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Women working in the rooftop solar sector

A look at India's transition to clean energy

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Abstract

India's rooftop solar targets represent a major opportunity for sustainable development and for women's employment. While India has shown a strong commitment towards a clean energy transition through its renewable electricity installation target for 2022, deployment of rooftop solar technology has been slow. With the potential to create a large number of jobs in general, the rooftop solar sector also generates the types of jobs attractive to highly skilled women in particular, a largely untapped pool in India.

Our analysis, based on a survey of rooftop solar companies as well as qualitative interviews with women currently employed in the sector, seeks to identify opportunities for better gender balance at work, as well as barriers to achieving it. Women currently account for only 11% of the workforce in the companies we surveyed. Participation of women is particularly low in roles involving frequent travel and a required onsite presence at project sites.

We recommend that the government enhance policies to scale up the rooftop solar market by addressing the general challenges facing this sector, and introduce gender-targeted policies to enable and encourage companies to advance actions that effectively support women's employment in this sector.

Highlights

- Women account for an estimated 11% of the workforce in the rooftop solar sector in India, significantly less than the global average of women in the renewables sector, at 32%. However, it is higher than the percentage of women in other energy sectors in India, such as coal, oil and gas companies, and electricity utilities.

- Women's participation varies across the value chain of rooftop solar companies. The design and pre-construction phase, and corporate segment – which offer mostly office-based positions – have a relatively high share of female employees at 18% and 34%, respectively. In the area of construction and commissioning, women constitute 3%, and, in operations and maintenance, a mere 1%. Both areas involve frequent site visits or onsite work.

- Factors governing the low representation of women include a lack of access to opportunities for women due to safety and security concerns at project sites and misperceptions of women's capabilities in some roles; insufficient human resource policies beyond legally mandated requirements; societal norms and practices at workplaces that fail to factor in the differentiated needs of women, and consciousness among employees.

- Policy makers can increase policies to accelerate the deployment of rooftop solar by addressing general challenges faced by the sector, such as high costs and a lack of appropriate financing.

- They can also create gender-targeted policies to enable companies to advance towards gender parity and ensure that the sector's growth will be gender-inclusive by tapping into the large, underutilised pool of India's highly educated women.

Executive summary

The importance of rooftop solar generation to India cannot be overstated. It contributes to energy security, replacing conventional power from the grid and diesel-based back-up generators at the point of consumption. It enhances multiple uses of land, a scarce resource, eliminating the need to engage in the complex process for land acquisition, and, in addition, it usually does not require additional transmission infrastructure.

While pursuing its renewable energy targets, India is also working to realise four of the United Nations Sustainable Development Goals: gender equality; access to affordable clean energy; inclusive and sustainable economic growth; and mitigation of climate change. In order to take stock of India's progress towards these goals, we chose the rooftop solar sector in India as a case study to assess the impact of a clean energy transition on women's employment.

Given both the high number and diverse types of jobs that the rooftop solar technology sector generates, it is well positioned to adopt a gender-responsive approach to employment which will attract professionally educated and trained women. For the benefits to accrue, however, deployment, which has been slow, must accelerate.

Given the lack of publicly available gender-disaggregated employment data, we conducted both quantitative surveys and qualitative interviews with rooftop solar project developers, and with engineering, procurement, and construction (EPC) companies, representing over 40% and about 20% of the market, respectively.

Our findings reveal that women represent on average 11% of the workforce across the companies surveyed. While this is lower than the global average of 32% for women in the renewable sector overall, it is higher than the percentage of women employed in other energy sectors in India – which is less than 10% in coal, oil and gas companies, and electricity utilities.

Women's participation varies across the value chain of rooftop solar companies. Participation is relatively high in the design and pre-construction phase, and corporate functions (at 18% and 34%, respectively). But women constitute less than 3% in the area of construction and commissioning, and only 1% in operations and maintenance, which involves frequent travel and onsite project work.

Gender ratios also vary across positions. At the top of the corporate hierarchy, only one-third of the companies surveyed have a female board member. None have more than one woman. Women in senior and mid-level management, in most cases lead a team or department in the support functions in divisions such as human resources, accounting and finance, and institutional relations. It is rare for women to head engineering or sales teams.

The low participation of women in some core business segments and senior management positions is in part a reflection of the low ratio of female applicants for these positions in the core phases requiring civil, mechanical and electrical engineering education or professional experience. While some companies admitted a bias towards women for roles requiring an engineering background, the low application rate is more likely to result from women's "self-selection" out of these positions rather than a lack of qualifications or skills. Indeed, the share of female students studying engineering and technology in India, a highly appreciated academic background for the rooftop solar sector, is over 30%, one of the highest in the world.

To summarise, factors governing the low representation of women include: 1) a lack of access to opportunities for women due to safety and security concerns at project sites and misperceptions of women's capabilities in the engineering field; 2) insufficient human resource policies beyond legally mandated requirements at the company and sector level 3) societal norms and practices at workplaces that fail to recognise and factor in the differentiated needs of female employees and 4) consciousness among employees.

We suggest two approaches to policy making. First, policy makers can enhance policies to scale up the rooftop solar market. Policies must address the issues underlying the slow deployment rate, such as the higher costs of procurement and installation of rooftop solar systems given their smaller size and distributed characteristics; and their higher financing costs compared to utility solar. Frameworks to evaluate the credit worthiness of smaller companies and consumers need to be established.

Second, policy makers can design gender-targeted policies that encourage and enable companies become more gender-inclusive. For example, encouraging investment in facilities that are suitable for women at project sites; setting guidelines for flexible working arrangements; having the public social security system contribute to cover the personnel costs during an employee's parental leave that is currently covered entirely by employers; and introducing a campaign to increase women's leadership.

Section 1. Employment in India's clean energy sector

The International Energy Agency (IEA) and the Council on Energy, Environment and Water (CEEW) jointly undertook this study, commissioned by Natural Resources Canada, to explore the potential employment impact on women of enhanced deployment of rooftop solar technology in India, an essential component in the transition to clean energy in this country. The topic of job creation potential for women in the off-grid renewable sector is well documented, particularly in the context of energy access. But few in-depth studies exist on the topic of careers for women in a grid-connected renewable sector such as rooftop solar. We assessed the job opportunities available in this sector for women interested in pursuing career development, with the aim of providing policy makers, companies and investors with a solid analytical basis for making decisions in this new area of research.

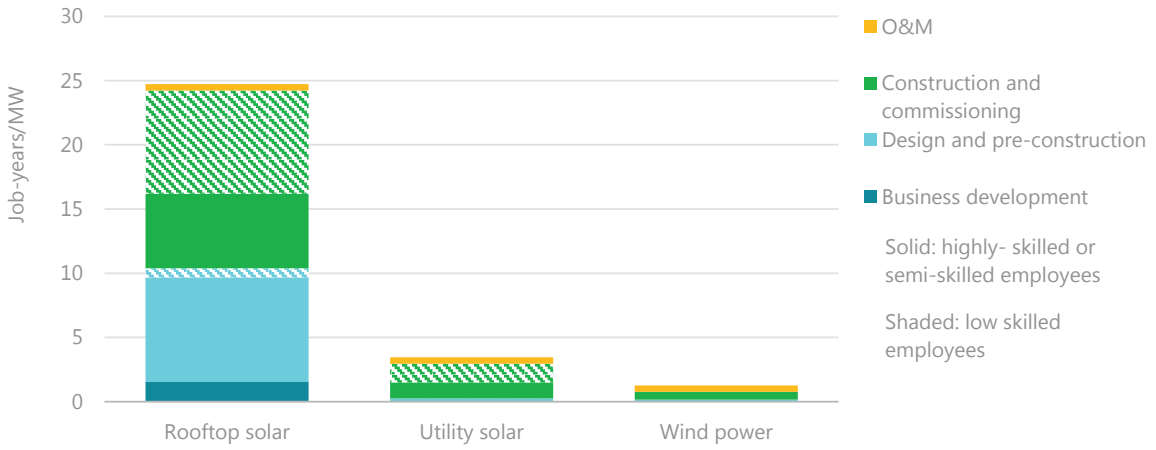
India, one of the fastest-growing economies in the world, has doubled its energy demand since 2000. While demand growth has been largely served to date by the consumption of fossil fuels, India's government has shown a clear commitment to a clean energy transition for the future. The country's firm commitment is evident through the renewable electricity target of 175 gigawatts (GW) in installed capacity by 2022 and the various policy measures at central and state government levels that have been put in place to achieve this target. As this target is pursued, India can benefit in a number of ways from this sustainable development, including through access to affordable clean energy, gender equality, decent work and economic growth, and climate change mitigation, which are four of the Sustainable Development Goals of the United Nations (goals 7, 5, 8 and 13, respectively).

Why rooftop solar?

We chose the rooftop solar sector from among the various clean energy technologies for three reasons.

