activities are installer, developer, manufacturing, service provider, and others (including consultancy companies, think tanks, academic and research institutes, training and educational centres, financial institutions, governmental agencies and marketing companies).

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## 1.2 Share of women in the solar PV workforce

IRENA has examined gender equity issues through a series of reports. In 2019, a first global report was built on a ground-breaking survey of employees, companies and institutions. The study found that 32% of the renewable energy workforce are women (IRENA, 2019). A subsequent survey focusing on wind energy put the share of women in that workforce at 21%, substantially below the average for all renewables (IRENA, 2020a). The current analysis finds that the share of women working full time in the solar PV industry is 40%, the highest share of any renewable energy sub-sector analysed by IRENA to date (see Figure 1.5) and well above estimates for the oil and gas sector, which have remained at 22% since 2017 (BCG, 2021). Yet the 40% share held by women in solar PV still trails the global average of women in the overall economy, estimated at 45.9% by the International Labour Organization as of 2020 (ILO, 2022a).

### Women's share in solar PV, by role

Beyond the overall share of women working full-time in solar PV, it is important to examine whether there are any imbalances among the different roles that women fulfil in the industry. Indeed, similar to the results for renewable energy overall and for wind, the survey indicates that women are not equally re-presented across the industry.[5]

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**40%**

**women working full time in the solar PV industry**

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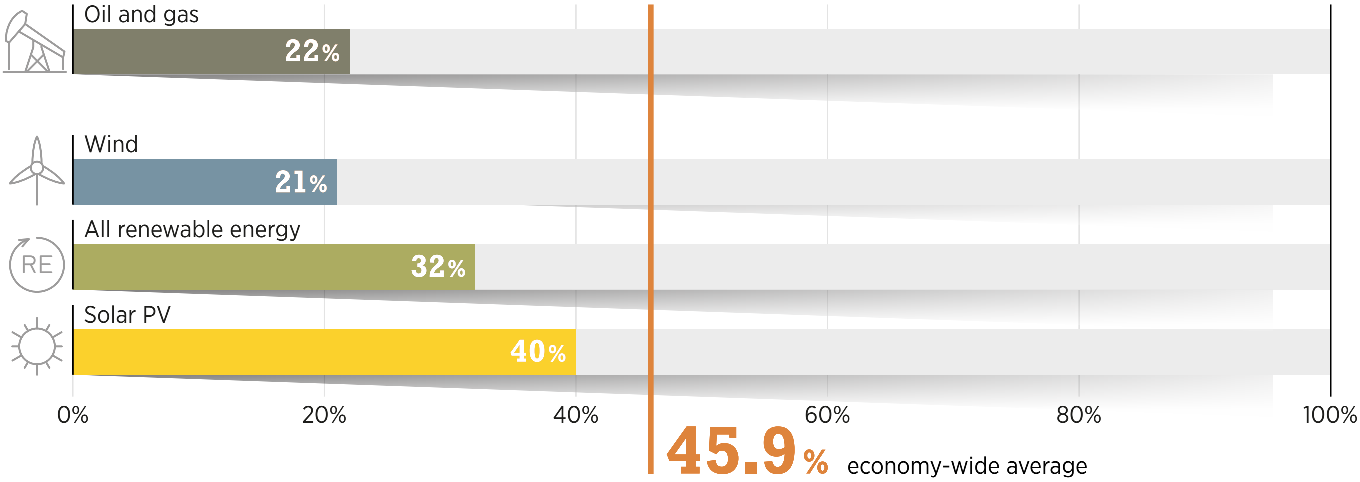
[5] Throughout this analysis, statistical significance is measured against a null hypothesis of randomness (or no relationship) using a 5% probability level (*i.e.* randomness or no difference/relationship is rejected if its probability is less than 5%). A significance level of 5% or less can be assumed if it is not stated, but where a relationship is significant at a different probability level this will be given.

**Figure 1.5** Women in oil and gas, renewables overall, wind, solar PV, and economy-wide average



Note: The results did not show any significant difference between off-grid and on-grid employment of women. Therefore we assume similar shares of women in both contexts.

Source: IRENA online solar PV survey, 2021.

Most women in solar PV hold administrative jobs (58%), followed by non-STEM technical positions (38%).[6] According to UNESCO (2017), only 35% of STEM students in higher education are women. Our survey finds that women in STEM positions in solar PV are close to the global figure, at 32% of the total. Meanwhile, driven in part by off-grid solar PV deployments, the survey finds that women account for 35% of other non-technical positions (*e.g.* marketing, sales, distribution, product assembly or installation) (see Figure 1.6).

Gender inequality is most evident at decision-making levels. It is well reported that across the economy, in policy making and governance, women's presence on company boards and in senior management positions is painfully small. The absence of female role models is even more acute in energy-related fields. According to IRENA's wind survey, women hold barely 13% of managerial jobs and 8% of senior management positions in that industry. Women are faring better in solar PV. IRENA's survey data show that women account for just under one-third of the sector's management positions (30%), but this drops to 17% for senior management.[7] In both industries, the share of female managers is far below women's average share in the workforce but very similar to the overall 31% of all senior management positions, globally, in 2021 (Grant Thornton, 2021). It is not as high as the average proportion of women in management positions in the overall economy of the G20 countries, which stood at 38% in 2020 (see Figure 1.7).[8]

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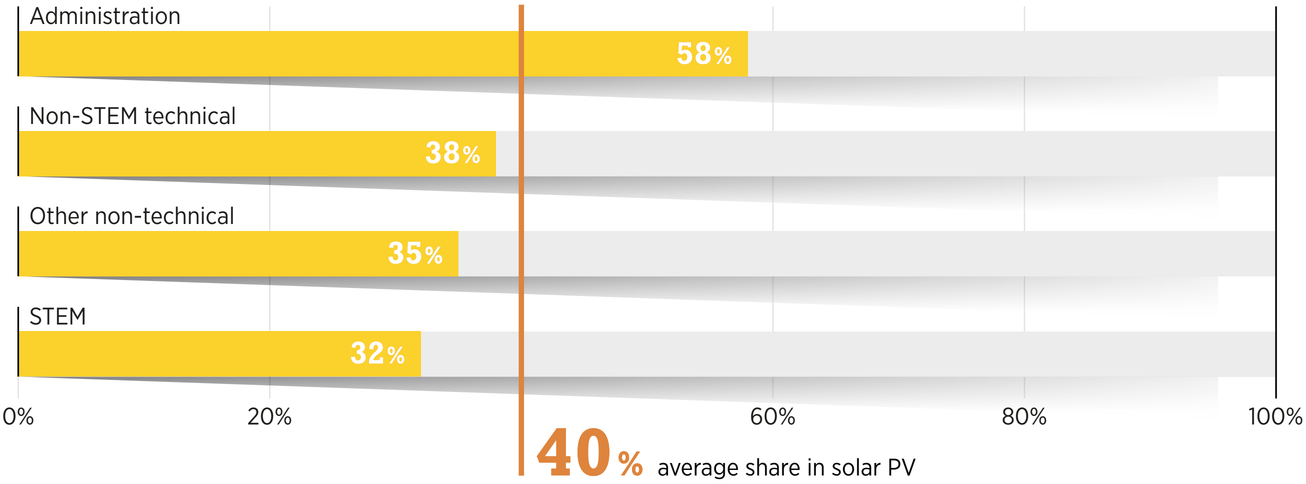
*[6] Non-STEM technical positions require higher education. Examples include lawyers and human resources professionals.*

*[7] Senior management includes positions responsible for setting long-term goals and defining strategies to achieve them. Examples may include chief executive officers, vice presidents, directors and division heads, board members, etc. If the data are not weighted (considering that the number of people serving on boards of directors is likely to be quite similar across all organisations), the share of women in these senior positions is 23%.*

*[8] The average share of women in managerial roles in G20 nations with data by economic sector is 38%, with significant variances among sectors. While the proportion of women in management positions is less than 25% in traditionally male-dominated sectors such as mining and quarrying (19.6%) and construction (13.7%), it is greater than 50% in sectors such as health and social work (67%), education (61%), household activities as employers of domestic personnel (60.5%), and other service activities (51.5 %) (ILO, 2020).*

**Figure 1.6** Women in the solar PV workforce, by role

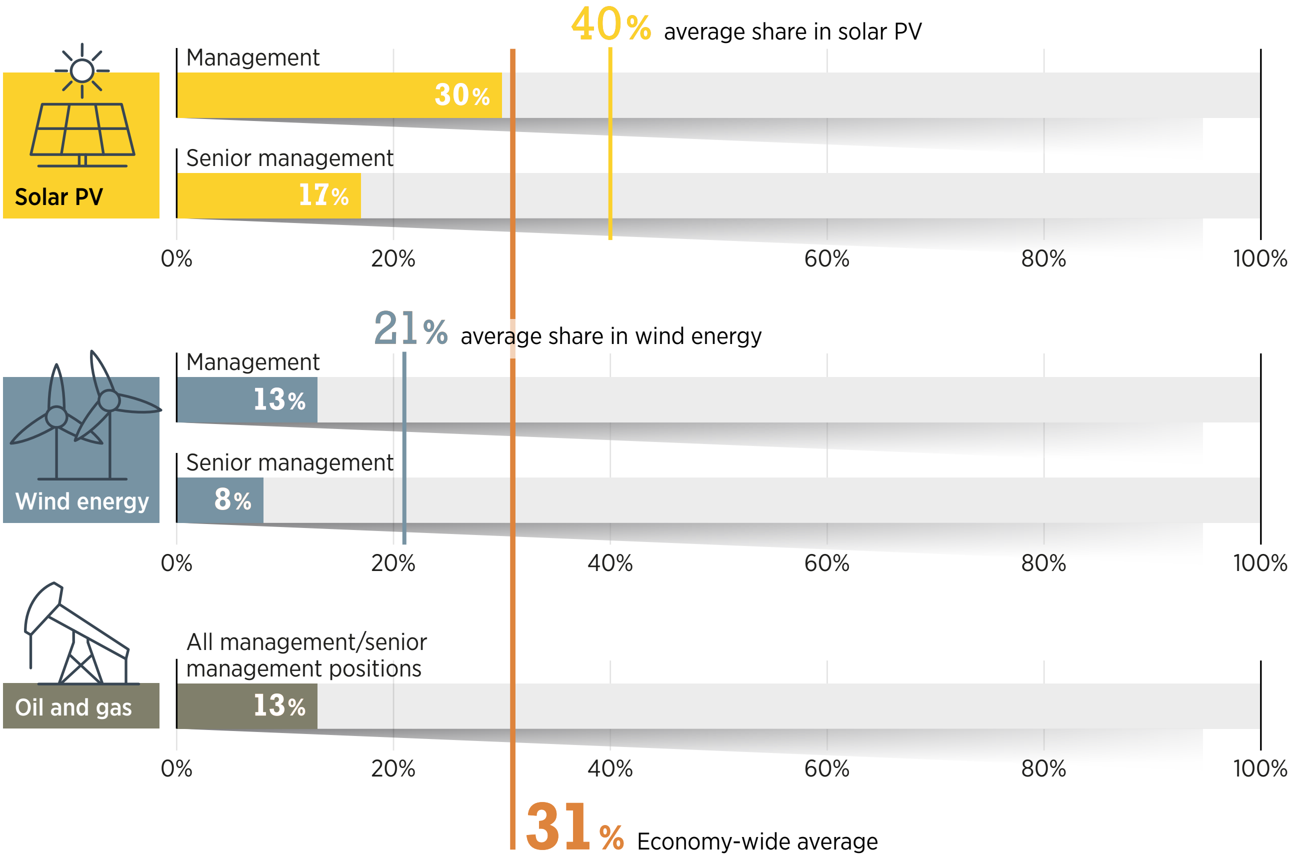


Note: STEM = science, technology, engineering and mathematics.

Differences were significant in all cases except for the share of women in administration. While the share of women employed in administration is very large, this is due primarily to the patterns of employment in large firms (which have a major impact on the global average share of employment of women in administration). Across all firms, the share of women in administration is variable, such that no significant difference was found between it and the overall share of female employment.

Source: IRENA online solar PV survey, 2021.

**Figure 1.7** Women in management positions in solar PV and wind energy



Source: IRENA online solar PV survey, 2021, and IRENA (2021), Grant Thornton (2021) and BCG (2021).

Therefore, while women are better represented in solar PV management than in other technologies and sectors, substantial efforts are nonetheless needed to enable greater participation of women at all levels and to expand the pool of skills and talents needed to drive the transformation.

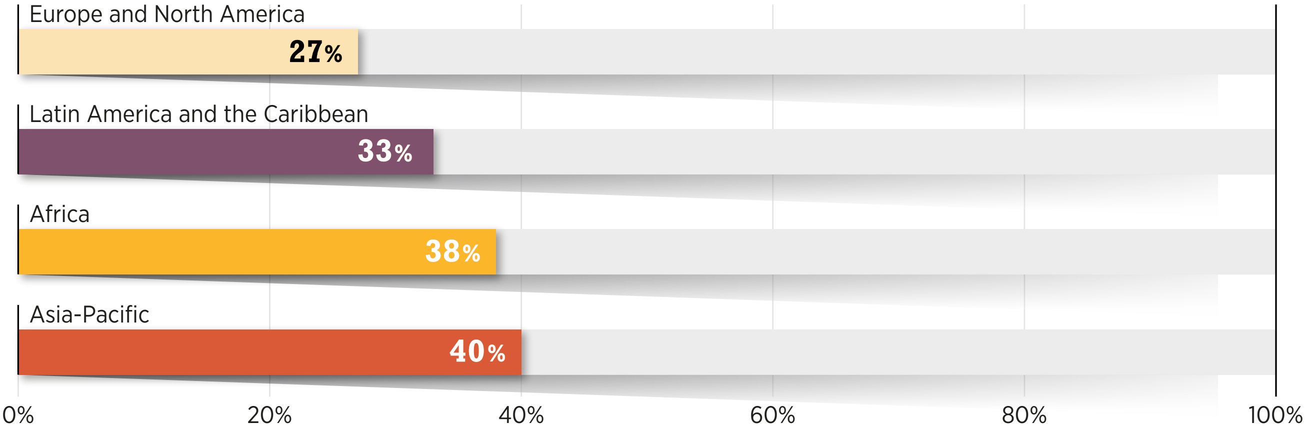
## Women's share in solar PV, by region

Women's share of solar PV employment is smaller in Europe and North America and in Latin America and the Caribbean than in the Asia-Pacific and Africa regions (see Figure 1.8), but the differences are not significant.

