IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, October 2022
Impact Factor: 6.252

Employment Opportunities in Solar Energy Sector

Rupali Chourasiya
Research Scholar, Department of Economics
Institute for Excellence in Higher Education, Bhopal, MP, India
rc301997@gmail.com

Abstract: *100 GW of the 175 GW of Renewable energy generation capacity that India now expects to install by 2022 will come from the solar power industry. Along with producing many more job possibilities for nearby communities, it also reduced life-cycle greenhouse gas emissions. Many of these newly created jobs are concentrated in the project's development, operation, and management phases. The assessment technique comprises a review of the available literature as well as an analysis of secondary data with important reports on renewable energy. An analysis is used to determine the importance of the solar energy sector in creating jobs and to research various career opportunities from particular scenarios and variety of job opportunities in Solar Energy Sector. The study concluded to that the solar industry already creates a variety of job opportunities. In the upcoming years, this is anticipated to increase. The nature of these professions is changing as the industry creates more intricate services.*

Keywords: Solar Energy; Employment Opportunity; Career in Solar Sector; Solar Jobs

JEL codes: E240, I380, Q420

I. INTRODUCTION

The usage of natural resources has increased recently as a result of the rising scarcity of conventional energy sources like coal, petroleum, and natural gases, which are also contributing to environmental and climatic changes. In order to make up for the lack of electrical energy, solar energy is essential. As electricity is produced by coal, nuclear, and other non-renewable power facilities, it is the primary contributor to industrial air pollution. The air, land, and water are all contaminated by conventional energy sources. The 1970s oil crisis forced the government to shift its emphasis from coal to renewable energy sources. It is essential that low-carbon, renewable energy sources supply the majority of this additional energy demand. An important turning point in the global fight to tackle climate change has been reached with India's announcement that it plans to achieve net zero carbon emissions by 2070 and to meet 50% of its electricity needs from renewable sources by 2030 (IBEF, 2022).

Green jobs are classified as either "jobs in businesses that produce goods and provide services that benefit the environment or conserve natural resources" or "jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources,". These definitions include employment in 1) renewable energy; 2) energy efficiency; 3) pollution reduction and removal, greenhouse gas reduction, and recycling and reuse; 4) natural resources conservation; and 5) environmental compliance, education and training, and public awareness (McGinn & Schneer, 2019).

1.1 Solar Energy Scenario of India

Solar energy uses the energy that originates from the sun, which is one of the renewable resources. One of the essential elements for converting sunlight into electricity is solar panels, which are constructed of solar cells. Solar panels, inverters, AC and DC protection devices, cables and earthing, and lighting protection are the fundamental parts of a solar power plant. While tiny, off-grid solar applications provide much-needed access to electricity to distant and energy-poor populations, large-scale solar projects supply power to the grid.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, October 2022
Impact Factor: 6.252