Firstly, the deployment of rooftop solar is highly labour-intensive among prevailing renewable technologies with a particularly high share of the high-skilled jobs on which our study focuses. According to Kuldeep et al. (2017), rooftop solar creates about 25 jobs per megawatt (MW) installed across the value chain in India, which is 7 to 20 times more than that of utility solar or onshore wind technologies. Of the 25 jobs, about two-thirds, or 16 jobs, are quality jobs that require high- or mid-level skills. The number of quality jobs created rooftop solar is eight times higher than that of utility solar.

Figure 1. Employment coefficient for solar and wind projects in India



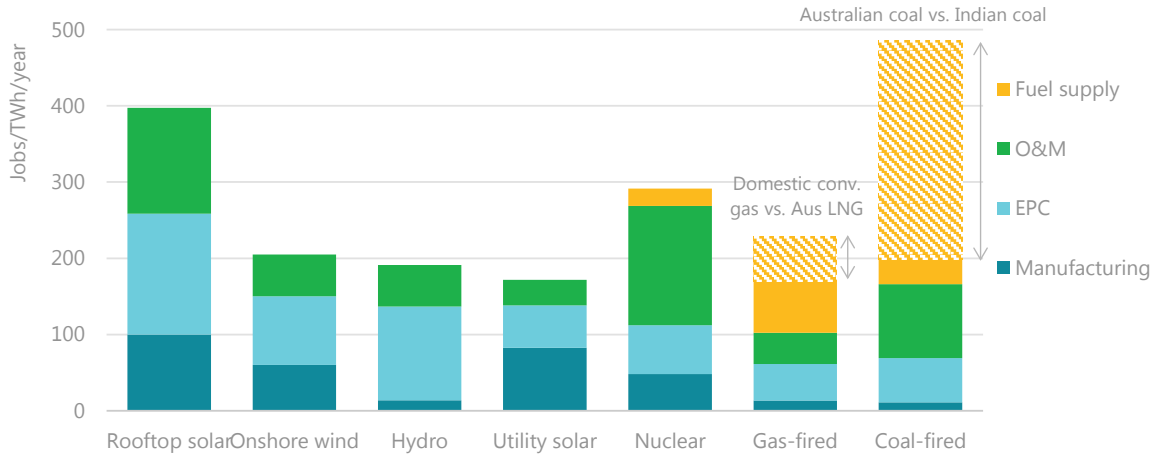
Note: Excluding solar module manufacturing. O&M = operations and maintenance.

Source: Kuldeep et al. (2017), "Greening India's workforce: Gearing up for expansion of solar and wind power in India".

Rooftop solar creates more quality jobs than utility solar and wind power for every GW installed.

Similarly, IEA (2017) analysed the job creation potential globally in terms of the number of jobs required to generate 1 terawatt (TWh) a year. It estimated rooftop solar to be among the most labour-intensive given its small unit size, customised nature of installation, and low capacity factor. While coal-fired generation in India can support more jobs given its labour-intensive coal mining sector, these are mostly for low-skilled miners.

Figure 2. Employment associated with 1 TWh of new power generation by technology



Note: The metrics, i.e. jobs per TWh per year, was calculated by estimating the number of employees and the number of years needed for one GW of capacity in each phase of the supply chain and then averaged over 25 years, assuming load factors representative for the given technology. Direct and indirect jobs in the supply chain are included. EPC includes business development, design and pre-construction, and construction.

Source: Adapted from IEA (2017), *World Energy Investment 2017*.

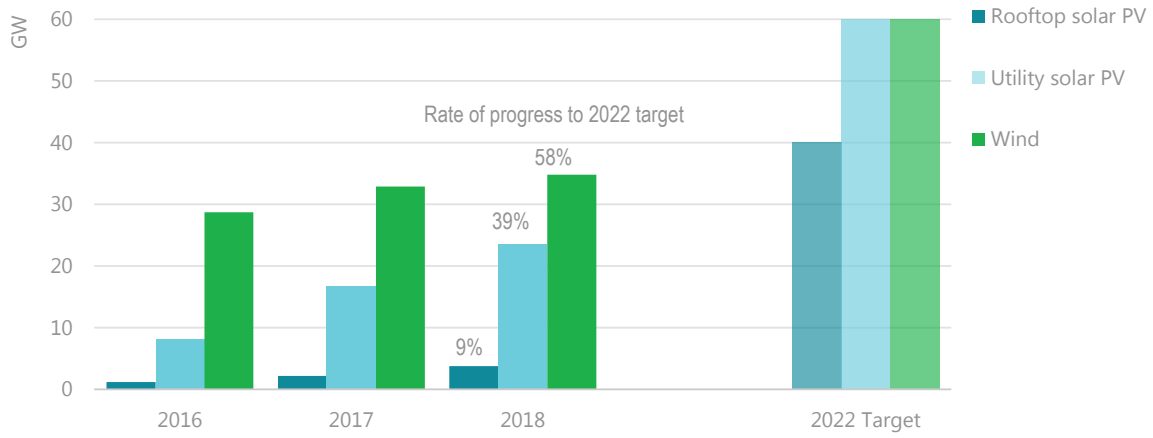
Rooftop solar is among most labour-intensive technologies in terms of jobs per unit of generation over the lifetime.

Secondly, the deployment rate of rooftop solar has been slow compared to other renewable subsectors. While 40 GW of the 175 GW targeted is allocated to rooftop solar photovoltaics (PV), less than 4 GW has been installed (Figure 3). The rate of progress is about 9%, compared to 39% for utility scale solar and 58% for wind power. Less than USD 1 billion was invested in rooftop solar generation capacity in 2017 (IEA, 2018a). This contrasts sharply with the approximately USD 7 billion of annual investment that is needed to 2022 in the IEA Sustainable Development Scenario, which projects the same scale of deployment as the government target (IEA, 2018b).

Thus, the rooftop solar sector has the potential to accelerate its growth towards the government's target in the years to come. Attention must be paid, however, in assuming that the high labour intensity will continue. There is a trade-off between cost evolution and deployment rate, and the labour requirement may need to decrease for deployment at scale. In fact, the slow deployment rate is due to the higher costs of procurement and installation of the systems, given the smaller size and distributed characteristics, and the financing costs which are higher than large projects such as utility solar. Moreover, there is no framework for evaluating the credit worthiness of smaller companies and consumers. All these challenges have resulted in limited financing made available to rooftop solar projects, thus hampering significant progress towards the target.

Yet, with adequate support mechanisms and policies in place, an acceleration of growth in rooftop solar PV is possible. This expansion would impact the types and number of jobs created, which may particularly affect women's employment prospects.

Figure 3. Actual deployment of renewable technologies and 2022 targets



Sources: IEA, Bridge to India (2019), "India's solar rooftop market January 2019".

The progress of rooftop solar PV has been slow compared to utility solar and wind due to higher costs and limited financing made available.

Thirdly, the rooftop solar sector can create a number of jobs that are categorised as professional jobs such as engineers and business professionals (e.g. financial professionals, accountants and human resources professionals), some of which are attractive to highly qualified women. Tertiary-educated women are more likely to hold these white-collar jobs (occupations which are classified as "professionals" and "technicians and "associate professionals" in the 68th round of the National Sample Survey) than less-educated women, and they offer women a higher wage on average than jobs in other sectors such as service and sales, and in the craft and trades

industries (MGI, 2015; NSSO, 2014). However, the increase in white-collar jobs that pull in highly qualified women in the labour market has not kept in pace with the increased supply of these qualified women (Klasen and Pieters, 2015; Ghai, 2018). There is an already existing pool of qualified candidates available to fill the high-skill jobs which an expanded rooftop solar sector would create. The rooftop solar sector could leverage this significant pool of qualified Indian women as well as lead more young women to invest in higher education and vocational training.

Overall, the clean energy sector is young. This is especially true of solar and wind. Compared to the conventional energy sector, there is enormous potential to embrace a larger female workforce as the clean energy sector grows. According to responses to our survey, this sector has a positive image as the phrases associated with it – "*new and dynamic*" and "*contributing to the society through clean energy*" – illustrate; it is known for offering a "*flexible work environment*" (see Box 1 for our methodology). These perceptions, which apply to the rooftop solar sector as well, could be leveraged to enhance hiring and retention of more female employees.

Indian women's participation in the labour force is low at present

Across the economy, the rate of participation in the labour force of Indian women is 26%. Compared to the labour participation rate of 46% at the global level (Figure 4), this is among the lowest in the world, except for Arab countries. Women account for one-quarter of the country's workforce compared to the world at almost 40%. Their share falls to below 20% if excluding the agricultural sector, which employs over half of the country's female workers (ILO, 2018).

Figure 4. Labour participation ratio by gender in selected countries and regions

Note: LM income countries = Low–medium income countries. The figure indicates the ILO's modelled estimates for the proportion of a country's working-age population over 15 years old that is employed.