These figures are consistent with findings from various national reports and statistics. Estimates from Australia, for example, indicate that 38% of its solar PV workforce are women (CEC, API and ETU, 2021). A recent study of women in Brazil's solar PV sub-sector finds that just a third of professionals are women (CFF and MESOL, 2021). Likewise, the United States National Solar Jobs Census yielded the finding that women's share in the workforce of all solar technologies grew from 26% in 2019 to 30% in 2020 (SEIA, Solar Foundation and IREC, 2021).

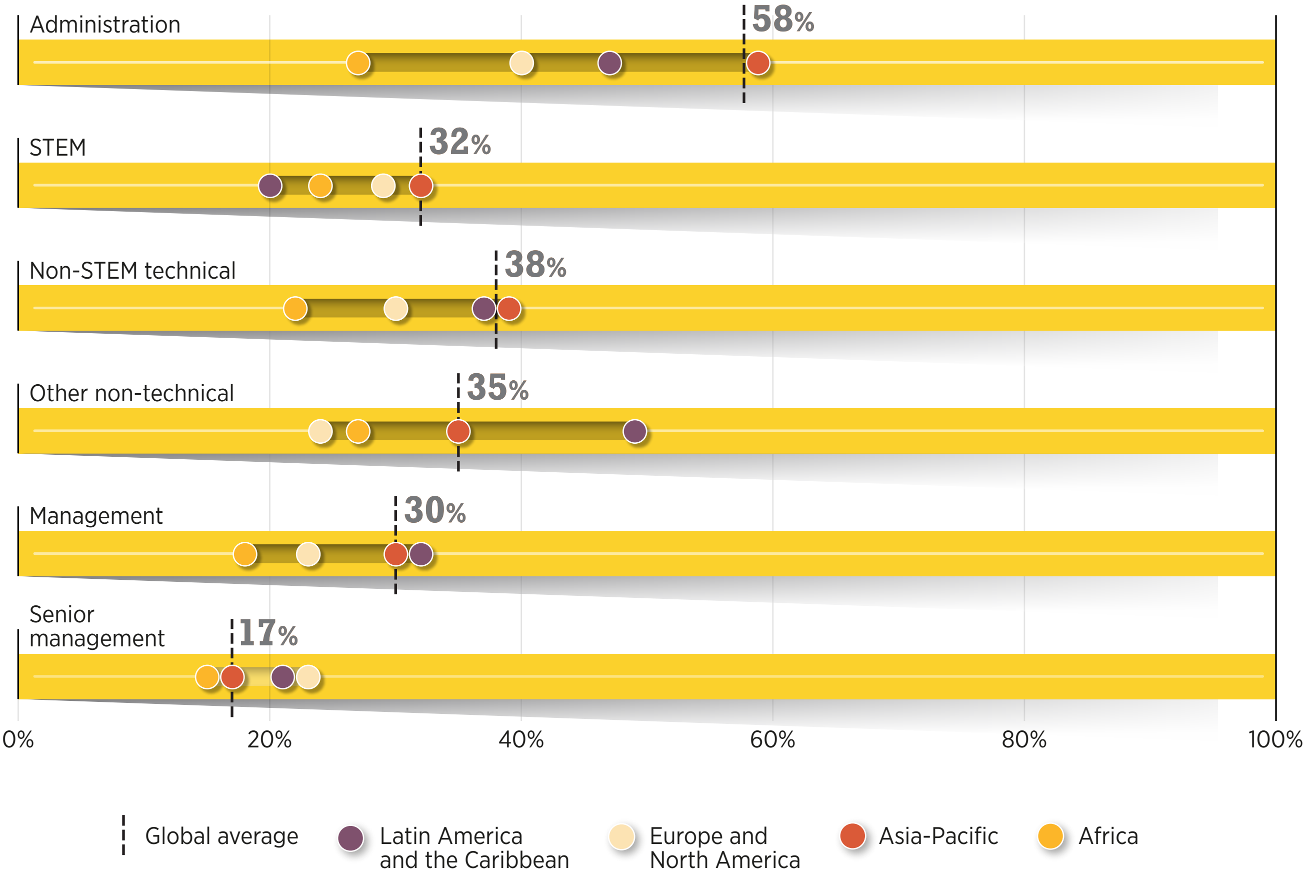
In the solar PV sub-sector, women are more represented in administrative positions across all world regions (see Figure 1.9). The spread between women's shares in administration and in all other roles is most pronounced in companies in the Asia-Pacific region. The heavy representation of women in administration explains why the region fares better in comparisons of women's overall participation in the solar PV workforce.

**Figure 1.8** Women in the solar PV workforce, by region



Source: IRENA online solar PV survey, 2021.

**Figure 1.9** Women in the solar PV workforce, by activity and region



Source: IRENA online solar PV survey, 2021.

Women's presence in Australia's solar workforce appears to be similar to IRENA's Asia-Pacific results, with women occupying 62% of administrative positions, 31% of STEM and managerial jobs, and 19% of senior management positions. However, non-STEM technical professionals are better represented in the Australian results, with almost half (48%) of positions being held by women (CEC, API and ETU, 2021).

Meanwhile, the figures on the share of women in managerial positions in Europe and North America (23% in both) are aligned with the US study cited above, which found that of the 26% women in the solar workforce in 2019, only 28% of them held positions at the manager, director or president level. In addition, participating solar firms reported that women represented just 20% of senior executive roles (Solar Foundation and SEIA, 2020).

### Women's share in solar PV, by activity

Manufacturing appears to employ the greatest proportions of women (47%). The "other activities" category – which includes consultancy companies, think tanks, academic and research institutes, education and training centres, financial institutions, governmental agencies and marketing companies – follows with 40%. Meanwhile, among service providers and installers, the proportion of women decreases remarkably, suggesting that it is harder for women to find employment in those activities (see Figure 1.10). The share of women employed in organisations engaged in off-grid, on-grid or both types of solar energy also showed no significant differences, either overall or in the different roles; therefore we assume similar shares of women in both contexts.

**47%**

**share of women in manufacturing**

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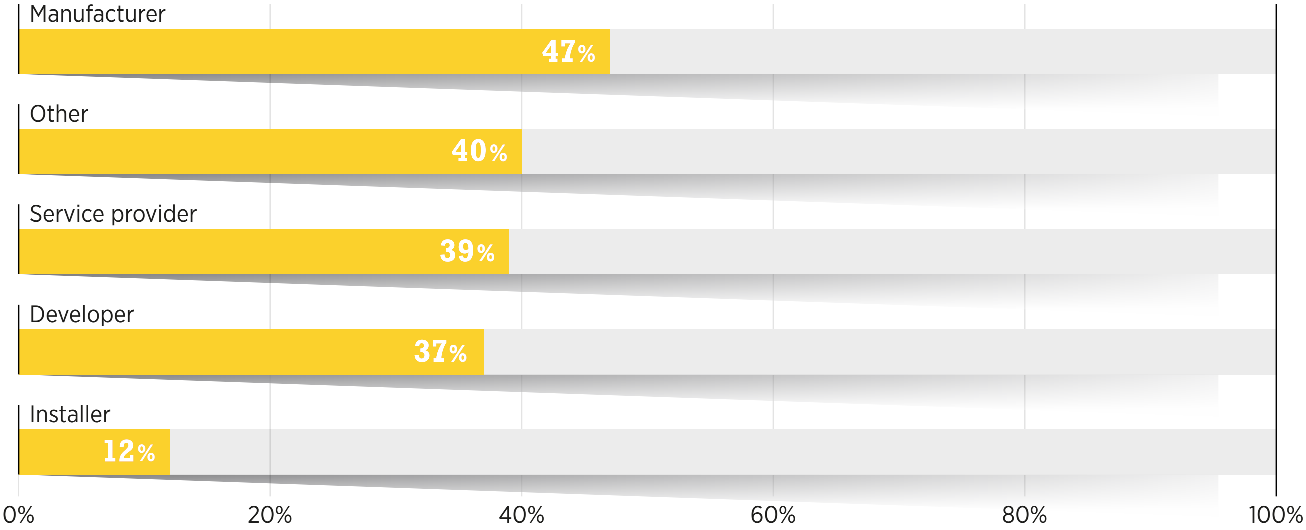
**Figure 1.10** Women in the solar PV workforce, by activity



Source: IRENA online solar PV survey, 2021.

Figure 1.11 disaggregates the findings presented in Figure 1.10, breaking down the share of women in each activity by broad occupational category (STEM, non-STEM technical, other non-technical, administrative and both levels of management roles).

Significant differences were found in the case of administration, where developers, manufacturers and "other" employ more women. The share of women is by far the lowest in senior management across all activities, attesting to the existence of gender-specific obstacles such as the "glass ceiling" that will be discussed in Box 2.2 in the following chapter.[9]

## Women's share in solar PV, by organisation size

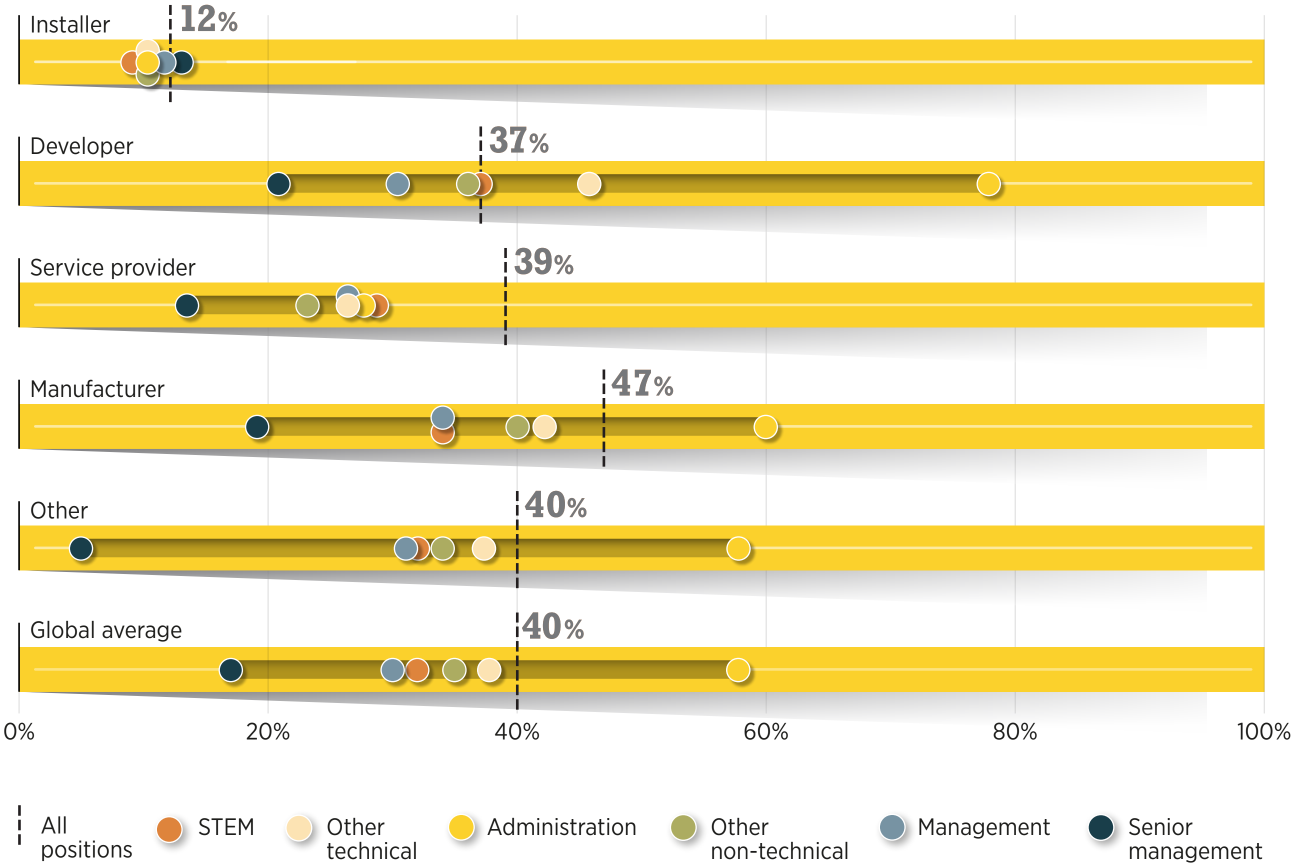
Shares of women in the workforce did not vary significantly by organisation size. Although the proportion is highest in the largest organisations (*i.e.* those with more than 1 000 employees), organisations in other size categories had fairly similar scores (see Figure 1.12). Smaller organisations have a slightly higher share of women in senior management.

The next section analyses the barriers to entry and advancement that women face.