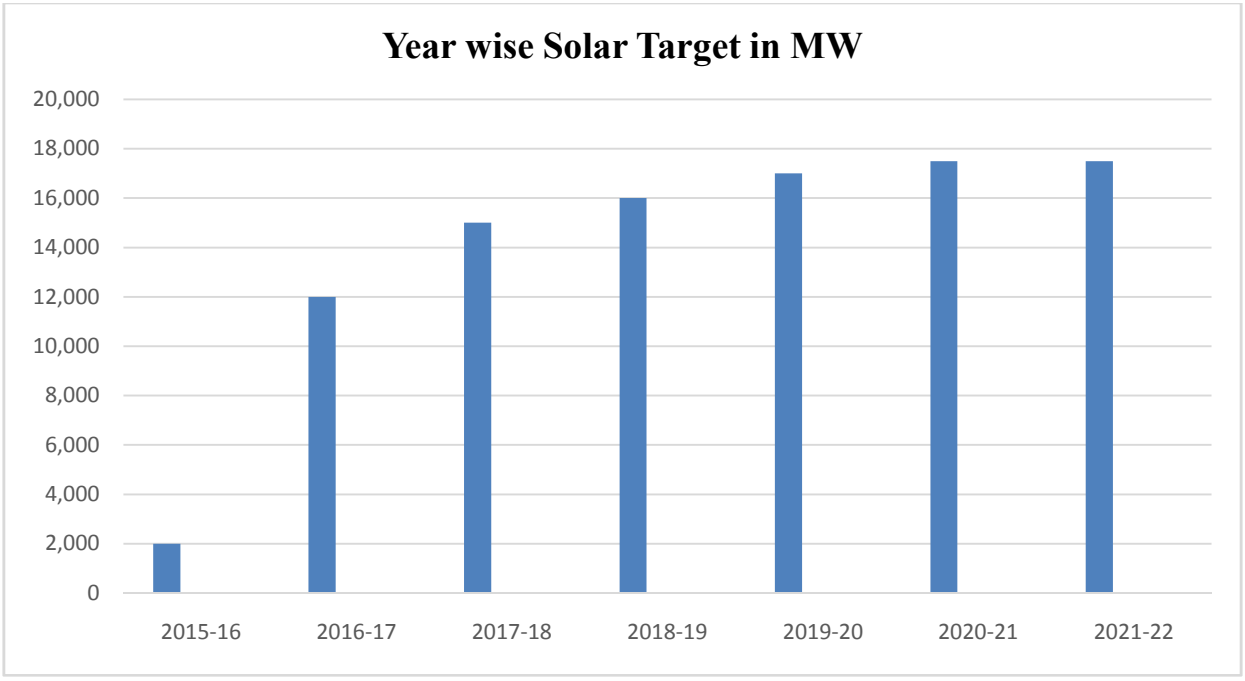

Figure 1: Year wise Solar Target in MW
Source: (MNRE, 2021)

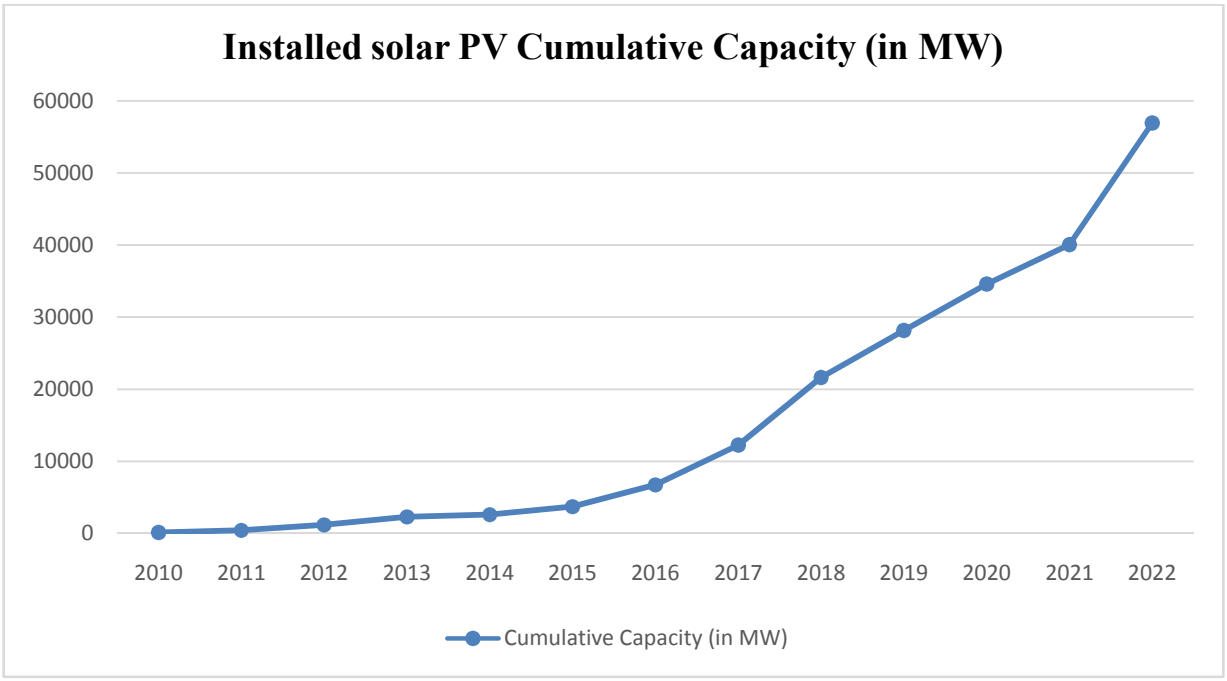

Figure 2: Installed solar PV Cumulative Capacity (in MW)
Source: (MNRE, 2021)