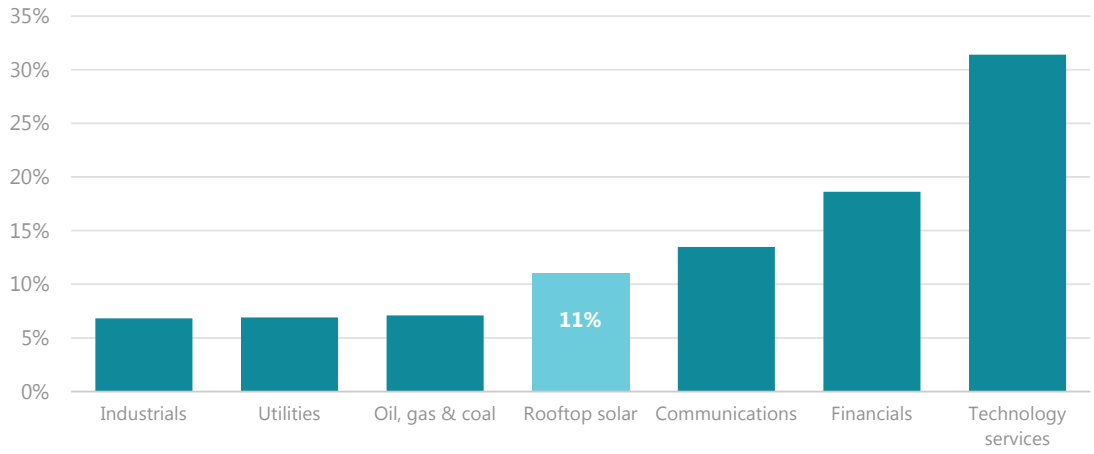
Source: ILO (2018), "Statistics and databases".

Women's labour force participation rate in India is among the lowest in the world while that of men is among the highest.

The energy sector workforce in India is no exception, characterised by an underrepresentation of women. The proportion of women in the rooftop solar sector stands at 11% (which is analysed in detail in the next section). This is higher than in other energy sectors such as coal, oil and gas companies, and electricity utilities where women make up less than 10% of the labour

force. However, it is low compared to service sectors such as technology services and financials, where women represent 20-30% of the workforce (Figure 5, Box 2).

Figure 5. The ratio of female employees in selected sectors in India



Note: The ratio indicates the simple average of the ratio of female employees of companies that disclose the information. 130 out of about 5 000 listed companies in India disclose gender-disaggregated employment numbers. Of those, there are 19 in industrials sector, 9 in utilities sector, 9 in oil, gas and coal, 5 in communications, 24 in financials, and 7 in technology.

Source: IEA-CEEW survey; company disclosure; Bloomberg LP (2019), Bloomberg Terminal.

The share of women is 11% across our surveyed companies in India's rooftop solar sector, which is higher than other energy sectors but lower than some service sectors.

Why women's participation matters

Raising women's labour participation and the quality of their jobs is beneficial for the economy, for women themselves, and for organisations. There are a number of studies that show the positive correlation among the factors of gender diversity of the workforce, the leadership of an organisation, and better financial performance (for example, McKinsey, 2018; Catalyst, 2011; Credit Suisse, 2018). Advancing women's participation in order to attract and retain a diverse pool of talent is essential to accelerate the transition to clean energy in India (CEM, 2018). Moreover, a better gender balance could provide various benefits to the sector such as enhanced financial performance, informed risk-taking, the adoption of a development and rights perspective, and collaborative processes (Pearl-Martinez, 2014). Given the sector's growth potential as well as the number and the types of jobs to be created as discussed above, India's rooftop solar sector is well positioned to receive such benefits.

Ultimately, it contributes to several of the SDGs, including gender equality and inclusive and sustainable economic growth. Studies have shown that closing the gender gap in the workforce can lead to a higher GDP. For example, McKenzie (2015) argues that closing the gender gap in the workforce at the rate of its best performing regional peer could drive up the country's GDP 18% by 2025, compared to a business-as-usual GDP. IMF (2017) also estimates that India would be richer by 27% by balancing the gender profile of its workforce. Improving opportunities for a paid job in the labour market contributes to the empowerment of women and enhanced quality of life. The financial autonomy of women leads to better treatment of women and improved intra-household power dynamics, reducing the likelihood of domestic abuse by male family

members; increased spending that benefits their children; and an improved standard of living for women and their families (World Bank, 2012; Duflo, 2012).

Box 1. Our methodologies

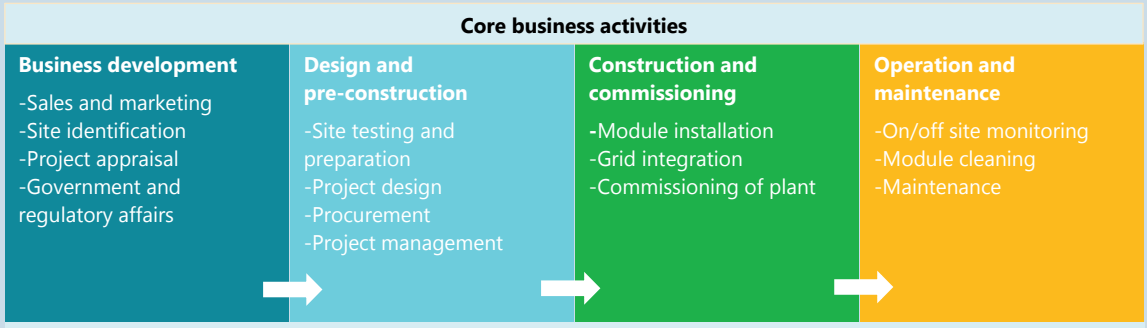
We conducted a survey with project developers and EPC companies that are engaged in the rooftop solar business in India, given the lack of publically available gender-disaggregated employment information for the sector. The data collection was undertaken in November and December 2018 through a web-based survey and follow-up qualitative interviews in person or over the telephone with employees. Our primary respondent in most cases was the human resources officer, but in the case of relatively smaller companies that did not have a separate human resources department, we interviewed the founders of the company or members of the senior management. Out of 14 companies contacted, we conducted interviews with 9 companies and received usable survey responses from 8 companies that represent over 40% of the project developers' market and about 20% of the EPC markets. In addition, individual semi-structured interviews were conducted with 9 female employees in senior and mid-management positions to understand their career paths. As a result, the insights provide a valuable indicator of the state of women's employment in the rooftop solar business but may not represent every case or situation.

The scope of the survey included the following five segments: 1) business development phase, 2) design and pre-construction phase, 3) construction and commissioning phase, 4) operation and maintenance phase, and 5) support functions.

The survey and interviews covered three broad topics:

- Gender profile of the workforce (discussed in Section 2)
  - Gender profile of the workforce in rooftop solar companies by segment
  - Gender profile by position
  - Gender profile of job applicants
- Barriers and challenges for increased participation of women in the sector (Section 3)
- Existing measures and policies to support women's career in the sector and increase their participation (Section 3)
- Recommendations to complement the existing support measures and policies to encourage women to join the sector's work force (Section 4)

The value chain of a rooftop solar project



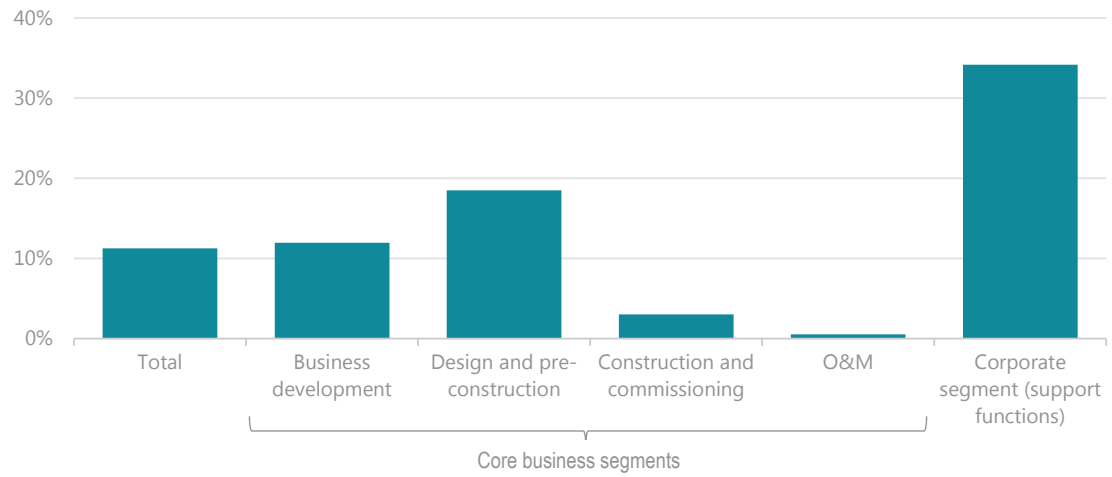
Sources: Based on Kuldeep et al. (2017), "Greening India's workforce: Gearing up for expansion of solar and wind power in India"; Ghosh et al. (2016), "Filling the Skill Gap in India's Clean Energy Market – Solar Energy Focus"; and communication with companies.