---

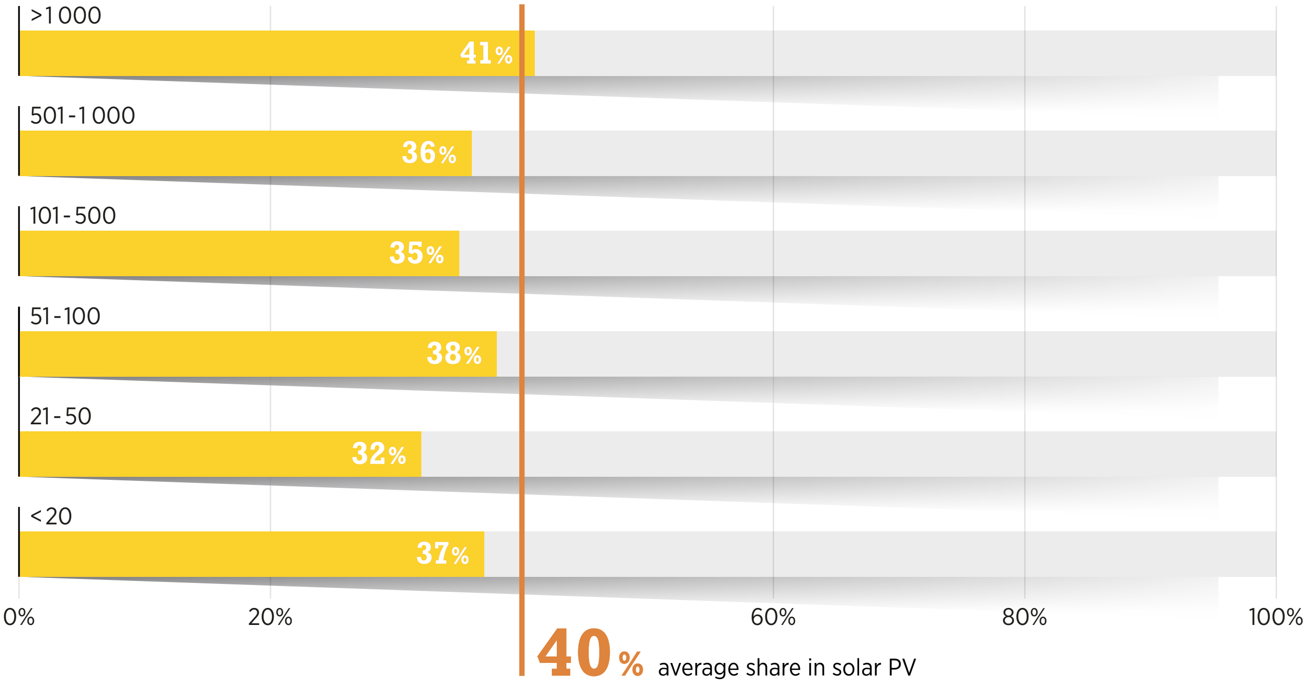
[9] *"Glass ceiling" refers to an unstated barrier to advancement in a profession. It affects women and members of minority groups in particular. For more information, see Box 2.2.*

**Figure 1.11** Women in the solar PV workforce, by activity and role



Source: IRENA online solar PV survey, 2021.

**Figure 1.12** Shares of women in the solar PV workforce, by organisation size



Source: IRENA online solar PV survey, 2021.

**58%**
**share of women working in administrative jobs**

# 2

# Challenges that limit women's participation in the solar PV workforce

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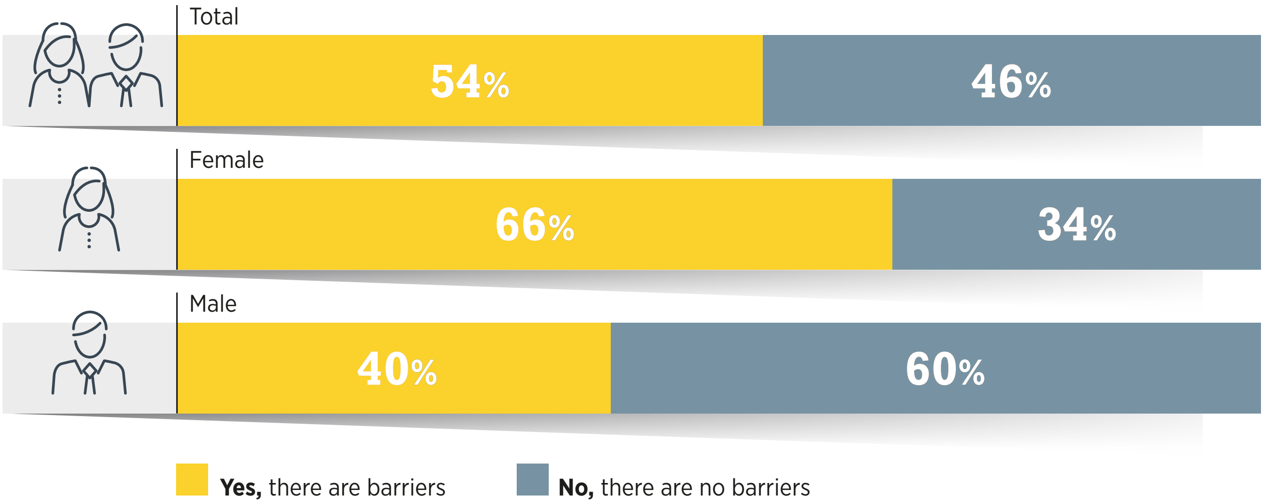
# 02

Women face challenges in the workplace simply because of their gender. These challenges are usually interconnected and often subtle. Understanding what the barriers are, and the reasons behind them, is the first step to addressing them, in part through legislation and regulatory measures. Such measures cannot address all of the barriers, however, since some are rooted in everyday attitudes and behaviours deeply ingrained in cultural and social norms. These attitudes may not be held or expressed in knowingly discriminatory ways.

Overall, 54% of the respondents to IRENA's solar PV survey stated that barriers do exist. As in IRENA's previous analyses of the entire renewable energy sector and the wind sub-sector, men seem to perceive fewer gender-related barriers than do women. In the solar PV sub-sector, two-thirds of female respondents recognised that they faced barriers, whereas only 40% of the male respondents agreed (see Figure 2.1). When men do not fully grasp the challenges that hold women back in their careers, they are likely less committed to fight for gender equity.

> **Gender barriers** are socially constructed obstacles faced by a particular group of people due to their gender.

**Figure 2.1** Male and female perceptions of gender-related barriers in solar PV



Note: The figure presents unweighted responses. Weighted by region, the total proportion of individuals who did not perceive barriers rose to 60%, implying that perceptions of barriers were lower in the Asia-Pacific region, given the larger participation of this region in the survey sample.

Source: IRENA online solar PV survey, 2021.

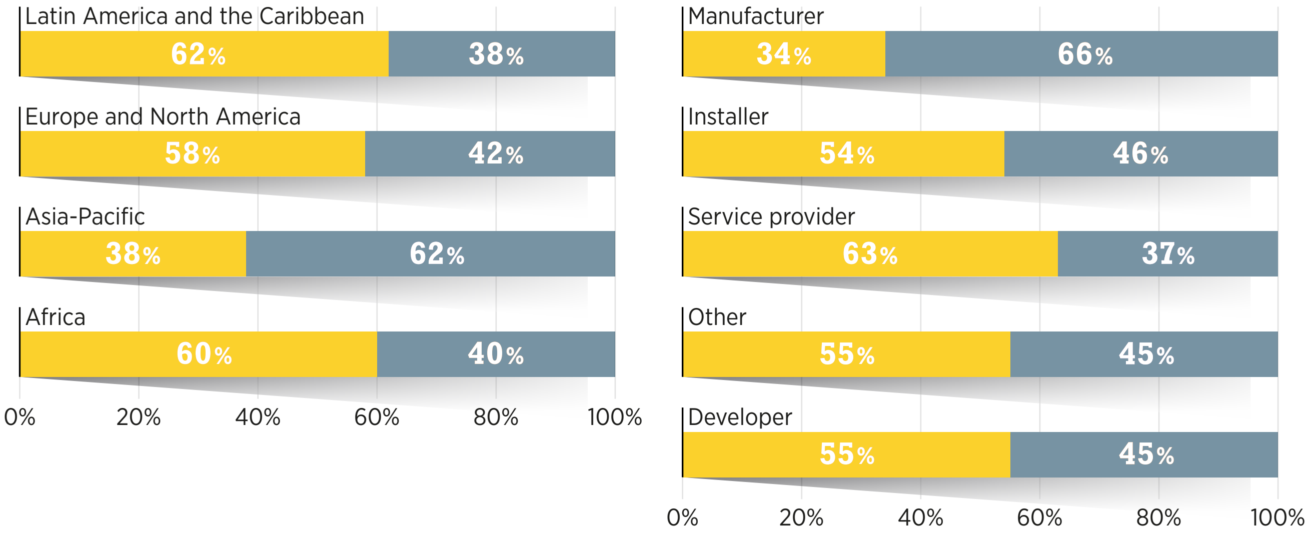
The results from most world regions largely reflected the existence of barriers – except the Asia-Pacific. This difference was highly significant, as was the differential perception of barriers by men and women (see Figure 2.2a).

The differences in perceptions of people working in organisations of different sizes, performing different activities and coming from different educational backgrounds yield some interesting conclusions. Employees from manufacturing facilities and larger organisations, for example, perceive lower barriers, which may be the result of the more generous employee benefits offered by many large organisations. People with higher degrees perceive more barriers than do high school graduates (see Figure 2.2d).

**Figure 2.2** Perceptions of gender-related barriers in solar PV, by region, activity, size of organisation and respondents' educational background

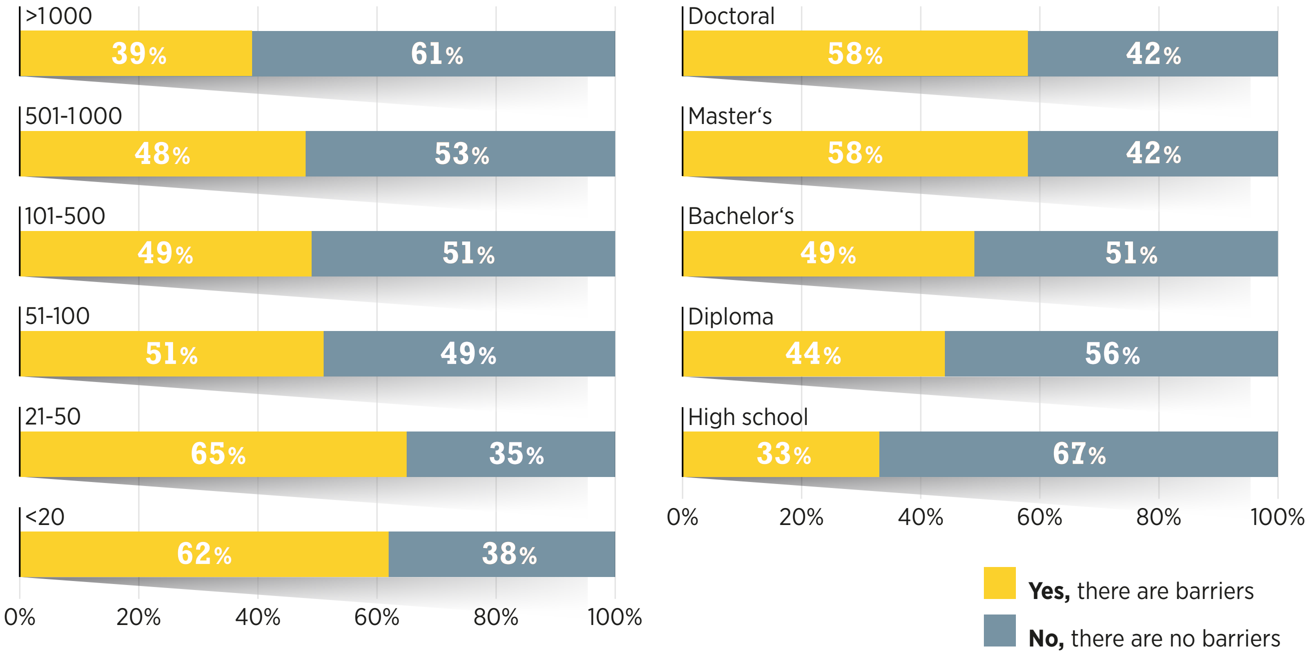
**a) By region**

**b) By activity**



**c) By size of organisation**

**d) By educational background**



Source: IRENA online solar PV survey, 2021.

Respondents who affirmed that women faced gender-related barriers were asked follow-up questions about the main barriers to entry, advancement and retention. The following section sheds light on the impediments highlighted by respondents.

## 2.1 Barriers to entry, retention and advancement

### Barriers to entry

Women may begin their careers expecting the path to success to be based on merit. However, hard work and personal achievements alone do not determine career advancement. Women face unseen hurdles that men do not; indeed, they face these challenges even before they enter the workplace. The survey asked individuals to rank the relevance of various barriers that confront women seeking entry-level employment in solar energy, either as a first job or as their first opportunity in the sector after a career switch. As in IRENA's previous surveys, two of the major barriers identified were social and cultural factors: perception of gender roles and social and cultural norms. The lack of gender targets and hiring practices were also highlighted. However, in contrast to previous surveys, limited mobility was also mentioned as a major barrier. This could be due to the survey being carried out after the COVID-19 breakout, with lockdowns being on respondents' minds, or to the fact that many of the respondents worked in manufacturing, where most opportunities are in cities and may require a willingness to move or commute longer distances for work.

Other barriers were seen as less relevant, particularly those related to educational background and self-perceptions of women seeking to work in the sector. Male-dominated sectors and occupations may deter female applicants, who struggle to see themselves fitting in. In some cases, women perceive that they are not suited for a role simply because they are women; in other cases, they are self-conscious because they may be considered the "token" woman. On still other occasions, the organisation's culture may be perceived as hostile to or uncomfortable for women. However, results suggest that women working in the solar PV industry are aware of their capabilities and do not perceive themselves as ill-prepared to enter the sector if they have a background relevant to it (see Figure 2.3).