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, October 2022
Impact Factor: 6.252

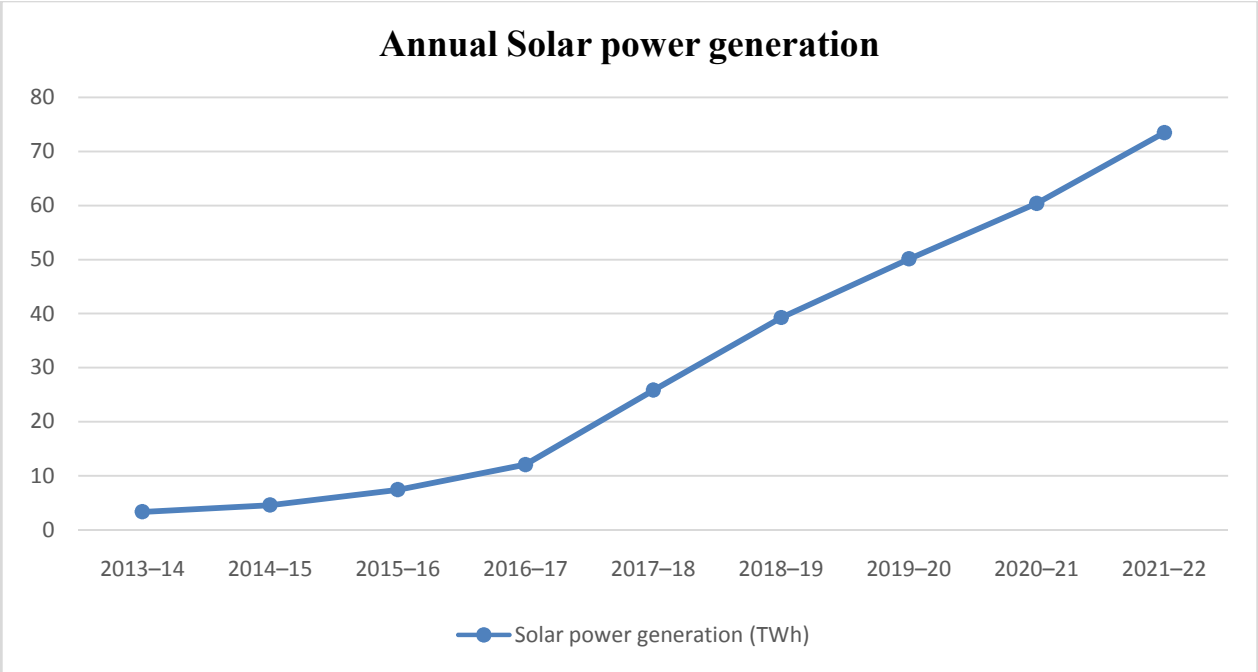

Figure 3: Annual Solar power generation
Source: (Central Electricity Athority, 2022)

The ambitious goal of the Indian government is to increase the capacity of renewable energy to 175 GW by 2022, with 100 GW coming from solar power (MNRE, 2022). As a kind of renewable energy, solar power is a rapidly growing sector in India. As of 31 March 2022, the nation had 53.997 GW of installed solar capacity (Chourasiya, 2022).

1.2 Employment Opportunities in Solar Energy Sector

Worldwide employment in renewable energy was estimated at 12 million in 2020, With 4 million employees, the solar PV sector accounts for one-third of all jobs in the renewable energy sector, and it will provide the most jobs by 2050 (20 million) (IRENA, 2021). Over the next three decades, there might be 43 million more jobs in the renewable energy sector. By 2030, there will be 18 million jobs under the PES, and there will be 23 million by 2050 after escalating efforts in a delayed response to the climate crisis. According to a sustainable scenario until 2030, the ILO estimates that 25 million new employments may be created globally in 2019. According to the ILO scenario results, there will be a loss of close to 7 million employments. Many of the lost jobs can be reallocated; for example, 5 million workers who lose their jobs as a result of industrial contraction will be able to find work in their same occupation in a different sector of the same country. Without openings for the same occupation in another industry, however, between 1 and 2 million jobs will become obsolete regardless of efforts made toward reallocation.