Section 2. Gender profile of India's rooftop solar sector

Men dominate the workforce, but gender diversity varies across the value chain

Our survey reveals that women account for on average 11% of the total employees in the rooftop solar business of surveyed companies. This is low compared to the nationwide women's share in the workforce at 24% (19%, excluding agriculture) and far from gender parity (i.e. having an equal proportion of men and women). However, the representation of female employees varies across the value chain of a rooftop solar project. The design and pre-construction phase (18%) and support functions (34%) have a relatively higher number of female employees. In contrast, women employees constitute 12% of the business development phase, but as low as 3% of the construction and commissioning phase and 1% in the operation and maintenance phase.

Figure 6. The share of female employees in India's rooftop solar sector by segment



Source: IEA-CEEW survey.

While the workforce of India's rooftop solar sector is far from gender parity, office-based jobs in corporate positions and in the design and pre-construction segment have more women than do onsite jobs.

More women in office-based jobs

There are notable distinctions between the segments that attract female employees and those that do not. Office-based jobs without frequent travel or work at project sites are perceived to be more appealing to women. Companies find it relatively easy to assign women to these positions. Among the core business segments, jobs in the project design and pre-construction phases are tied to a specific project, but they do not require frequent travel to the project site.

Employees design and manage projects mainly from corporate offices; in some cases, they are allowed to perform these tasks from home. Among the respondents, one company responded that as many as 12 out of 20 employees on its project design team within the design and pre-construction phase are women, and three companies specified that there was at least one female employee engaged in procurement. These female employees, most of whom hold an engineering degree and/or an MBA degree with relevant work experience, are as qualified as their male counterparts.

Support functions of the corporate segment, such as human resources, finance and accounting, legal and compliance, and public relations, are also office-based roles requiring a high level of expertise. Several companies stated that there are female employees with an engineering degree who have chosen to work in corporate roles. This "self-selection" may be based on societal misperceptions of women's abilities, socially ascribed gender roles, and women's accumulated workplace experiences (see Section 3, "Access to opportunities for women").

Fewer women have onsite jobs in core business activities

In contrast, there are few women in roles requiring frequent travel to project sites to deal with clients and contractors. The lack of women in roles requiring a presence at project sites is feature that is represented in most core business segments, namely, the business development phase, in construction and commissioning, and in operation and maintenance. The construction and commissioning, and the operation and maintenance phases, have even fewer female workers. Half of the surveyed companies reported no female employees in either of the phases at all. Factors which discourage women from taking these roles include safety concerns and general perceptions that onsite work is male-dominated (see "Access to opportunities for women" in Section 3).

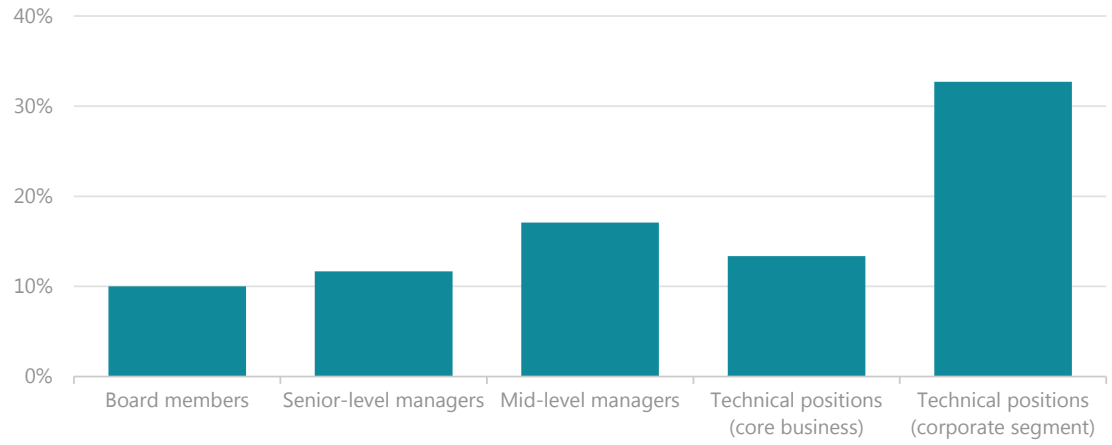
Higher positions have lower female representation

Gender ratios also vary across positions. At the top of the corporate hierarchy, only one-third of the companies surveyed have a female board member. None have more than one woman. The remaining companies have executive boards made up of men only. Women represent 12% of senior management and 17% of mid-level management. In most cases, female managers lead a team or department in the support functions and in the design and pre-construction segment. There are cases where women head an engineering team or a sales team, but it is rare. The lower ratio of women in higher management could mean that many women leave the workforce while in the middle of the corporate ladder. Some female employees indicated that mid-level managers are in their 30s on average and go through major life transitions such as marriage and childbirth. The difficulty of balancing work and family responsibilities often leads them to take a pause or to end to their career. The tendency is stark in India where the burden of managing household chores and childcare responsibilities falls disproportionately on women, although some professional women with a higher income are able to afford paid care services to balance these responsibilities (see Section 3 and Box 3).

At the same time, it is worth noting that half of the companies surveyed reported that female staff account for a higher ratio in the senior and mid-level management than in the entire company. This is largely because the women's ratio in the entire company is pushed down by the male-dominated areas of construction and commissioning, and operation and maintenance, which together represent on average 40% of the workforce. Another possible factor is that almost all female managerial staff joined the rooftop solar sector as experienced professionals rather than in junior or entry-level positions, as our follow-up interviews revealed. While we note that this higher ratio is partly due to the particular functions in the corporate segment with

a relatively high presence of women; we are also aware that the positive perceptions of rooftop solar as a new and meaningful sector with an open and flexible work culture may have attracted female managers.

Figure 7. The share of female employees in India's rooftop solar sector, by position



Note: Technical positions indicate positions classified as highly skilled jobs, for example, engineers and project managers in core business and accountants and HR specialists in corporate segment. The ratio of non-technical staff was asked in the survey but the responses are not displayed here due to the insufficient number of usable responses.

Source: IEA-CEEW survey.

Two-thirds of the respondents do not have even one woman on the board. Professional workers are predominantly men at all levels except technical staff in corporate functions.

Fewer women applicants for engineering jobs in project management

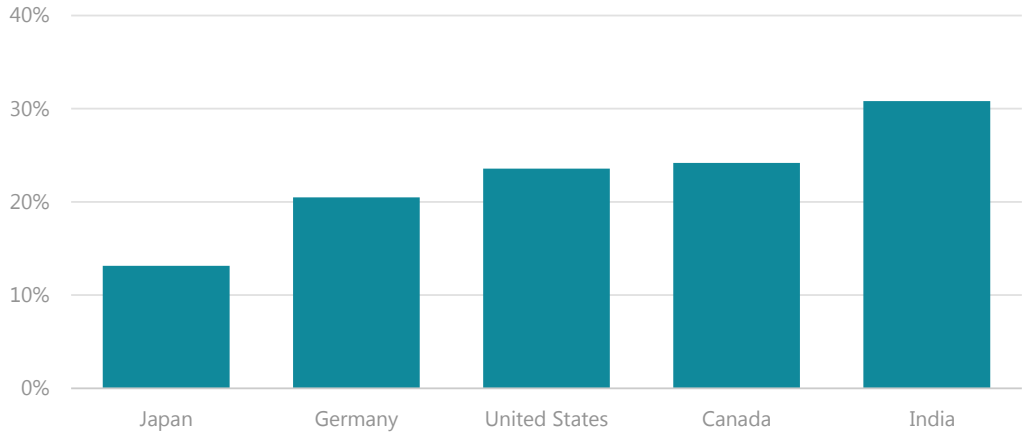
Because the share of female applicants by type of jobs and position varies significantly across companies, it is difficult to draw significant conclusions at the sector level. However, the general observation is that the number of female applicants remains low for positions in the core phases requiring civil, mechanical and electrical engineering education or professional experience. One explanation is that women tend to self-select themselves out of these positions because of the job requirements or because there is a bias at the sector level against hiring women for such positions.

Our survey asked companies to select the range of female applicants' proportion by type of position in order to illustrate the recruiting trend over the last 2-3 years. The choices given were 0%, less than 5%, 5-10%, 10-25%, 25-50%, and over 50%. Two-thirds of the companies responded that women applicants represent 10-25% of entry-level job positions. For board member positions, companies' responses are either no job openings or that there are very few female applicants (0% or 5-10%). For the other positions, although the range of answers varies widely, there are generally more women applying for support functions and fewer women for technical positions in core business segments and management positions within a company.