**Figure 2.3** Relevance of various barriers to entry for women working in solar energy

Source: IRENA online solar PV survey, 2021.

### Barriers to retention

Retaining women in mid-career has always been a problem. It has been particularly challenging in the last few years because of the COVID-19 pandemic, which hit mothers of child-bearing age and caregivers particularly hard. Studies of the US corporate sector show that in 2020, 23% of women with children under 10 considered leaving the workforce, while only 13% of men thought about it (McKinsey, 2021).

As in the IRENA wind energy survey, the relevance of barriers to retaining women in the solar workforce scored much higher than those related to job entry and career advancement (see Figure 2.4). Fairness and transparency in internal policies and processes was again identified as the most relevant concern, closely followed by several of the other barriers, including lack of maternity and paternity leave (see Box 2.1), a common barrier for women to remain in the workforce. This result confirms the previous findings that a focus on investing in the retention of female employees could be an effective strategy for improving gender balance in the sector.

**Figure 2.4** Relevance of various barriers to retaining women working in solar PV

Source: IRENA online solar PV survey, 2021.

### Box 2.1 The salience of more-generous maternity and paternity leave

Organisations and individuals were asked whether maternity and paternity leave were available beyond that required by national employment legislation and, if so, how many additional weeks of leave were available (see Table 2.1).

As the table shows, the responses from organisations and individuals were quite different. Only 8% of the participating organisations reported that neither maternity nor paternity leave were available, while 23% of the individuals participating indicated that these were unavailable within their organisations. However, just over half of both groups said that maternity and paternity leave were available at the legal minimum requirement. In terms of additional leave, 36% of organisations said that it was available, but only 11% answered the follow-up questions about how many weeks were available, possibly suggesting that this was decided on a case-by-case basis. For individuals, 26% affirmed that additional leave was available; 18% could say how many additional weeks were granted.

Based on these responses, it seems that around half of the solar workforce is entitled to maternity and/or paternity leave as specified in national law; 10–20% may not receive any; 10–20% may enjoy a greater amount of leave; and another 10–20% may receive the legal minimum and be able to negotiate for more.

In terms of the amount of additional maternity or paternity leave available, there were also major differences in the responses of organisations and individuals, with individuals reporting much larger amounts of additional leave where this was available. Again, this could suggest that organisations reported only the minimum that may be available and that more might be available on request.

The consistent finding from the responses of organisations and individuals alike was that additional paternity leave was much less common than additional maternity leave, with many respondents reporting that no additional paternity leave was available. In terms of gender equality, only 15% of organisations and 10% of individuals stated that the same number of additional weeks were available for maternity and paternity leave, with all reporting lower amounts of additional paternity leave.

Table 2.1 Availability of maternity and paternity leave

| Availability and amount | Organisations | Individuals |
|---|---|---|
| Not available at all | 8% | 23% |
| Available at legal minimum | 56% | 51% |
| Additional (unspecified) leave available | 25% | 8% |
| Additional (specified) leave available | 11% | 18% |
| Average maternity leave in addition to legal minimum (weeks) | 3 | 27 |
| Average paternity leave in addition to legal minimum (weeks) | 1 | 5 |

Note: Responses are weighted.

## Barriers to advancement

While challenges to retention scored as a greater concern, barriers to advancement in women's careers are a big issue as well. Women are frequently disadvantaged compared with men, as they are more likely to step into roles that offer fewer prospects for advancement (Leung, 2016). Additionally, the road to leadership positions and the larger corporate culture still embody antiquated male norms that make it difficult, if not impossible, for women to reach the top (McKinsey, 2021). Furthermore, despite data showing that female leaders are taking on more work, women in leadership roles are more likely than men to encounter micro-aggressions (including being interrupted, having their emotional condition remarked on, and having their judgement called into question) that reflect doubts on their competency to act as a leader. The same microaggressions are less frequently experienced by men and tend to become even less frequently as men gain seniority. Men gain respect; women lose it (McKinsey, 2021).

In the solar PV industry survey, respondents again pointed to social and cultural norms as the most relevant barrier to advancement. Those norms are followed, again, by mobility limitations (see Figure 2.5). Many studies have reported how women are often penalised when mobility is a requirement, ignoring that they may have different patterns, needs and behaviours. So-called trip-chaining – travel involving multiple purposes to single or multiple destinations – and time impoverishment define women's mobility. Because women carry out three-quarters of unpaid domestic care work globally, they must consider commuting schedules and travel connection options when applying for a job or accepting a promotion. Additionally, women's routes and modes of transportation are influenced by the need for personal safety. This is especially true when traveling alone at night, given that women are more vulnerable than men in unsafe situations and more likely to be assaulted or harassed (Criado Perez, 2019).

Lack of childcare and the absence of gender targets and workplace flexibility were the next most often cited barriers. Mothers are three times more likely than men to be responsible for the majority of housework and childcare; this was especially true during the pandemic (McKinsey, 2021). While this is a cultural and social construct that needs to be changed through awareness and education, systemic change will take time. Solutions need to be found in the meantime, through measures such as flexibility and childcare facilities.

A surprising outcome from the survey analysis was that the perception of a glass ceiling was much lower than in IRENA's previous survey of gender and employment in the wind energy industry. This may be due to the large number of respondents working in manufacturing, where women tend to assume roles with limited prospects for growth. As a dynamic industry less dominated than wind by a small number of large, established companies, solar PV may well be more progressive (see Figure 2.5).

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**Figure 2.5** Relevance of various barriers to advancement for women in solar energy

Source: IRENA online solar PV survey, 2021.

In summary, the responses support the following conclusions:

- The most significant barrier for women in the solar energy workforce is the general perception of gender roles.[10]
- Responses differ widely by region and other underlying characteristics. Generally, respondents from the Asia-Pacific region viewed almost all of the barriers to entry, advancement and retention as less relevant than respondents from Latin America and the Caribbean.
- Respondents working in organisations employing more than 500 people (*i.e.* the two largest size categories) tended to see most barriers as less relevant, particularly with respect to retention.
- The reported relevance of various barriers was also usually higher in the minds of individuals possessing a technical certificate or a master's degree, but relatively lower for those with a secondary-school diploma, a bachelor's degree or doctoral education. The lack of any clear trend in perception of barriers by education level likely reflects the types of work done by respondents at different education levels, although it does seem that those at the opposite ends of the spectrum tended to view most of the barriers as less relevant.

**Patriarchy** is a social system in which men dominate over others, but can also refer to dominance over women specifically

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[10] *As in IRENA's previous gender studies, the difference in importance of most of the barriers was not significant, as most of the scores given to these barriers had a confidence limit of about +/- 2 percentage points.*

## 2.2 The gender pay gap

The gender pay gap is a multi-faceted problem, with its causes rooted in the discrimination women face in access to work, advancement and rewards.

First, there is women's greater concentration in lower-paying jobs, either because they hold specific low-wage jobs or because they work in industries that generally pay less than those that are male-dominated.

This "career preference" could be attributed to societal and cultural norms that channel women into less "male-oriented" careers (and which can play an indirect role in dissuading women from entering STEM-related fields) (Spiggle, 2021). Additionally, women are more likely to experience career disruptions, particularly for child-rearing and care-giving reasons. Added to this is the fact that women may perform as much as 30% more unpaid work than men in some countries (Donner and Goldberg, 2021). Phenomena such as the glass ceiling and the sticky floor also hold back pay equity (see Box 2.2).

---

### Box 2.2 The glass ceiling and the sticky floor effect as factors in the gender pay gap

**The "glass ceiling"** refers to the obstacles that keep women from advancing in their careers. An example of its contribution to the gender pay gap would be a woman declining a promotion or not considering applying for one because of her care-giving responsibilities.

**"Sticky floors"** refer to discriminatory employment patterns that affect even highly educated women when they are hired at the bottom of a hierarchy while their male peers tend to get positions further up the scale. One example could be lower salaries in job offers made to women on the assumption that women are less qualified or more likely to accept the lower offer.

**Pay gap** refers to the overall differences in pay between classes of people within a grouping, such as a country, sector or organisation.

**Pay equity** means equal compensation for employees with similar job duties, experience, time on the job, location and performance.

**Pay equality** is broader than pay equity. It refers not just to equal pay for employees in similar situations, but also to equality of opportunity, motivation and acceptance that yield roughly equal proportions of men and women in positions across the pay spectrum.

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**28%**

**of respondents believed that men were paid more for equivalent work in the solar PV sector**

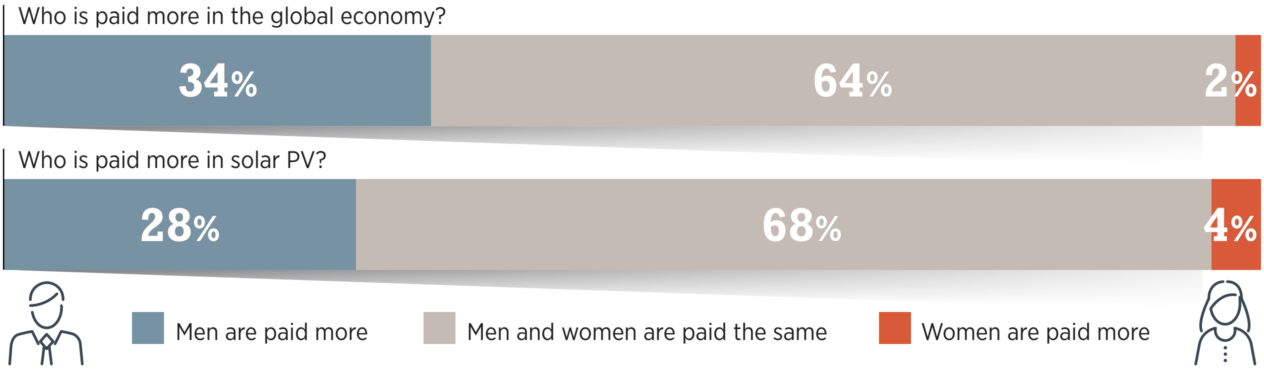
All of these factors combine to produce the gender pay gap. The most egregious situation arises when women are not paid the same as men for identical or equivalent jobs. Women, unfortunately, face a conscious and unconscious bias that can result in pay discrimination. The underlying sexism leaves women in a weaker position when negotiating pay raises.

To assess perceptions of pay equity and equality, individual respondents were asked how they perceived hourly wages for female employees compared with male employees both in the overall economy and in solar PV, based on their own experience.

Overall, 28% of respondents believed that men were paid more for equivalent work, while 4% believed that pay was higher for women. Individuals' perceptions of a pay gap in their current employment (in solar PV) were slightly higher than their perceptions of a pay gap in the workforce as a whole (see Figure 2.6).

At the global level, the share perceiving pay equity in solar PV was 68% compared with 64% for employment across the economy. This slight difference appeared in all the regions except Latin America and the Caribbean, where a smaller share of respondents believed pay to be equivalent in solar PV and across the economy. It was also noticeable that a relatively high share of respondents from this region – and from Europe and North America – believed that women were paid more than men in solar PV. These differences between the regions in perceptions of pay equity were highly significant (see Table 2.2).

**Figure 2.6** Individuals' perceptions of pay gaps in solar PV and in the overall economy



Source: IRENA online solar PV survey, 2021.

**Table 2.2** Perceptions of pay equity and barriers to participation in the solar energy workforce, by region

| **Region** | Who is paid more (in solar PV)? | | | Who is paid more (entire economy)? | | |
|---|---|---|---|---|---|---|
| | Men | Neither | Women | Men | Neither | Women |
| | % of respondents | | | % of respondents | | |
| Africa | 30% | 66% | 4% | 38% | 60% | 3% |
| Asia-Pacific | 26% | 73% | 1% | 31% | 67% | 3% |
| Europe and North America | 46% | 37% | 17% | 66% | 33% | 1% |
| Latin America and the Caribbean | 44% | 34% | 22% | 60% | 40% | 0 |

Source: IRENA online solar PV survey, 2021.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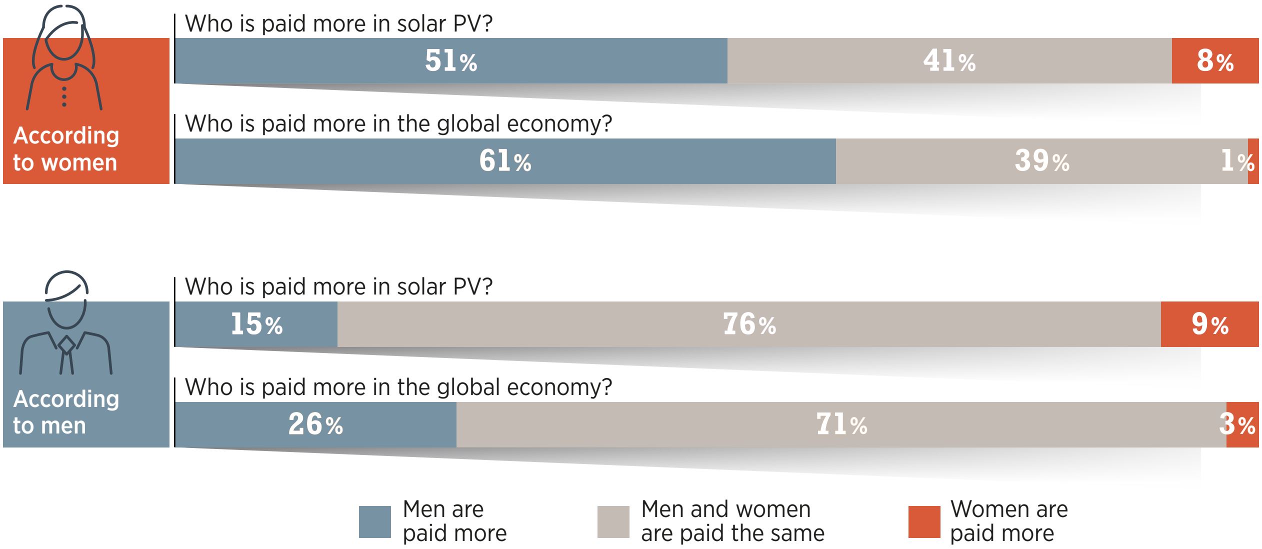
Participants across all regions believe the pay gap in the solar PV industry is lower than in the overall economy

**Figure 2.7** Perceptions of pay gaps in solar PV and the overall economy, by gender



Source: IRENA online solar PV survey, 2021.