In India, solar power generation added the greatest new capacity in 2020. Even still, the amount of solar PV capacity installed 4.1 GW was much less than it had been the previous two years. The labour-intensive rooftop solar industry (primarily for commercial and industrial uses) added 1.35. Manufacturing jobs relating to solar energy are still scarce. India continues to be a net importer of modules and has almost no presence in the manufacture of polysilicon, ingots, or wafers. With an additional 69 600 jobs in off-grid locations, India's solar employment is anticipated to total 163 500 jobs. Manufacturing jobs relating to solar energy are still scarce. India continues to be a net importer of modules and has almost no presence in the manufacture of polysilicon, ingots, or wafers.

Long-standing initiatives by the Indian government include domestic content rules, subsidies, and manufacturing-related auctions to boost domestic manufacturing. However, Indian module producers have so far found it difficult to compete with Chinese counterparts in terms of price, R&D spending, manufacturing volume, or the integration of module, cell, and wafer production. The rate at which an existing "safeguard tariff" (an import tari) should be imposed is a crucial policy issue in India; the current rate was more than compensated by the continuous drop in the costs of foreign manufacturers (Ladislaw, 2021).

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, October 2022
Impact Factor: 6.252

In their study, Akanksha, Kuldeep, and Joshi evaluate the potential for direct employment created by the use of floating solar PV technology. 2019 saw the creation of 1.5 GW of floating solar capacity, and the government set a target of 10 GW by 2022. A medium-sized plant (up to 10 MW) can directly employ 45 people, compared to 58 for a small plant with a capacity of less than 1 MW. In a medium-sized facility, construction would account for about half (52%) of the jobs before the operations stage, followed by business development (29%), module and system component manufacture (15%), and design and preconstruction (4%). Most business development and design positions are permanent and highly skilled. In contrast, just around a quarter of positions in construction and operations are permanent, and the majority are semi-skilled (Akanksha, 2021).

II. Literature Review

Globally, the shift to a green economy and renewable energy is already under progress. In this research, the energy sector is highlighted together with a global overview of current employment developments related to the greening and decarbonization of the economy. It examines qualitative factors, such as education, skills requirements, and shifting talent profiles in the green transition, and it comes to a conclusion by highlighting key figures and offering policy recommendations to get past labour-related obstacles in a just transition to a cleaner energy system (Czako, 2020).

In India, using renewable energy is primarily done to advance economic growth, increase energy security, increase access to electricity, and slow down climate change. By using sustainable energy and guaranteeing that all residents have access to cost-effective, dependable, sustainable, and contemporary energy, sustainable development is made feasible. India is becoming one of the top leaders in the most lucrative markets for renewable energy in the world because to strong government support and the increasingly favourable economic environment. Over the coming years, it is projected that the domestic employment situation in the renewable energy sector will improve significantly. Due to the growth of renewable energy in India, there have been significant accomplishments, prospects, projections, electricity generation, as well as challenges, investment opportunities, and employment opportunities. These achievements have also identified the various challenges the renewable sector faces. (Kumar & Majid, 2020). One of the biggest and most ambitious efforts to increase solar renewable capacity is being carried out in India. One of the most important factors in socioeconomic development, solar energy also contributes to the establishment of long-term jobs in the economy and society. (Patil & Memon, 2022).

The total number of employments that the solar power industry will generate nationally in the future is estimated in the literature now in existence. However, due to various geographic and socio-political circumstances, the distribution of these employment varies significantly at the state and regional levels. By comparing the anticipated solar power capacity of each Indian state with the potential for job creation based on existing government plans and policies, this thesis aims to close this knowledge gap. Furthermore, media accounts frequently imply that any jobs lost in the existing fossil fuel industry can be countered by the newly established "green" jobs. They don't, however, do a thorough comparison of the two industries' respective types of employment. This study compares the two types of employment based on number, type of skill, and location (Das, 2019).

III. Objectives

The assessment technique comprises a review of the available literature as well as an analysis of secondary data with important reports on renewable energy. An analysis is used to determine the importance of the solar energy sector in creating jobs and to research various career opportunities from particular scenarios.

The key aim of the study is to identify the Employment Opportunity in Solar Energy Sector on which some questions arise which are become objectives of this study are:

1. To identify the significance of Solar Energy Sector in employment generation.
2. To analyse the variety of job opportunities in Solar Energy Sector.