A couple of companies commented that in general (i.e. not limited to the rooftop solar sector), a male candidate would be more likely to be offered a job unless a competing female candidate is significantly better than him. On the other hand, most companies indicated that their female applicants and employees are not inferior to men when it comes to skills. In fact, 30% of students enrolled or graduated in technical and engineering programmes at Indian universities

are women, among the highest in the world (OECD, 2018; UGC, 2017). Despite this, qualified Indian women are unlikely to pursue careers as engineers in physical infrastructure industries. The male to female ratio is four times higher in core industries such as the construction, machinery, and manufacturing sectors where they work as civil, mechanical, and electrical engineers, in comparison to the IT or software industry where they work as system engineers or in related engineering roles (see Box 2; Data Quest, 2013). The low participation of women for certain technical roles in the rooftop solar sector may be ascribed to traditional societal values and gendered norms that misperceive women's competencies in the engineering field and which lead women to self-select themselves out of the engineering field as well as discourage companies from hiring women.

Figure 8. The share of female graduates in engineering in selected countries



Note: The figure indicates the share of women out of the graduates who completed education at bachelor's, master's or doctoral level in the field of engineering, manufacturing and construction in 2016.
Source: OECD (2018), OECD.Stat.

The share of female students in the engineering field in India is among the highest in the world, supporting companies' contention that a lack of skills is not an issue for hiring women.

Box 2. Comparison with IT sector and its implications

As discussed in Section 1, the proportion of women in the rooftop solar sector stands at 11%, which is higher than in the traditional energy sectors but far lower than it is in some other sectors. In particular, the IT sector has emerged over the last three decades to become the largest private sector employer, with female staff accounting for over 30% of the work force, according to our analysis, which is broadly consistent with other studies (NAASCOM, 2018; India Skills Report, 2018). Many qualified women with science, technology, engineering and mathematics (STEM) backgrounds choose to work in the IT sector over the physical infrastructure industry.

In the IT sector, comparatively high salaries, easy international mobility, gender-neutral policies based on knowledge-centric skills possession, flexible work routines, and physically less demanding work in comfortable indoor work environments are among the most important factors

that influence the high participation of highly skilled women (Bhattacharyya and Ghosh, 2012). Many of the companies selected as the "best work place for women in India" belong to the IT sector (Outlook Business, 2018).

The rooftop solar sector is still in an early stage of development as an industry with an annual market size on the order of USD 1 billion. The number of employees in these companies is typically in the range of 50 to 300 rather than 1 000 to 10 000 or even higher. The IT sector now generates USD 170 billion of the annual market contributing to about 8% of the country's GDP (IBEF, 2018; NASSCOM, 2018).

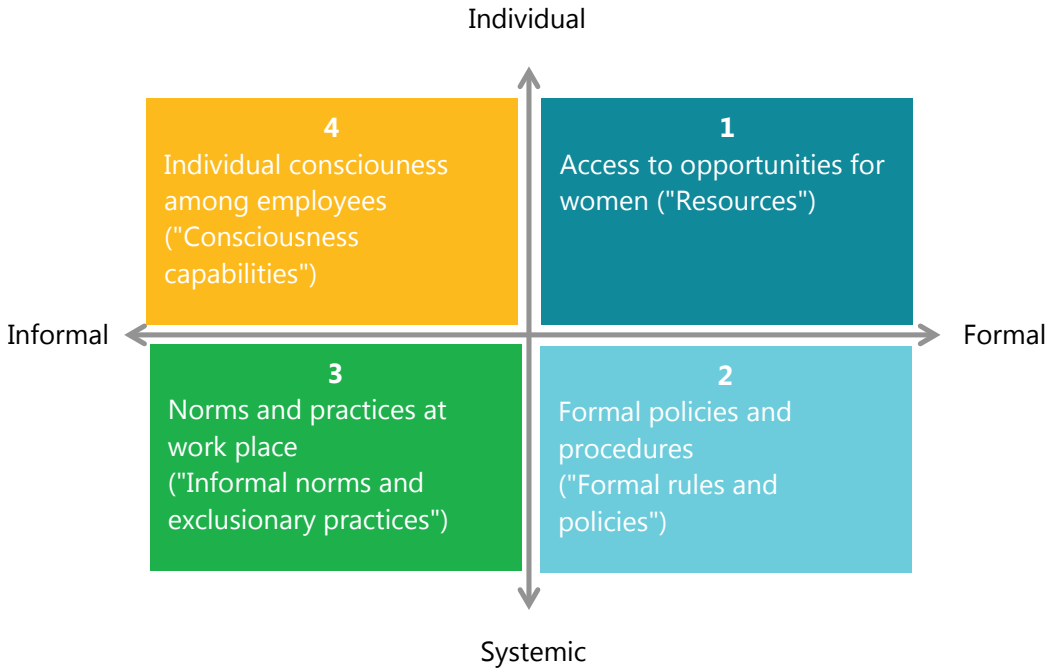
The value chain in the rooftop solar sector, which involves physical infrastructure as well as office-based business activities, is inherently different from the IT sector. However, the rooftop solar sector (or, more broadly, the clean energy sector) could learn from the success of the IT sector in creating work environments and conditions that embrace women's labour power. This could enable the rapid growth that is necessary if India is to achieve the government's 2022 target and make sustainable development a reality.

Section 3. Existing barriers to and support for women's participation in the sector

The emerging and non-traditional nature of clean energy technologies like rooftop solar presents the sector with an opportunity to adopt a gender-responsive approach. The low level of participation of women in the rooftop solar workforce underscores the importance of understanding the barriers that women face in this sector. With tremendous growth potential, the rooftop solar sector is at an opportune stage to focus on increasing women's representation in the workforce.

In this section, we analyse the existing barriers to and support available for women in solar rooftop companies across India that have become clear through our survey and interviews. We assess the barriers at individual, company, and societal levels, as well as the existing formal and informal support arrangements for women. The four dimensions include 1) access to opportunities for women, 2) formal policies and procedures, 3) norms and practices at workplaces derived from the social structures, and 4) the individual consciousness of female and male employees. These dimensions are adapted from the "*Gender at Work*" framework, which has been widely used to identify opportunities and barriers to gender equality, evaluate progress, and build a strategy at the work place (Gender at work, 2018; Figure 9).

Figure 9. Four dimensions of issues identified in our analysis



Note: The original name of each quadrant from the framework is given in parentheses. We adjust the interpretation of the four quadrants that are built on the individual/systematic and formal/informal dimensions for our analysis.

Source: Adapted from Gender at Work (2018), "Gender at work framework".

We identified and assessed the barriers most women face in the sector in four dimensions.

The four issues we discuss in-depth in this section are listed below. They are linked to certain features of the rooftop solar sector, such as the fact that it is a relatively young industry and that it involves jobs traditionally held by men (such as onsite construction work) in its value chain. While other sectors share some of these elements, addressing these issues will help the rooftop solar sector maximise women's talent and, in doing so, fuel its growth.

1. **Access to opportunities for women:** The perception of a lack of safety and security at rooftop solar project sites can discourage women from undertaking work in male-dominated positions such as engineers and project managers. This concern is also observed in relation to site-based jobs in other sectors. Some companies actively take supportive steps to encourage female employees to take up these jobs. Supportive measures include providing appropriate accommodation and sanitation facilities, transportation, and careful planning, but companies in general are still in the process of developing the capacity to accommodate female employees' needs.
2. **Formal policies and procedures:** Support beyond legally required policies needs to be formalised to attract and retain female employees. All companies in this sector, as in others, have human resources policies required by the government such as paid maternity leave and prevention of sexual harassment at workplace. However, few companies have yet to take the initiative to go beyond that, given that this sector is in an early stage of development.
3. **Norms and practices at workplaces**: Traditional societal values and gendered norms as they prevail in Indian society in general can affect rooftop solar companies and their employees. In the rooftop solar sector, further supportive policies in long-term human resource planning are needed to allow both men and women to challenge the expectations of the traditional gender roles.
4. **Individual consciousness among employees**: The consciousness and personal experiences of men and women, such as their respective level of knowledge regarding equality and women's rights, attitudinal bias towards women's rights, and actions taken to protect these rights, are potent forces that shape gender equality within a company and the sector. Awareness varies across individuals, but some companies have seen a change for the better in the gender-biased perceptions of employees through active interactions with female employees and employees with different cultural backgrounds.

1. Access to opportunities for women

Table 1. Issue 1: Access to opportunities for women in the rooftop solar sector: Examples of existing barriers and support

Barriers for female employees	Existing support and practices
Adverse perception of safety and security at project sites	Organisational support during travel to field locations, such as provision of appropriate accommodation, sanitation and transport facilities, and careful planning.
Self-selection of women opting out of roles that conflict traditional familial obligations	Mentorship from female role models in functions that are predominantly occupied by men. Organisational support for women in executing day-to-day functions and from the supervisors in functions with fewer women. Examples include flexibility in work timing, addressing women's needs during travel arrangements, and delegation of decision-making authority.