Disaggregating responses by gender, men perceive greater pay equity than women, with 76% believing equity to exist in solar PV, compared with 41% of women sharing that perception. A similar difference was observed for pay equity in general although, again, perceptions of equity in solar PV were slightly better than for employment in general. These differences between the responses from men and women were highly significant and very similar to the responses to IRENA's earlier survey of the wind energy sector (see Figure 2.7).

The difference in perception between men and women indicates that pay inequity is a structural problem requiring structural solutions.

Several other factors had a significant effect on perceptions of pay equity and barriers to women's employment. Table 2.3 shows the differences in perceptions of employees of organisations of different sizes, engaged in different activities and with different educational backgrounds.

Generally, perceptions of pay equity are stronger for those working in larger organisations and among employees in manufacturing, where, congruently, perceptions of barriers are much lower as well. Perceptions of pay equity also vary significantly among individuals working in organisations of different sizes[11] (see Table 2.3).

**76%**

**of men believe equity exists in solar PV, compared with 41% of women sharing that perception**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[11] Significance at the 10% probability level.

**Table 2.3** Differences in perceptions of pay equity and barriers, by organisation size and activities

| Organisation size | Who is paid more ? | | |
|---|---|---|---|
| | Men | Neither | Women |
| | % of respondents | | |
| Under 20 | 39% | 52% | 9% |
| 21-50 | 35% | 55% | 10% |
| 51-100 | 34% | 51% | 15% |
| 101-500 | 32% | 57% | 11% |
| 501-1 000 | 38% | 59% | 3% |
| Over 1 000 | 28% | 67% | 5% |

| Activity | Who is paid more ? | | |
|---|---|---|---|
| | Men | Neither | Women |
| | % of respondents | | |
| Developer | 37% | 55% | 8% |
| Other | 38% | 54% | 8% |
| Service provider | 33% | 56% | 11% |
| Installer | 34% | 55% | 12% |
| Manufacturer | 26% | 73% | 1% |

Source: IRENA online solar PV survey, 2021.

To explore why gender pay gaps occur, respondents reporting that pay was not equal were also asked why that might be the case. Figure 2.8 presents the relative frequency of the possible reasons cited by respondents, including the variance in responses where men or women are perceived to be paid more.

The lack of a common pay scale or company policy was the most frequently identified explanation of perceived pay differences, with 45% of respondents citing it as a reason. Differences in the types of work performed was the next most frequent answer (40% of respondents), followed by negotiating skills (35%). Seniority was mentioned by 23% respondents.

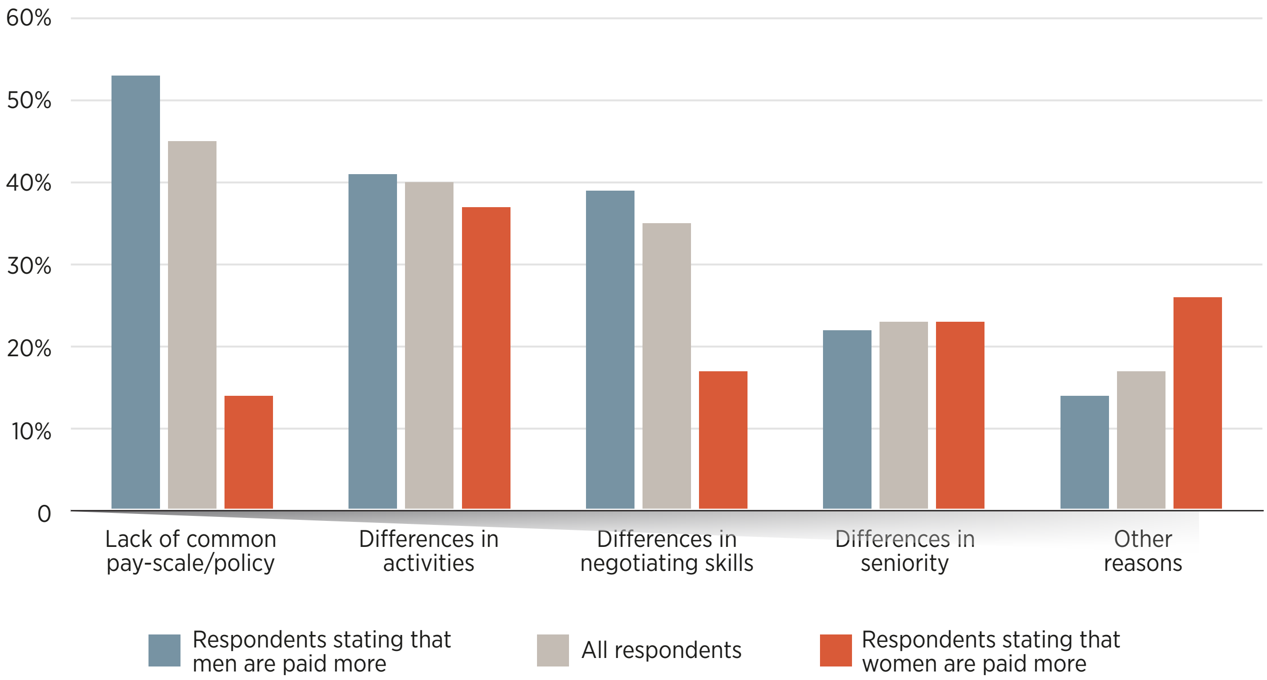
A variety of other reasons were also given, mostly cultural reasons why men or women are expected to do certain types of jobs. Many of these answers mentioned that women are not expected or encouraged to enter careers in engineering.

Employees of manufacturers and large organisations, as well as people working in the Asia-Pacific region, tend to have greater access to some important benefits, higher perceptions of pay equity and lower perceptions of barriers for women in the sector. A large portion of the solar workforce is employed in organisations meeting one or more of these criteria, which may explain why the overall share of female employment in the sector is relatively high. Large manufacturing companies may also be more likely to have common pay scales and policies.

For other regions of the world, activities other than manufacturing and smaller organisations, the sector is not as homogenous and probably requires a different mix of skill sets, experiences and educational qualifications. Under these circumstances, more barriers to women's employment are reported by respondents.

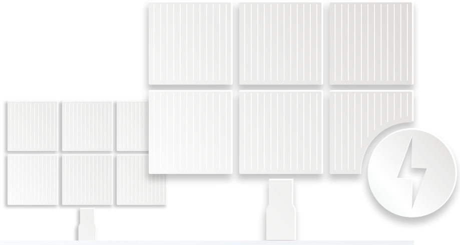
Closing the wage gap and removing the employment barriers that women face demand an investment of time and resources. Chapter 3 explores the measures available and possible solutions.

**Figure 2.8** Reasons given for gender pay gaps



Source: IRENA online solar PV survey, 2021.

**Many factors contribute to the gender wage gap, including discriminatory practices; in this case, against women.**



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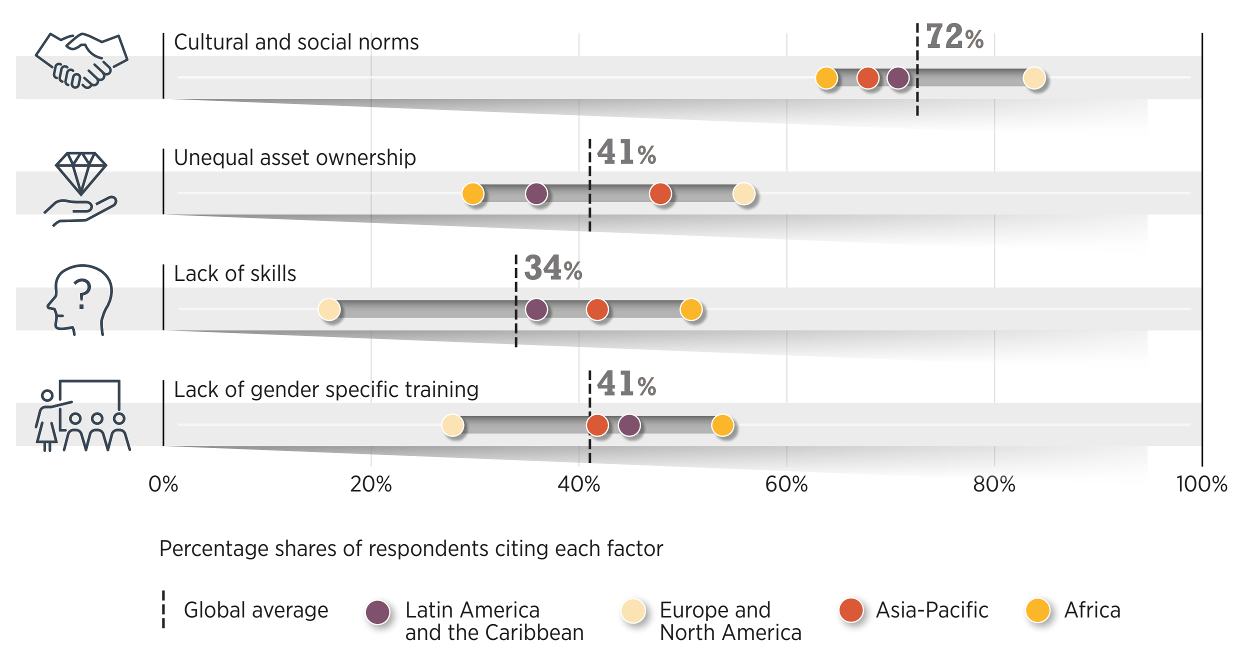
# Up close: Challenges and opportunities for women in off-grid solar power

In contexts where access to modern forms of energy is scarce, off-grid solar-based solutions are playing a growing role in expanding access. Combined with energy efficiency, the off-grid solar PV value chain offers significant opportunities to engage women both in delivering solutions and as beneficiaries. In fact, studies suggest that women, as customers, are great ambassadors for rural electrification. Women who purchase solar kits, for example, refer four new customers on average, compared to three by men (Deign, 2018).

Women represent a vast reservoir of entrepreneurial potential, talent and resilience that can ignite productive activity and anchor a path for sustainable economic development. They are well positioned to lead and support the implementation of innovative energy access via solar PV products and services, including through entrepreneurship (IRENA, 2019). However, restrictive laws in some countries prevent them from participating actively in the economy, notably as entrepreneurs. Additional impediments are found in countries that restrict women's asset ownership (IRENA, 2019; Almodóvar-Reteguis, 2019).

IRENA's 2019 survey found that barriers to women's participation in settings where access to modern forms of energy was being established or expanded were associated with several factors. Cultural and social norms were cited by respondents as the most common impediment, followed by inequity in ownership of assets and lack of gender-sensitive policies and skills (see Figure 2.9). In addition, more than half of the respondents to that survey also cited improving access to finance and mainstreaming the gender perspective in energy access programmes as important to improving women's engagement.

**Figure 2.9** Barriers to women's participation in expanding access to energy using renewables, by region



Source: IRENA, 2019.

Through unpaid work, women play critical roles in the rural economy. They are responsible for the well-being of their family members, including food preparation and caring for children and the elderly, while also functioning as keepers of traditional knowledge, which is critical to the livelihoods, resilience and culture of their communities.

Yet women suffer barriers to economic participation due to gender-based discrimination and societal norms, disproportionate participation in unpaid labour, and uneven access to education, healthcare, property, and banking and other services. This makes them disproportionately vulnerable to the effects of natural catastrophes and climate change (ILO, 2019).

Off-grid solar PV can help redress these imbalances by facilitating women's access to education where lighting is an issue, helping them to improve their livelihoods through productive uses of electricity and allowing them to become decision-makers in household energy management. Wider access to health care, water and sanitation facilitated through off-grid renewables is a particular boon to those who bear a disproportionate share of household and child-related duties.

In the solar PV survey reported in this volume, respondents from the off-grid sector referred to the need for more funding for off-grid projects targeting women as beneficiaries. Respondents also referred to the need for more training, flextime and home-based work, as well as more maternity leave.

In the energy access context, women represent a crucial stakeholder group whose talents and energy should be exploited in the electrification of off-grid areas. Many successful examples suggest how off-grid renewables offer employment opportunities to women and how their engagement brings essential improvements in women's self-perception and empowerment within the community (IRENA, 2019). Several of these are described in Box 2.3. Such initiatives help make women agents of change.

The link between gender inclusion and energy access is well established (UN Women, 2016), as is that between women's empowerment and decent employment (ILO, n.d. b). Solar PV's value chains related to grid extension, mini grids and solar home systems present excellent opportunities for inclusive, sustainable economic growth and a larger supply of decent jobs. Ensuring equitable participation of women and other disadvantaged groups is crucial to create sustainable solar businesses.

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### Box 2.3 Initiatives empowering women in the off-grid solar PV workforce

**Barefoot College** is an example of the transformative potential of training women in rural areas. Over six months, trainees – many of whom are grandmothers – receive instruction on the assembly, installation, operation and maintenance of solar lanterns, lamps, solar water heaters and parabolic cookers, among other devices. The programme has trained over 2 200 women from 93 countries, leading to the deployment of at least 1 million solar systems (Barefoot College, n.d.).

**Solar Sister** is a training and job creation initiative for female entrepreneurs that distributes portable solar lights in rural Sub-Saharan Africa. Over 5 800 Solar Sister Entrepreneurs have reached 2 million people in Africa with clean energy (Solar Sister, n.d.).

**Remote Energy** mentors aspiring Solar PV technicians and motivated instructors in remote and underrepresented communities worldwide. They have trained over 933 students and teachers, with almost half of them women (Remote Energy, n.d.).

# 3

# Practical measures to support women in solar PV


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# 03

Poor representation of women in solar PV can cause several problems. Among them is a skills shortage that is already in evidence, and which may bedevil the sector for an extended period of time. An expanding solar energy sector implies a growing demand for labour. But if women are not properly considered for job openings, the industry runs a severe risk of not having enough professionals to cover its needs. Therefore, not only does the sector need to consider women for its hiring needs, but it must create an attractive environment for them. Offering decent pay and adequate benefits is the first step to attracting talent to the sector.

This section discusses the benefits presently available, according to the organisations and individuals who participated in the survey. There are several ways to increase women's participation in solar PV.

## 3.1 Availability of employment benefits

Growing numbers of organisations understand that they must prioritise their employees' well-being, acknowledging that people are their most important resource.[12] The well-being of employees is an important determinant of an organisation's long-term performance. Many studies reveal a clear relationship between production levels and workers' health and well-being (ILO, n.d.). Meeting employees' needs translates into a commitment to the company, decreases workplace conflicts and improves overall performance. Making available a wide range of benefits will boost employees' happiness and lower their stress levels. This is especially critical in the aftermath of the COVID-19 pandemic (Miller, 2021). Solutions vary widely; they include leadership, communication, and a focus on learning and development. Yet even basic benefits are still not fully available around the world.

**Solutions vary widely; they include leadership, communication, and a focus on learning and development.**
**Yet even basic benefits are still not fully available around the world.**

### Employment benefits according to organisations

To sketch a picture of present realities in solar PV, participating organisations were asked to identify the benefits available to their full-time employees. Figure 3.1 shows the share of the total solar workforce covered by each benefit as well as the same information for women working in the sector.

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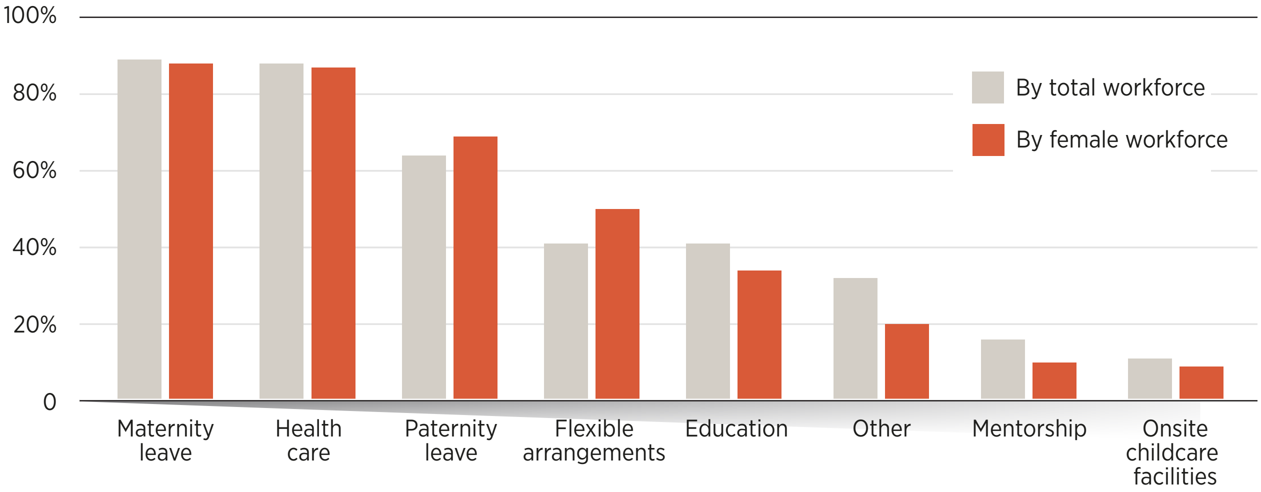
*[12] According to the International Labour Organization, "workplace well-being" relates to all aspects of working life, from the quality and safety of the physical environment, to how workers feel about their work, their working environment, the climate at work and work organisation (ILO, n.d. a).*

**Figure 3.1** Availability of employment benefits



Source: IRENA online solar PV survey, 2021.

The figure shows that maternity leave and health care are available to many employees (benefits that are, in many countries, compulsory and regulated by law). These are followed by paternity leave and flexible work arrangements. The availability of maternity leave and health benefits for women working in solar PV is the same as for the workforce as a whole; probably driven by legal and regulatory requirements in most countries. However, the availability of other benefits, such as education funds and mentorship programmes, were not only lower overall but were lower for women than for men.

One interesting result was that the availability of flexible work was quite low compared with the results from previous surveys (for wind and for the renewables sector as a whole). This is probably due to the weight in the sector of large-scale manufacturers, where the scope for flextime work may be more limited. In smaller companies outside manufacturing, flexibility has probably been more available, especially during the COVID-19 health crisis. The availability of mentoring was also relatively low, possibly for the same reason.

Several "other" benefits are also available for solar PV employees. Some respondents mentioned pension and insurance schemes, profit sharing or bonus schemes, and benefits such as transport and meal subsidies.[13] Again, these mentions could be explained by manufacturing's large share in the sample.

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[13] *Some answers reflected a duplication of other benefits already listed (e.g. health care, education and training).*

## Part-time employment

Several questions were asked about part time employment in organisations. Sixty percent of respondents said that part-time employment is available, which translates, after weighting, into a 10% share of the solar workforce that can avail itself of this option.

For those where part-time work is available, the weighted results showed that 20% do not get any other benefits and 65% get fewer benefits than full-time employees. Only 15% of part-time workers get the same benefits as full-time workers. The share of female employment in part-time jobs (where available) is also relatively low at 25%.

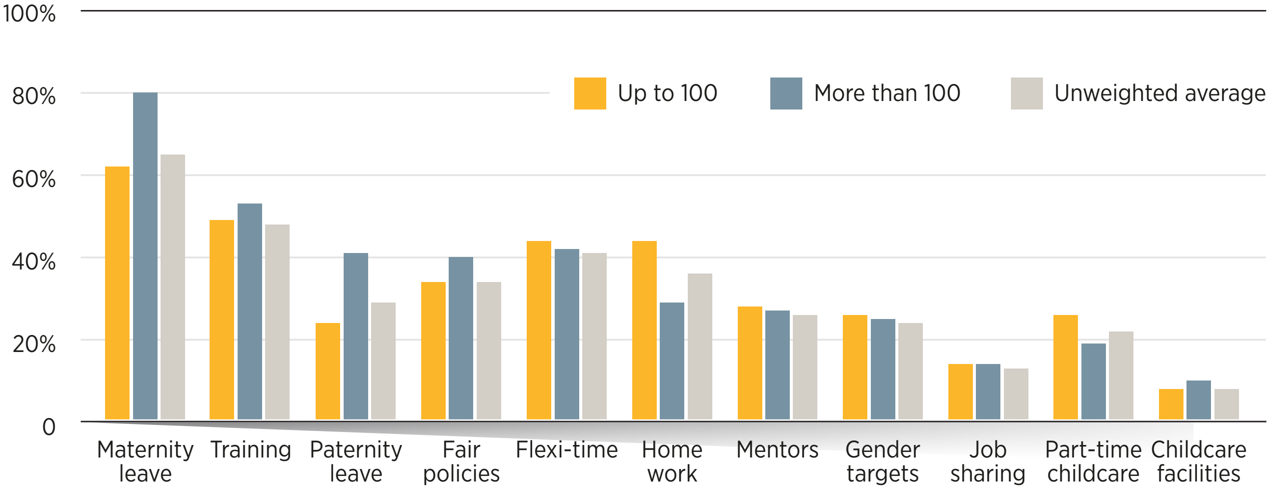
Due to the weighting of the survey responses by location, activity and size, the results for part-time employment largely reflect the situation in large employers and manufacturers. These organisations make a major contribution to full-time female employment in the solar sector, but the results also suggest that these employers do not present many opportunities for part-time employment and the jobs that are available may not be increasing female participation in the workforce.

## Employment benefits according to individuals

Individuals were also asked about the benefits their organisations made available. As in the case of the organisations' responses, the most common benefit mentioned was maternity leave which, as mentioned, is prescribed by law in most countries. However, paternity leave was not reported as available at the rate suggested by responses from participating organisations.

As Figure 3.2 shows, the availability of benefits also differs between small and large organisations. The measures having a positive impact on the reporting of no barriers (maternity and paternity leave, training opportunities, and fairness in policies) are far more frequently available in organisations employing over 100 people than in smaller organisations. Conversely, home-based remote work and part-time work is much more widely available in smaller organisations.

**Figure 3.2** Availability of other employment benefits and measures, by organisation size



Source: IRENA online solar PV survey, 2021.

The upshot is that, as might be expected, there are fewer barriers to female employment in large organisations compared to small organisations, largely due to the greater availability of benefits and measures that lead survey respondents to feel that there are no significant barriers to female employment. For those measures that seem to have a negative impact on the perception of whether there are barriers, this may result from their greater availability in smaller companies (where the positive benefits are less commonly found) rather than indicating that these benefits have a negative impact on female employment.

## 3.2 Broader solutions to supporting women in the solar PV workforce

Women face significant obstacles in gaining access to decent work. Measures to eliminate those barriers are critical. IRENA's solar PV survey included a question on preferred solutions (see Figure 3.3).

Additional measures that would be helpful for the solar PV sub-sector, and for the overall economy, are discussed below.

A majority of the respondents simply mention the need for equal opportunity and no discrimination. However, the other half were more specific, citing **equality in recruitment and promotion**, decision making and other aspects of their work. Several respondents mentioned the need for someone (manager, director) with responsibility for gender issues. A few mentioned measures such as anonymising CVs and ensuring women's representation on interview panels. While only one respondent suggested the need for new laws or regulations on gender equality or discrimination, several others felt that existing laws on this issue needed to be implemented or enforced.

**Figure 3.3** Preferences for measures to support women in solar PV energy

Source: IRENA online solar PV survey, 2021.

The second most commonly mentioned specific measure was a **target or quota for women's recruitment or employment** – or some sort of affirmative action. This was usually mentioned in terms of general recruitment, but some respondents specifically mentioned recruitment or promotion of women into senior positions. Respondents also mentioned training, sponsorships, internships or education (grouped together as **"capacity building"**). While most referred simply to more training for women, quite a few mentioned improving women's access to existing training and capacity-building activities. A number also mentioned more generally the need to encourage women to take STEM courses and pursue other relevant qualifications or for schools to begin breaking down perceptions that women are not suited to careers in these areas.

**Maternity and paternity leave, flexible or home-based work** opportunities and **improvements in workplace facilities and practices** were each mentioned by around 10% of respondents. These responses covered a wide variety of issues. With respect to maternity leave, very few mentioned that this was needed (*i.e.* does not exist); most suggested improvements, usually an expansion of coverage to staff who do not currently qualify or the improvement of benefits. However, several mentioned other problems related to maternity leave and its impact on women's careers, stating that the career break clearly has an impact on women's professional growth and development. Quite a few respondents also mentioned the need for men to be treated equally by making paternity leave available.

**Mentoring/networking, cultural change** (in general) and **gender training/mainstreaming** (within organisations) were each mentioned by 6% of respondents. The need for **improved workplace safety for women** (codes of conduct, combatting harassment) was mentioned as well, together with the need for greater transparency in pay, hiring and other areas (as seen in Figure 3.3).

## Understanding the complexity of issues women face by raising gender awareness

Through **gender awareness**, solar PV companies can increase general sensitivity, understanding and knowledge about the challenges that women face, as well as the ingrained bias against women that 9 out of 10 men and women around the world hold (UNDP, 2020).

Gender awareness can also support solar PV by promoting the idea that the sector presents opportunities for women.

Additionally, raising awareness about gender will make it easier to include a gender perspective in policies, programmes, projects and services that respond to the differential needs of women and men, and to eliminate negative economic, social and cultural practices that impede equality and equity.

## Improving national policies and removing restrictive laws

Billions of women still do not have the same legal rights as men, and nearly 2.4 billion women of working age worldwide are still not afforded equal economic opportunities. Some countries still have laws that actually prevent women from working in specific jobs or require a man's consent to such work (World Bank, 2022). **Removing these restrictions** is imperative, not only as a matter of fairness, but because gender equality makes economic sense, as it increases productivity and improves the welfare of families and children while boosting per capita GDP over time.

Countries can take many measures to combat the forms of discrimination and inequality that affect women.

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The key is **mainstreaming gender equality** and women's empowerment within all their policies and programmes, including education, labour and property laws.

**The right to education** on the basis of non-discrimination and equality is recognised under human rights law (United Nations, n.d.). Yet women and girls continue to face gender-based barriers to exercising their right to education. Girls and women are often steered away from science and math. Educators need to ensure that young girls are encouraged to explore their potential and remove the bias that women should pursue only certain careers (such as care-giving or administration).