The perceptions of insufficient safety and security may limit opportunities for women to work in some roles traditionally held by men

As discussed in Section 2, the share of women overall in the rooftop solar sector is 11%. However, the number of women working in the core engineering functions is far lower than the number of women working in support functions in the corporate segment. A significant factor accounting for this disparity is that job roles in the core phases often require extensive travelling to project sites for industrial clientele located in remote and rural areas, which poses challenges for women.

Employers do not always consider it appropriate to send female employees to potentially risky locations. The issue of perceived safety at project sites in distant locations (especially for industrial customers) is related to the threat of sexual harassment or assault from strangers or male co-workers, as well as to certain safety risks associated with physically intensive onsite work. In addition, the employers' hesitation may also result in part from "protective legislation" in India that, historically, has limited the employment of women workers by placing restrictions on women working during the night and on the type of operations in which women can engage (Ghai, 2018). For example, such legislation requires companies to provide safety measures such as transportation for women working after 19:00 in the evening at project sites. The need to provide additional facilities suitable for women at project sites may be seen as a financial burden by the companies.

These generalised anxieties about women's safety at site locations often keep women out of many roles. Some female interviewees highlighted the challenge of exercising supervisory authority among contractors and vendors onsite in addition to a bias among some clients to hosting women at their sites.

In fact, many female employees themselves often prefer not to stay for extended periods at project sites in remote locations. Moreover, an employer's hesitancy to deal with the challenge may also reflect the likelihood that women will self-select out of these positions by not even applying; thus, employers do not anticipate the need to address the challenges facing women working at remote locations. This opting out of certain roles by women may reflect women's self-perception of incompetence in technical occupations in the sector, and more broadly in the engineering field (Baruah, 2016). Companies, too, are often of the opinion that jobs requiring significant travel and time away from home may be challenging specifically for women, who are traditionally seen as the primary caregivers for children.

However, almost all women say that site visits are important for career growth. Understanding the execution of projects helps professionals to design better systems, gain more authority and perspective in conversations, and guide their team on the subject. Given that site visits are integral to most core phases in the rooftop solar sector, the inability to travel means that women lose out on opportunities to advance their careers.

Organisational support plays a key role in encouraging women employees to take up roles in male-dominated functions

Even though the safety of women is considered a barrier, some companies have facilitated site visits for women to learn and integrate their knowledge into the design and operations of projects. Supportive measures by the companies such as providing safe accommodation and transportation during late hours and having male colleagues accompany women to project sites

have increased women's participation in project management (at least in certain phases such as pre-construction and design). Although these practices have emerged in a few companies, given the early stage of the industry many others lack the resources to provide a work environment at project sites that is suitable for women. As the sector evolves, and more women participate, we foresee an increasing investment in human resources, based on the commitment of some forward-thinking companies to implement changes.

A senior general manager in the Project Management function with 7+ years of experience in the sector states, "The issue of safety and security at project sites stems from societal perceptions and gender bias. Most people are apprehensive and simply not used to the idea of women working on construction sites. I have never faced any problem on my site visits through the years." [1]

Role models and mentorship could help to increase the proportion of women in leadership positions

As discussed in Section 2, the proportion of women decreases as we move up the corporate ladder in most companies. Since prior work experience and existing skills are prerequisites for senior positions, low numbers of women in entry-level positions leads to skewed representation at the levels of mid- and senior management. As individuals, female employees in leadership roles are in a position to positively influence female colleagues. Women in the workforce, especially those in core functions traditionally held by men, tend to act as mentors and role models for other women who are interested in joining the sector. Their support is an important component of the career development of junior colleagues. Overall, a higher level of participation of women in the rooftop solar sector has the potential to facilitate the transition of women to leadership positions.

"Women tend to learn much better from other women than from men - but there aren't enough female role models in the sector." - A mid-management employee with 2+ years of experience in project management.

Shaili Yadav – AVP Project Management, Amplus Solar

Shaili has led the project management team at Amplus Solar for the last two years. In the past, she worked in the petrochemical industry where she was the only woman to work as a drilling engineer. Her professional career has always been considered male-centric because it involves a lot of onsite work. Shaili has to work with vendors and contractors to set up her company's warehouse operations. She states, "It is quite challenging to work with people from various backgrounds who are still adapting to working with women and being led by them. The key to overcome these societal prejudices is to stop thinking about what they are thinking about an individual and focus more on getting the work done. In the long term, people will realise that a true leader always believes in great ideas and meritocracy."

[1] The quotes in section 3 are mostly taken from the interviews with women across different positions. Some quotes were also provided by men in positions of CEO, founder or human resource managers.

She mentions that the organisation has provided her with the flexibility to implement the project development plans as she sees fit. Shaili strongly believes that having more women in the workforce makes the presence of women in leadership position much more acceptable within the organisation. At Amplus Solar, having women in senior management has led to an environment more conducive to having other women in general working in the organisation.

2. Formal policies and procedures

Table 2. Issue 2: Formal policies and procedures in the rooftop solar sector: Examples of existing barriers and support

Barriers for female employees	Existing support and practices
Lack of support and commitment to gender equality beyond the limited legally mandated requirements.	Formal policies such as six-month paid maternity leaves and prevention of sexual harassment policy.
Lack of support for many women on the personal front (from partners and families).	Additionally, paid paternity leave, personal support from spouses, parents, relatives, childcare facilities and house-help (Box 3).
Lack of childcare facilities – owned or shared – available to both male and female employees.	Investors have been key in encouraging some companies to improve gender balance.

Support is needed beyond legally mandated policies at the company level

All companies in the rooftop solar sector have human resource policies mandated by the government, including six months of maternity leave and the prevention of sexual harassment at workplace. Most companies also provide an average of seven days of paternity leave, which is lower than that offered in other countries that value gender parity and the father's participation in parenting. However, few companies have taken the initiative to go beyond the mandate and provide greater support. This is partly because the sector is in the early stages of development, and most companies are relatively small with no capacity to extend support, unlike larger and older companies in other sectors. The lack of support beyond legally mandated policies can be an additional hurdle that discourages women from joining and remaining in this sector.

Gaps in wages remain despite initial steps taken by some companies

The causes of the persistent gender gap in pay are multifaceted. They include women's greater concentration in lower-paying jobs and junior positions in absolute terms, their comparatively weaker negotiating abilities, and the greater likelihood that they will take time off from their careers for parenting and caregiving. In addition, there are the attitudes and values of employers to consider. Like many other sectors in India, most companies in the rooftop solar sector have no policy in place to ensure equal pay for equal work. Often, policies that offer similar benefits to men and women do not ensure equity because of the pre-existing inequality of opportunities. Almost all the surveyed companies stated that they do not discriminate by gender regarding compensation, which implies they follow a salary structure where wages are

based on educational qualifications, work experience, previous salary, and negotiation skills. But if there are no policies in place to ensure equality of pay for particular roles, then a company's assessment of how much to compensate a candidate financially will be subjective and variable. This leads to a prominent gender pay gap since women employees are more likely to take breaks in their career after childbirth and because of childcare obligations. Fortunately, some companies have introduced pay brackets that are not linked to an employee's prior compensation to help job seekers transition between sectors, a move that has the potential to reduce the pay gap among employees in general.

A senior employee in a leadership position with two children states, "The maternity break makes it difficult to break back – there comes a wage gap and work gap (in terms of roles and responsibilities)."

Childcare-related support: Another area for improvement

Some female interviewees highlighted the importance for a woman's career of support during the initial years after childbirth. Companies could better embrace childcare support in their human resource policies for new parents in their increasing workforce. Almost no company has identified the need for childcare facilities located within organisations, owing primarily to the lack of women and nursing mothers in the sector and a pre-existing perception that childcare needs do not apply to men. Fewer women translates to lesser expressed need for childcare facilities at work. A few companies have contracted with external childcare services to provide facilities near the workplace to employees. In addition, we also noted supportive measures such as longer lunch breaks for young mothers to spend some time with the child during the day, which some companies offer.

Can external pressure drive a better gender balance in the rooftop solar sector?

Many companies speak of the intent to recruit more women to create a diverse workforce. However, their recruitment policies do not demonstrate affirmative action taken in the recruitment of women or include a gender diversity clause in their vacancy announcements. Some companies mentioned that recent capital injections from private equity firms has resulted in a mandate to ensure a greater gender balance and has led to setting up of internal goals for doing so. This highlights the value of adopting gender equality targets and policies at higher institutional levels. Even if, initially, companies that adopt such measures are motivated primarily by the need to comply in order to satisfy international funder or donor requirements, the outcomes will be positive. And, as the gender composition of the workforce changes, companies' values too may shift in more progressive directions.