Additionally, **integrating a gender lens into national labour** laws – that is, provisions making those laws sensitive to gender issues – is critical to ensure that women's rights are protected and to guarantee that women have **equal job opportunities** and receive the **same wage for equivalent work** as men. Furthermore, legislation and regulations should protect those who choose to start a family, ensuring that all parents are entitled to **parental leave**.[14] Paternity leave can help fight cultural and social norms, as it can lay the groundwork for more equitable responsibility sharing in the future and shape fathers' decisions about how to devote resources to childcare, household duties, and paid labour in later years.

Despite these benefits, however, fewer than half of the countries in the world offer statutory paid paternity leave at present (Promundo, 2019), and the statutory paid minimum is often no more than a few days. Longer leave periods are typically voluntary, with the result that few men take them for fear of career setbacks (New York Times, 2021b).

While the potential of women as entrepreneurs is under-utilised across the economy, solar PV is a sector with unique conditions to empower women's entrepreneurship, especially in the off-grid context. Solar entrepreneurship can allow women to become **financially independent** while boosting efforts to bring clean energy to all. However, existing gender gaps in access to finance, information, technology, goods and services, and markets make this an elusive goal. Efforts are needed to facilitate access to finance and capital for women entrepreneurs, and to abolish restrictive laws.[15]

## Establishing better workplace practices, policies and regulations

While a bedrock of national laws and regulations is needed to combat workplace gender discrimination, organisations can adopt additional measures to ensure that women are **fully represented in the workforce** and are empowered to take up leadership positions.

First, organisations can **gather more gender-disaggregated data**. Gender statistics are scarce but critical. They reflect the workplace realities of women and men. Establishing a clear picture is the basis for designing proper gender policies and the first step towards improving women's representation at all levels. **Gender quotas** can be put in place to correct gender disparities in various occupational roles and leadership positions.

Also, organisations need to **increase transparency**, particularly related to **hiring practises, promotions, and equal pay**. Hiring processes could include salaries on job advertisements, for instance, to close gender and ethnicity pay gaps. Eliminating the pay gap would create trust between the organisation and female employees, improving morale and working relationships.

If not required by law (or if the law is very conservative), organisations can take the lead in offering **maternity and paternity leave** to employees. Promoting work-family balance and a more equal sharing of care responsibilities can be achieved by facilitating, and perhaps even subsidising, workplace **child-care or breast-feeding facilities**. This can result in better access to a larger talent pool

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*[14] While this report focuses on parental leave for mothers and fathers, IRENA acknowledges that there are many other kinds of families (families with two mothers or two fathers, adoptive families, and so on) that face similar challenges and thus can benefit from parental leave.*

*[15] Many countries still legally undermine women's economic participation and under-value women's work. Of the 189 economies surveyed for the World Bank's 2018 report on Women, Business and the Law, 90% have at least one regulation that impedes women's economic opportunities.*

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for the organisation (including of women in management positions).

The global workforce is rapidly evolving, and the preference for workplace flexibility is increasing, especially in the wake of the COVID-19 health crisis and the rise of remote work. Organisations can provide **flexibility in work arrangements**. Flexible work arrangements include hybrid work, telecommuting, remote work, condensed work weeks, flextime, part-time work, shift work and job sharing. Allowing employees to adapt their traditional office schedules to meet personal or family needs can result in lower absenteeism, longer tenure, less turnover and generally better performance. Flexible work arrangements help women only if they are also offered to men; otherwise, such measures may actually make things worse for women (Ruppanner and Meekes, 2021).

### Forming networks and systems to support training and mentorship

Organisations can support women by **facilitating training, mentorship and network systems**. These can arise within single organisations, but a growing body of industry associations and women's networks are coming together within sectors. This is true of solar PV and the broader renewable energy landscape.

**Networking** is important for career development and success. Often, women have fewer opportunities to develop and exercise networking skills. Because professional networks are closely implicated in career advancement, limited access becomes an obstacle to women's progress. Networks empower women by connecting them with other expert women who could become long-term business contacts. Whether these networks operate within solar PV or the broader renewable energy sector, they provide an excellent platform for securing advice from peers and experts and for sharing knowledge and experiences. They promote greater visibility for women, offer mentoring opportunities and professional connections, and even provide career opportunities, including internships that allow them to make a start in the workforce. They also allow women to become role models, which can change other women's self-perceptions and increase awareness of the multiple opportunities available to them.

Some examples of such networks include: Women in Solar Energy (WISE), a network to foster diversity and inclusion in all aspects of the solar energy industry (WISE, n.d.); MESol is a Brazilian support network for women in solar energy (Rede MESol, n.d.); AMES (Asociación de Mujeres en Energía Sustentable) (AMES, n.d.); and Global Women's Network for the Energy Transition (GWNET, n.d.).

Beyond networks, skills training and education can help to level the playing field between women and men. **Dedicated training programmes** can provide women with the skills and knowledge they need to become competitive and confident decision makers, technicians and educators in the solar PV industry.

Women's participation in the solar PV industry and the renewable energy sector more broadly can enhance women's quality of life while benefitting the sector, boosting economic growth, and assisting governments in providing gender-balanced, sustainable energy for all.

# 4

# The ultimate goal: Diversifying the solar PV workforce

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# 04

There is no quick fix to improving women's representation in solar PV, the renewable energy sector, or the economy at large. To make meaningful progress, the solar PV industry should implement measures to attract, retain and promote women.

- **Attraction.** Provide access to training at all levels and remove restrictive laws to unlock new livelihood opportunities focusing on access to financing and markets.
- **Retention.** Ensure leadership accountability and managerial support, especially in the childbearing years.
- **Promotion.** Foster networks and mentoring for women to help build tomorrow's leaders. Setting gender quotas to encourage gender diversity on corporate boards can improve a company's profitability.[16]

Achieving diversity in the renewable energy sector is critical to making the energy system inclusive and sustainable. When societies become more equal and equitable, economies become more resilient. For that, the solar PV sub-sector, the renewable energy sector, and the larger energy sector must mainstream gender at all levels, including policy making, programme design and project implementation.

While *engendering*[17] the energy sector is critical, diversity extends beyond women. Energy transition efforts must incorporate an economic empowerment agenda that builds on and values everyone's vision, talents and skills: women, minority groups, indigenous communities, migrants and refugees, elders and youth, LGBTIQA+,[18] people with disabilities, and other disadvantaged groups. Addressing the interests of single segments of the population runs the risk of creating new inequities.

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*[16] Including women in C-suite positions can translate into a 15% increase in profitability for a typical firm (Harvard Business Review, 2016).*

*[17] Engendering: to endow with gender; to create gender or enhance the importance of gender. Ensuring women's empowerment within society and the energy transition, supporting women as active agents, instead of as passive beneficiaries (IRENA, 2019).*

*[18] LGBTIQA+ stands for lesbian, gay, bisexual, transgender, intersex, queer/questioning, asexual and many other terms (such as non-binary and pansexual) (ILO, 2022b).*

# References

**Almodóvar-Reteguis, N.L. (2019),** "Where in the world do women still face legal barriers to own and administer assets?" World Bank Data Blog. https://blogs.worldbank.org/opendata/where-world-do-women-still-face-legal-barriers-own-and-administer-assets.

**CEC (2021),** Clean Energy Council, Australian Power Institute, and Electrical Trades Union. *Empowering Everyone Diversity in the Australian Clean Energy Sector. Gender + Solar Factsheet* https://assets.cleanenergycouncil.org.au/documents/advocacy-initiatives/women/Diversity-gender-and-solar-one-pager.pdf

**AMES (n.d.),** Asociación de Mujeres en Energía Sustentable. https://www.linkedin.com/company/amesargentina/.

**Ban, Ki-moon (2016),** "Gender Equality 'Greatest Human Rights Challenge of Our Time', Secretary-General Tells High-Level Panel on Women's Economic Empowerment, un.org: www.un.org/press/en/2016/sgsm18122.doc.htm.

**Barefoot College (n.d.),** www.barefootcollege.org/ (accessed 24 July 2022).

**BCG (2021),** "Untapped Reserves 2.0: Driving Gender Balance in Oil and Gas". www.bcg.com/publications/2021/gender-diversity-in-oil-gas-industry.

**CFF and GIZ (2021),** *Solar Energy in Brazil: Which [sic] Are the Barriers and Opportunities for Women Professionals in the Sector?* C40 Cities Finance Facility and Deutsche Gesellschaft für Internationale Zusammenarbeit, Bonn and Eschborn, Germany. https://cff-prod.s3.amazonaws.com/storage/files/xN8vR2JvpEAKhG8YfklmnPXXukMtDErJvDNknQzS.pdf.

**Clerkin, C. (2017),** *What Women Want – and Why You Want Women – in the Workplace*. Center for Creative Leadership and Watermark. https://cclinnovation.org/wp-content/uploads/2020/03/whatwomenwant.final_.pdf?webSyncID=5d4e31b8-170d-28b6-6996-287043c8e393&sessionGUID=d1354dce-b354-6c5b-6459-c7a7abe17db8.

**Criado Perez, C. (2019),** *Invisible Women: Data Bias in a World Designed for Men.* Abrams Books, New York. www.abramsbooks.com/product/invisible-women_9781419735219/.

**Deign, J. (2018),** *Why Gender Is Key to African Off-Grid Solar Energy Sales.* Wood Mackenzie. www.greentechmedia.com/articles/read/why-gender-is-key-to-african-off-grid-energy-sales.

**Donner, F. and E. Goldberg (2021),** "In 25 years, the pay gap has shrunk by just 8 cents". *New York Times*, 24 March. www.nytimes.com/2021/03/24/us/equal-pay-day-explainer.html.

**Grant Thornton (2021),** *Women in Business 2021: A Window of Opportunity*. www.grantthornton.de/globalassets/1.-member-firms/global/insights/women-in-business/2021/grant-thornton-women-in-business-report-2021.pdf.

**GWNET (Global Women's Network for the Energy Transition) (n.d.),** www.globalwomennet.org/about-gwnet/ (accessed 24 July 2022).

**Harvard Business Review (2016),** "Study: Firms with more women in the C-suite are more profitable". https://hbr.org/2016/02/study-firms-with-more-women-in-the-c-suite-are-more-profitable.

**ILO (2019),** *Empowering Women in the Rural Economy.* International Labour Organization, Geneva. www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/publication/wcms_601071.pdf.

**ILO (2020),** "Women in managerial and leadership positions in the G20 – Data availability and preliminary findings". www.ilo.org/global/about-the-ilo/how-the-ilo-works/multilateral-system/g20/reports/WCMS_762098/lang--en/index.htm (accessed 24 July 2022).

**ILO (2022a),** ILOSTAT (database). https://ilostat.ilo.org (accessed 24 July 2022).

**ILO (2022b),** *Inclusion of lesbian, gay, bisexual, transgender, intersex and queer (LGBTIQ+) persons in the world of work: A learning guide.* International Labour Organization, Geneva. www.ilo.org/wcmsp5/groups/public/---dgreports/---gender/documents/publication/wcms_846108.pdf.

**ILO (n.d. a),** "Workplace well-being". www.ilo.org/safework/areasofwork/workplace-health-promotion-and-well-being/WCMS_118396/lang--en/index.htm.

**ILO (n.d. b),** *Women's Empowerment through Employment and Health (WEEH),* www.ilo.org/declaration/follow-up/tcprojects/eliminationofdiscrimination/WCMS_164818/lang--en/index.htm.

**IRENA (2016),** *Leveraging Local Capacity for Solar PV.* International Renewable Energy Agency, Abu Dhabi.

**IRENA (2019),** Renewable Energy: A Gender Perspective. International Renewable Energy Agency, Abu Dhabi.

**IRENA (2020a),** *Wind Energy: A Gender Perspective.* International Renewable Energy Agency, Abu Dhabi.

**IRENA (2020b),** The Post-COVID Recovery: An Agenda for Resilience, Development and Equality. International Renewable Energy Agency, Abu Dhabi.

**IRENA (2021a),** *Renewable Energy and Jobs: Annual Review 2021.* International Renewable Energy Agency, Abu Dhabi.

**IRENA (2022),** World Energy Transitions Outlook: 1.5°C Pathway. International Renewable Energy Agency, Abu Dhabi.

**IRENA and ILO (2022),** *Renewable Energy and Jobs: Annual Review 2022.* International Renewable Energy Agency, Abu Dhabi.

**Jayachandran, S. (2021),** "Universal Paternity Leave Needs More Than New Laws for a Push". *New York Times.* Article updated 18 October 2021. www.nytimes.com/2021/06/25/business/paternity-leave-companies-fear.html.

**Leung, M. D. (2016),** *The dilemma of mobility: The differential effects of women and men's erratic career paths.* IRLE Working Paper 111-16, University of California at Berkeley. www.irle.berkeley.edu/files/2016/The-dilemma-of-mobility.pdf.

**McKinsey and Company (2021),** "Women in the workplace". www.mckinsey.com/featured-insights/diversity-and-inclusion/women-in-the-workplace.

**Miller, S. (2021),** "Employers enhance well-being benefits for a post-pandemic workforce". Society for Human Resource Management. www.shrm.org/resourcesandtools/hr-topics/benefits/pages/employers-enhance-well-being-benefits-for-a-post-pandemic-workforce.aspx.

**Promundo (2019),** *State of the World's Fathers Unlocking the Power of Men's Care 2019* https://promundoglobal.org/wp-content/uploads/2019/06/SOWF-2019_006_WEB.pdf

**Rede MESol (n.d.),** https://linktr.ee/RedeMesol (accessed 24 July 2022).

**Remote Energy (n.d.),** https://www.remoteenergy.org/ (accessed 24 July 2022).

**Ruppanner, L. and J. Meekes. (2021),** "Flexible work arrangement help women but only if they are also offered to men". The Conversation (website). https://theconversation.com/flexible-work-arrangements-help-women-but-only-if-they-are-also-offered-to-men-155882.

**SEIA, Solar Foundation and IREC (2021),** *National Solar Jobs Census 2020.* Solar Energy Industries Association, Washington, DC. https://irecusa.org/wp-content/uploads/2021/07/National-Solar-Jobs-Census-2020-FINAL.pdf.

**Solar Foundation and SEIA (2020),** *U.S. Solar Industry Diversity Study 2019: New Resources on Diversity and Inclusion in the Solar Workforce.* Interstate Renewable Energy Council, Albany, NY, USA. www.seia.org/sites/default/files/2019-05/Solar-Industry-Diversity-Study-2019.pdf.

**Solar Sister (n.d.),** https://solarsister.org/ (accessed 24 July 2022).

**Spiggle, T. (2021),** "The gender pay gap: Why it's still here". *Forbes,* 25 May. www.forbes.com/sites/tomspiggle/2021/05/25/the-gender-pay-gap-why-its-still-here/?sh=41b2c8f67baf.

**UN Women (2016),** *Leveraging Co-Benefits between Gender Equality and Climate Action for Sustainable Development: Mainstreaming Gender Considerations in Climate Change Projects.* UN Women, New York. https://unfccc.int/files/gender_and_climate_change/application/pdf/leveraging_cobenefits.pdf.

**UNESCO (2017),** Cracking the Code: Girls' and Women's Education in Science, Technology, Engineering and Mathematics (STEM). UNESCO, Paris. https://unesdoc.unesco.org/ark:/48223/pf0000253479.

**UNDP (2020),** *2020 Gender Social Norms Index (GSNI): Tackling Social Norms: A Game Changer for Gender Inequalities.* United Nations Development Programme, New York. https://hdr.undp.org/system/files/documents/hdperspectivesgsnipdf_1.pdf.

**United Nations (n.d.),** "Goal 5: Achieve gender equality and empower all women and girls". UN Sustainable Development Goals. www.un.org/sustainabledevelopment/gender-equality/.

**United Nations (n.d.),** "Universal Declaration of Human Rights". www.un.org/en/about-us/universal-declaration-of-human-rights.

**Williams, A. and I. Luginaah (2021),** *Geography, Health and Sustainability: Gender Matters Globally.* Routledge, London. www.routledge.com/Geography-Health-and-Sustainability-Gender-Matters-Globally/Williams-Luginaah/p/book/9780367743901.

**WISE (n.d.),** www.linkedin.com/company/women-in-solar-energy/ (accessed 24 July 2022).

**World Bank (2022),** *Women, Business and the Law 2022.* World Bank Group, Washington, DC. http://hdl.handle.net/10986/36945.

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# Annex. IRENA's 2021 online survey on gender and solar PV energy

The International Renewable Energy Agency (IRENA) conducted an online survey on gender and solar PV energy ([www.irena.org/solargendersurvey](www.irena.org/solargendersurvey)) from 8 March 2021 (International Women's Day) through 31 December 2021. The objective of the survey was to gather quantitative and qualitative information about women's participation in the solar PV energy sector, the challenges women face, and respondents' suggestions for improving gender diversity across the industry. It was an open survey; anyone accessing the online link could complete it.

Respondents could complete the survey either as individuals or as representatives of their employer (organisations). From those participating as individuals, the survey collected perceptions of the main barriers to attracting and retaining women in the workforce and solicited suggestions about how to surmount those barriers. From those responding as representatives of organisations, the survey asked for more quantitative information about the gender distribution in the organisation's workforce and the policies and measures used to support greater gender diversity. Answering these questions required some knowledge of the relevant staff statistics, so the respondents who were targeted to complete this part of the questionnaire were, most likely, human resources staff.

## Response statistics

Total respondents: **1 283**

- On behalf of an organisation: **294**
- As individuals: **984**

An additional **437** respondents started the survey but did not complete it.

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## A.1. Limitations of the survey

As noted in IRENA's previous gender surveys, online surveys can result in several types of bias. However, as this survey focused on one sector (solar), more is known about the population of interest (employees in the sector). Thus, it is possible to adjust for some issues through the use of weights that reflect the distribution of characteristics in the underlying population. The potential effect of various characteristics on the reliability of the survey results are described below.

**Location.** Respondents' regional location may affect their responses to survey questions. For that reason, location is a critical factor that should be considered in the calculation of global averages.

Table A.1 shows the distribution of employment in the solar PV sub-sector across regions and compares this to the responses received in the survey. As the table shows, the Asia-Pacific region was under-represented in the sample, and the three other regions were over-represented. To adjust for these differences, weights were used to calculate global averages, so that they would more accurately reflect the regional distribution of employment in the sector.

**Main activities.** Examination of the distribution of employment among different activities in the solar PV sub-sector had no significant effect on the responses to the questions asked in this survey. Thus, any bias introduced by possible over or under-representation of different types of organisations in the sample is likely to be quite small.

To account for the fact that many organisations work in several renewable energy technologies, a question was also added to the survey asking both organisations and individuals to specify the proportion of their **activities** that are related to solar energy. For organisations, the unweighted average of the response to this question was 69% but, after accounting for location and the size of organisation, the figure was 75%. For individuals, the corresponding figures were 64% and 71%, respectively (with the latter only adjusted for location). In the analysis, the answer to this question by each respondent was used as an additional weighting factor in the calculation of global averages and totals.

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**Table A.1** Location of survey respondents and employment in solar PV

| | Share of employment in solar PV | Responding as representatives of organisations | | Individuals | |
|---|---|---|---|---|---|
| Region | | Share of responses | Weight | Responses | Weight |
| Africa | 5% | 34% | 0.15 | 30% | 0.16 |
| Asia-Pacific | 80% | 26% | 3.09 | 31% | 2.59 |
| Europe and North America | 12% | 26% | 0.46 | 22% | 0.54 |
| Latin America and Caribbean | 3% | 15% | 0.19 | 17% | 0.17 |

Source: IRENA online solar PV survey, 2021.

**Size of organisation.** Size is an important variable in the calculation of global averages for two reasons. First, as with any other variable, answers may differ significantly between respondents from organisations of different sizes. Indeed, this was found to be the case for some questions. Second, and more important, size is a crucial variable for the interpretation of responses from organisations, where each reply must be treated as though it represents multiple employees in the sector.

For responses from organisations, each reply was treated as representing the number of employees in that organisation. This was calculated as the mid-point of the corresponding size category.[19] This implicitly assumes that the sampling fraction (proportion of organisations surveyed in each size class) is the same.

Given the huge difference in number of employees in the smaller and larger size classes, the responses from large organisations have a very large impact on the calculation of global averages. Figure A.2 shows that organisations with over 1 000 employees have a weight of 86% in the calculation of global averages, and the three largest groups with employment of over 100 people have a weight of 98% in the calculation.[20]

Certainly, the replies from organisations cannot be treated with equal weight, but the weighting of replies by the number of employees in each respondent's organisation risks over-representing large originations. Ideally, future surveys should start with a better indication of the distribution of employment across the size categories used in the survey.

For individuals, the responses were not weighted by organisation size, but were adjusted for location and the share of each individual's work activities related to the solar sector. The information about organisation size reported by individuals was also used to calculate an alternative

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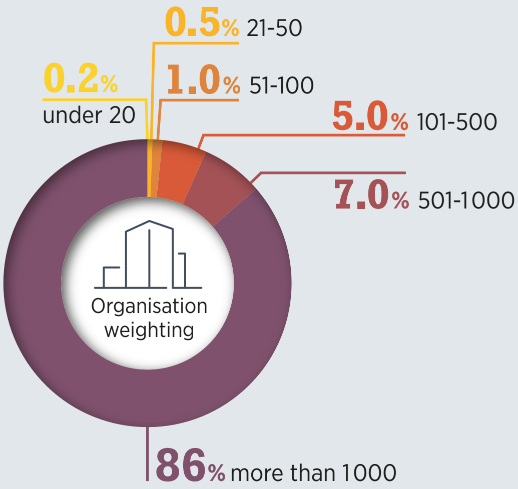
*[19] For the largest size of "over 1 000 employees" a value of 3 200 employees was used, based on the average size of companies with over 1 000 employees taken from an online directory of companies in the sector.*

*[20] This impact of organisation size on global averages is almost exactly the same as recorded in the previous survey of gender and employment in the wind sub-sector.*

**Figure A.2** Weight of organisation size categories in calculation of global averages



Source: IRENA online solar PV survey, 2021.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measure of the female employment share to see how sensitive that calculation is to the distribution of employment across organisations of different sizes.

**Sex and educational status of individuals:** Women were slightly over-represented in the individual responses to the survey, accounting for 54% of responses against their 40% estimated share of employment. Where there are major differences between the sexes in responses, the results are presented for each group separately.

In terms of educational status, the under-representation of non-degree holders is a concern in a few cases where they held views significantly different from those of the rest of the sample. However, lacking statistics about the distribution of employment in the sector by education level or even job type, it was not possible to adjust the sample to correct for this factor.

## A.2. Representativeness of the survey

Based on the stated organisation size, the responses from organisations presented the current employment and benefits packages of 136 000 people, of whom 88 500 work in solar energy. IRENA's latest estimate of total global employment in solar energy is 4 million people, so the sample can be considered to represent 2.2% of the global solar workforce.

For the calculation of global averages, the replies from organisations were adjusted for location, the share of activities related to solar energy, and organisation size. The first two adjustments were made so that the survey responses would more accurately reflect the population of all employees working in the sector, but the grossing up of sample results based on the distribution of organisation sizes reported in the survey remains a weakness of the analysis.

Similarly, for individuals, the first two adjustments were also applied to the survey results, but no adjustment was made for organisation size (so this remains a source of uncertainty in the analysis). The other major issue for the analysis of individual responses is the distribution of responses by education level, which is likely to be heavily biased towards degree holders. This could also affect the accuracy of those results.

Wherever these potential sources of bias might be an issue, we endeavoured to note this in the text.


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International Renewable Energy Agency

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# A GENDER PERSPECTIVE

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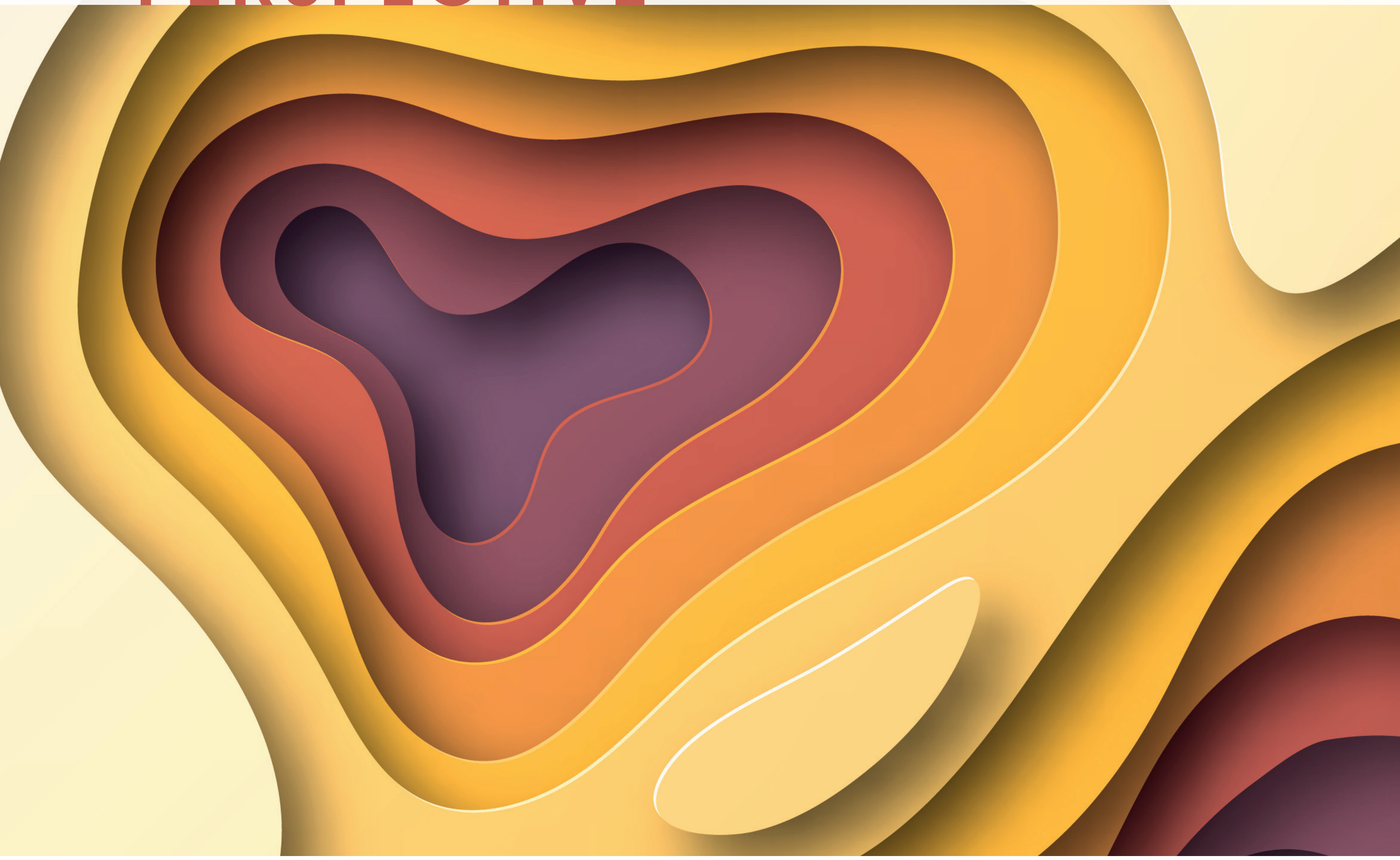

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