Box 3. Support at the personal level is instrumental in career growth for women

Indian men spend less time on unpaid housework than do their peers in most major countries in the world (OECD, 2018). Marriage and childcare responsibilities were cited as the most common reasons for women quitting their jobs across the companies surveyed. Men continue to prioritise professional life while the link between personal and professional life remains strong for working women, each impacting the other. Throughout the interviews we found that company policies go hand-in-hand with the personal support needed for women at different levels. All the women interviewed had personal support and encouragement from their families which helped them balance parenting and work. For some professional women from middle-class families in India, the

limitations of household management and childcare responsibilities may not be as sizeable as for their counterparts in industrialised countries. Once women start earning higher incomes, family members of extended, joint and inter-generational family configurations often become willing to share domestic responsibilities, and women also have access to relatively affordable paid caregivers (Baruah, 2016).

Vijayti Agrawal – Associate Vice President (AVP), Design and Engineering, Sunsource Energy

Vijayati has been part of Sunsource Energy for over seven years. She is currently working as the AVP of Design and Engineering at the organisation, leading a team of 25 people. Vijayati suggests that despite the challenges in the sector, there exist opportunities for growth for women in functions such as design and engineering that makes for important roles with the organisation. As part of her job, she visits site locations regularly to inform her ability to design projects better.

The organisation has been supportive of Vijayati's personal obligations. She was given the opportunity to work remotely from a different city for a period of two years when she had to move cities for personal reasons. Having done well for herself, Vijayati highlights that the maternity break is one of the biggest barriers for women, often slowing down their career growth. In the rapidly changing solar industry, a six-month break and lack of childcare facilities could become a setback for female professionals. Not all companies can afford to operate without employees in critical functions for an extended period. She believes this issue can be addressed by extending childcare support to both male and female employees and helping them balance personal and professional commitments.

3. Norms and practices at workplaces

Table 3. Issue 3: Norms and practices at workplace of the rooftop solar sector: Examples of existing barriers and support

Barriers for female employees	Existing support and practices
Masculine work culture failing to recognise the differentiated needs of female employees on an everyday basis. These also affect men who deviate from traditional work roles	Flexible work arrangements at company level such as occasional work from home, flexible working hours, and flexibility to plan travel as per personal needs.
Company's inability to factor into strategic decisions the differentiated needs of women.	Initiatives to retain valuable female employees, outside of the formal policies like working from remote locations for an extended period.

Barriers for female employees	Existing support and practices
Human resource decisions tend to be oriented towards the short term, seeing maternity leave as a cost, rather than towards the long-term benefits of retaining female employees.	

Human resource strategies should address the differentiated needs of employees and recognise the benefits for companies

Lack of long-term human resource strategies at the company level can be another barrier to women's participation in the sector. From a short-term perspective, hiring a woman is often associated with higher costs than hiring a man; the positive impact that gender diversity can have on decision making in business operations and financial performance over the longer term is not widely recognised.

Across the industry, many female employees view maternity leave as a setback to their career. They also think the possibility of maternity leave makes companies hesitant about hiring a woman because companies have to cover her salary and the cost of a temporary replacement during maternity leave. This is partly because of the pre-existing social norms that assume women are the primary caregivers of children and partly because the rooftop solar sector is currently a rapidly changing industry with small teams in organisations. Usually there are not many people working in the same role on a team, which makes it difficult for young organisations to find appropriate replacements quickly when employees go on extended leaves. This is especially the case with project management teams in the pre-construction and design phase whose timely operations are crucial for the company's performance.

Rooftop solar work culture provides a flexible working environment for women

A number of rooftop solar companies have a work culture that allows employees to work flexible hours as well as from home. These policies make it easier for both genders to balance personal and professional lives. Many forms of the support that women require during their transition phase do not have an economic cost for companies. For instance, some companies allow female employees to take a longer lunch time in order to attend to their children in the nearby crèche. It may not be a written policy but an informal arrangement that is very much part of the work culture has helped many young mothers. Similarly, both male and female employees benefit from flexible yet fixed work hour formats. Cultural norms around parenting, as well as economic reasons, have prevented companies from providing childcare support unless there are enough "women" in the organisation – as compared to enough "parents" – which has had an impact on the few mothers who are balancing parental responsibilities along with highly demanding jobs.

Family obligations pose a greater difficulty for women while transitioning from early career to mid-level or senior level positions. Rather than losing out on valuable female employees, some companies recognise the value of retaining them by offering the flexibility to work remotely for long periods when they have to move cities. This support from senior management has helped many women balance their family obligations and professional growth. Another company has an internal referral programme to facilitate recruitment of women in which an employee receives a higher reward if he or she refers a woman candidate who is hired. Initiatives like a women-led forum within the company have helped female employees express their challenges and concerns directly with the senior management.

One of the senior women employees in the sector points out, "Flexi-work arrangements with fixed working hours, technological connectivity and women-friendly policies and work culture can improve women's participation in the industry. Companies need to be more empathetic about what it means to be a female employee working full-time while balancing most of the household responsibilities."

While a number of rooftop solar companies provide greater support in the form of work culture, formal human resource policies institutionalise such efforts. At the same time, these policies need to be evaluated in practice to assess whether they actually deliver on the intended benefits.

Ritu Lal – Senior Vice President and Head, Institutional Relations, Amplus Solar

With over 20+ years of work experience in the corporate world, Ritu joined Amplus Solar more than four years ago, as the company's first female employee. She is also an investor in the company. She leads the work on Amplus Solar's institutional and external relations. As someone in senior management who was also one of the first five employees at Amplus Solar, Ritu has played a significant role in raising the organisation's consciousness to the benefits of creating a diverse workforce. Ritu emphasises three key elements to achieve a gender balanced workforce: flexible working arrangements, technological connectivity and supportive organisational policies.

The existing societal norm of women leaving their jobs after marriage or childbirth has led to very few women working within the sector. The choice of prioritising work over family often does not reside with women in a patriarchal framework. Organisational support in the form of flexible working hours, a corporate culture that encourages women in leadership, the freedom to bring children to work occasionally, and the flexibility to plan business travel when children are young have all helped Ritu balance professional growth with personal obligations. Her family's support has also been instrumental in balancing personal responsibilities with her professional life in the fast-growing and demanding rooftop sector. She is optimistic about the potential for change and the possibilities for amplifying women's participation in this sector through the supportive leadership of organisations like Amplus Solar.

4. Individual consciousness among employees

Table 4. Issue 4: Individual consciousness among employees in the rooftop solar sector: Examples of existing barriers and support

Barriers for female employees	Existing support and practices
Lack of ability of all employees to understand the gendered bias in culture and needs of female colleagues.	Personal values and experiences sensitising men and women through work

Barriers for female employees	Existing support and practices
	Cultural diversity in companies with international operations enabling new perspectives for women and men.

Progressive gender policies depend on recognising the value of and need for gender equality at the workplace

Individual consciousness represents values and personal experiences that can align with or deviate from the existing social norms. The traditional social norms are often cited as a barrier to Indian women's participation in economic activities, and the rooftop solar sector is no exception, as we find in our interviews. However, being conscious of all employees' equal rights and responsibilities – both women and men – is essential to achieve gender equality at work.

Increasing the individual's ability to understand the bias embedded in society helps to create a culture of equality than a culture of policies only that are not necessarily internalised. In the absence of this internalised sense of the values promoted by policies, individual employees could reinstate patriarchal notions and perceptions instead of challenging them. Our research illustrates that this consciousness among male employees has often been fostered through their personal experiences or interactions with female colleagues who raise concerns about policies and practices that affect them disproportionately. For women, this consciousness stems from their personal experiences, the influence of other women as role models, and the lessons learned from business activities at workplace. In companies where women and men in senior positions are cognisant of the need for gender equality and of systemic bias in processes, this awareness has translated to increased discussion on policies for encouraging a larger proportion of women in the organisation, implementing progressive policies for employees and introducing initiatives to retain valuable female employees outside of the formal policies.

Interventions focused on sensitisation of employees create a more empathetic work culture

There is a need to encourage sensitisation of employees (across hierarchies) and to equip human resource teams to talk about the issues faced by women as well as how to include greater support for women employees in company policies. The senior management can ensure that the mindset of their employees is not biased against female employees, intervening through informal sessions, off-site and group meetings, and sensitisation workshops. Some organisations conduct soft skills training sessions on emotional intelligence, interpersonal skills and societal issues, which also help to mainstream gender issues among employees. This could have a long-term impact on the work culture of the organisation.

Cultural diversity has a positive influence on personal values and professional aspirations, regardless of gender

Cultural diversity among rooftop solar companies operating in countries outside India also provides employees an opportunity to adopt the positive aspects of the work cultures in other nations. It broadens employees' perspectives regarding work–life balance, career aspirations and personal obligations, and it increases the individual consciousness of employees. During our interviews, women employees in companies with international operations pointed out that the challenge of working in a male-dominated sector motivates them to further break gender stereotypes. However, while cultural diversity was deemed positive by some respondents, others thought that other cultures have their own biases against women; therefore, organisations should be careful when identifying the strengths and limitations diversity to

ensure a progressive transition. There also seems to be a generational shift in the ambitions of women to have a stable and growing career, and of men towards balancing personal and professional expectations, which appears to be a factor of cross-learning across cultures.

The founder and CEO of one rooftop solar company mentions, "The masculine work culture adversely affects both men and women because the quantity of time is often equated to quality of work and commitment; this model is inherently masculine and biased against women."

Taral Ajmera – Legal and Compliance Officer, Cleantech Solar

Taral has been a part of Cleantech Solar for past three years leading the Legal and Compliance division for India. She has been instrumental in laying down the foundation of critical internal policies and commercial agreements, and she has advised the board on key legalities and strategic mergers and acquisitions during a period of fast growth. In addition to excelling in her work, she has been at the forefront of a number of contract negotiations that have resulted in increased client retention, resolved counter party disputes, etc.

Cleantech provided her opportunities to travel, allowing her to work with members across the entire chain of command, from board members to the daily wage workers. Diverse cultures at the workplace helped broaden her perspectives on gender norms and values. The company's flexible schedule policy allowed her to maintain a good work–life balance.

Taral has been instrumental in Cleantech's growth story, and her efforts are evident in the company's achievements. She has emerged as one of the strongest female leaders at Cleantech and in the solar power market. Although there have been recommendations made on how women should adopt a male leadership model, she believes the work should speak for itself. She emphasises the need to be self-aware and the importance of support from the organisation.

Section 4: The way forward – Recommendations for enabling sectoral interventions

Gender and employment to complement the clean energy policy agenda

To date, the impact of the deployment of rooftop solar power on women's employment is weak in India, as suggested by the low gender ratio in this sector compared to other sectors. However, it has major growth potential, with multiple benefits for sustainable development and women's employment. To take advantage of this opportunity, governments can pursue two types of policies: 1) policies to accelerate the deployment of rooftop solar by addressing the general challenges that the sector faces, and 2) policies targeted to improve gender diversity and encourage more women to participate in the rooftop solar sector's workforce.

Firstly, to scale up the rooftop solar market, the government needs to address the challenges causing the slow deployment rate to date. The smaller size and distributed characteristics of this sector contribute to higher costs of procurement and installation of the systems and higher financial transaction costs.[2] In addition, a framework for evaluating the credit worthiness of smaller companies and consumers is lacking. These challenges have resulted in limited financing made available to rooftop solar projects. The government at central and state levels could strengthen measures to facilitate financing by increasing preferential lines of credit by public financial institutions and by helping to develop innovative business models with electricity regulators and utilities to address financing challenges, especially for the residential sector.

Secondly, to support women's participation in the rooftop solar or renewables sector to fuel their growth, policy makers can set policies that target gender. Examples of such policies include those that:

- enable investment in facilities suitable for women at project sites
- set guidelines for flexible working arrangements
- have the public social security system contribute to partially or fully cover the personnel costs during an employee's parental leave
- facilitate financing from socially aware investors
- promote a campaign to increase women's leadership in the sector
- enable men to break traditional stereotypes through allowing them to take longer paternity leaves.

[2] For more discussion on general challenges in India's rooftop solar sector, refer to Kuldeep, Saji and Chawla (2018) and IEA (2018a).

Job creation potential for women in the grid-connected renewable sector including rooftop has not been studied in-depth. A topic for future analysis includes lessons learnt from gender-targeted policies in this renewable sector in other countries that India's rooftop solar sector can look towards.

Areas where companies can make a difference

As discussed in Section 3, there are several specific areas where companies can take measures to offer support that sufficiently addresses women's needs. Following are six recommendations:

1. Encourage site visits for women to relatively safe and accessible locations

Companies should encourage women who want to build careers in the core functions that involve working at project sites or dealing with external vendors. The issue of a perceived lack of safety and security for women in field locations acts as the major barrier to involving more women in these key jobs. The immediate safety risks for women can certainly be mitigated by specific actions and practices (better transportation, better lighting and working in pairs, for example), but they would still leave untouched the prejudices against women, masculinist values and biased work cultures intact. Additionally, measures ensuring women's safety must be complemented with efforts to promote the values of safe and harassment-free workplaces among male employees and in society at large. Our findings suggest that not all project sites are equally unsafe and inaccessible. Companies could therefore lend the needed support by mapping the degree of safety that the site of work offers, and, accordingly, plan for accommodation, travel and work hours suitable for female employees.

2. Keep up with innovations in the value chain

Companies can also pursue process innovation to mitigate challenges related to fieldwork as well as to increase operational efficiency. Examples include standardisation of installation work, which can make the process less dependent on individual workers, and remote control and operation data processing technologies with which operation and maintenance jobs can be performed from offices. However, process innovation may change the required skill sets and reduce overall labour requirements while making the value chain more women-friendly. This underscores the importance of vocational training and continuous skills development at work.

3. Address the persistent gender pay gap

Making pay scale information publicly accessible is an important first step to enable all workers, especially women, to negotiate starting salaries. Raises, bonuses and promotions can help to address the persistent gender wage gap in this sector. Employers should be encouraged to adopt the practice of making pay scales and information about career trajectories more transparent. Even anonymous salary data grouped by qualifications, skills and years of experience would enable applicants to understand what fair salaries are at specific career stages. All entry-level workers should be able to understand the career trajectories available and the possibilities for advancement specific to their sector. This would help level the playing field for women, who are more likely to lack the familial and social connections that often provide men with information about career and salary trajectories in male-dominated fields.

Making pay scales transparent can make an even bigger difference in addressing gender wage equity over the course of women's careers if it is coupled with institutional mechanisms for reporting, correcting and seeking redress for wage differences. Other changes such as aligning informal and formal reward systems, including a redefinition of the "ideal employee" for advancement that emphasises good performance over sheer number of hours spent at work,

could also help to level the playing field for women. Developing feedback and performance management processes that ensure women (as well as men) get timely, honest and direct feedback to aid their development are also important. Research has shown that women are more likely to receive vague feedback, whereas men will receive specific guidance on what they are doing well and how to improve their performance.

4. Adopt more progressive and flexible work policies, especially when women's attrition rate is highest

The rooftop solar sector is a young, emergent field where there is a scope for formulating new policies as well as improving existing policies. There is room to address gendered needs as have been done in some other, more mature sectors. Our findings suggest that most women leave their jobs in companies due to the transfer of a spouse or because of personal obligations after marriage and childbirth, all of which are common across sectors. This is a transitionary period in a woman's life, which requires additional support due to the existing social norms dictating that women be the primary caregiver. Progressive work policies from other sectors that have a higher percentage of women participating, such as technology services and banking sectors, can offer good examples for many of these emerging companies. To retain qualified talent (especially female employees with competing obligations) over the long term, some companies have experimented with flexible working hours, pick-up-and-drop facilities, training programmes to upskill employees, and the option of a temporary move to a less demanding role.

5. Raise awareness through more employee diversity, gender sensitisation, and soft skills training

Consciousness of individual employees plays an integral role in overcoming the gender bias that can exist in all sectors. Increasing the diversity of gender and cultural backgrounds or exposure to markets outside India at company level can raise employees' awareness in a sector like the rooftop solar sector, which is inherently domestic. As in other sectors, introducing gender sensitisation and other soft skill training sessions (e.g. interpersonal skills) could also help foster a more empathy-driven work culture within the organisations.

6. Strengthen a supportive work culture

The work culture at company level, which almost all companies and their female employees in our survey and interviews described as rather flexible and supportive, can be further enhanced. Most organisations in the solar rooftop sector are in their nascent stages and still in process of developing their formal policies. The work culture itself, therefore, plays an important role in ensuring a healthy support system for employees, both women and men. Initiatives like support groups, mentorship and guidance for current women employees that some rooftop solar companies already have in place could be introduced more widely to help attract and retain women within the sector.

Investors play an important role

Financial institutions can encourage companies to hire more women at project and company levels by integrating gender elements as a social aspect of lending requirements. There are cases where private equity firms that invested in rooftop solar companies encourage them to set internal goals on the number of women in the workforce and improve gender diversity, including their board of directors. Public financial institutions are another good example. In 2016, the Asia Development Bank and the World Bank earmarked preferential lines of credit for rooftop solar projects in India in collaboration with the Punjab National Bank and the State

Bank of India, respectively. In these first programmes of their kind to target India's rooftop solar, the lending requirements include gender elements such as encouraging companies to hire women for projects and facilitating compliance with the law against the sexual harassment of women. As the sector evolves and more financing needs arise, we see an increasingly important role for investors to play by providing the necessary impetus and support to companies in India's rooftop solar PV sector in order to achieve greater gender balance.

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