IV. Methodology

Today's energy industry relies primarily on fossil fuels and is to blame for 89% of the world's greenhouse gas (GHG) emissions. India, while having exceptionally low per capita emissions, is the third largest contributor to world GHG emissions, trailing only the OECD and Gulf Cooperation Council nations in terms of emissions. This is mostly due to the fact that a sizable portion of the nation's installed energy generation capacity is coal-based.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, October 2022
Impact Factor: 6.252

Direct, indirect, and induced employment can all be generically categorised into three groups (Mutton, 2016). The design, development, management, building, and maintenance of the project are all directly related to jobs in the solar PV sector (CEEW-NRDC, 2017). While indirect employment is connected to the production of facility-related equipment, along with supply-chain workers who deliver raw materials and services to manufacturers. Jobs in finance and banking developed by the industry to supply services for building and running the facility are also regarded as indirect jobs (CEEW-NRDC, 2017). Jobs that are induced are those that are produced as a result of employees who are either directly or indirectly involved in the project spending their wages. According to optimistic projections, the solar PV business in India might employ up to 4.5 million people by 2040 (Mehra, 2018).

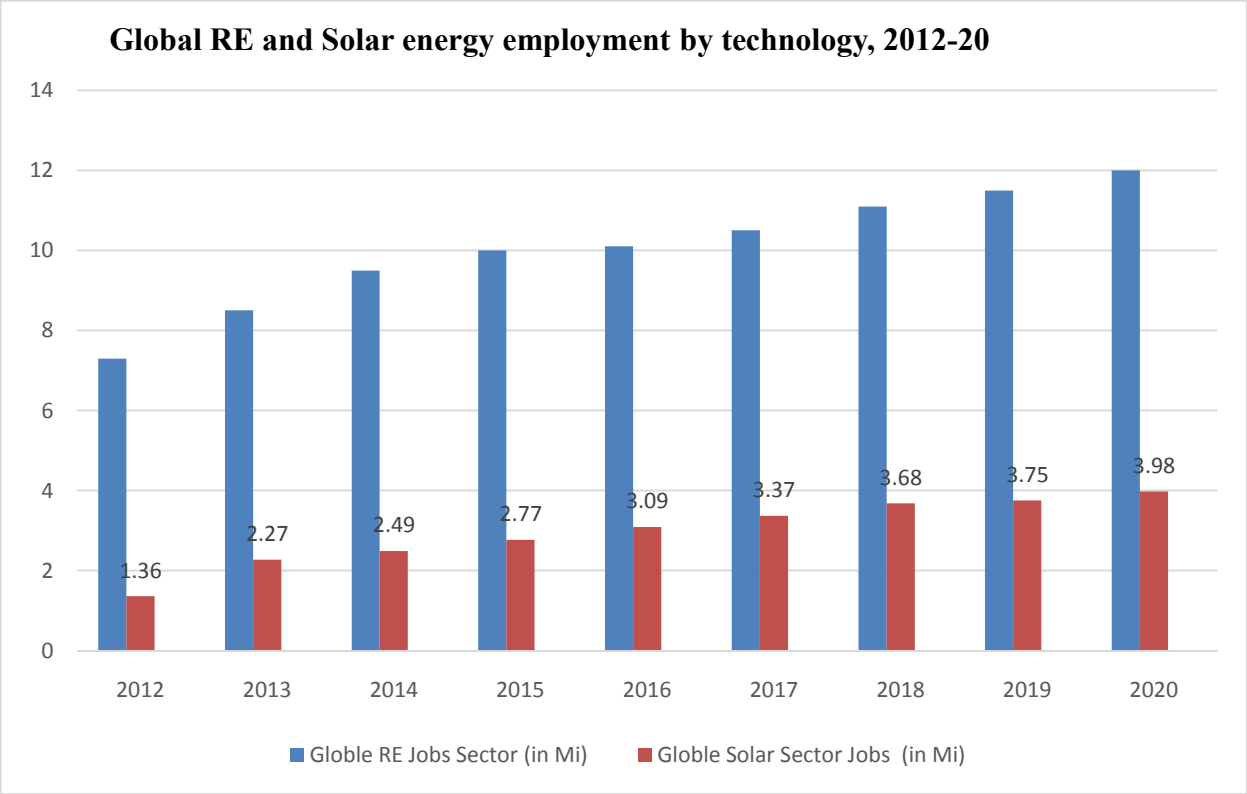

Figure 4: Global RE and Solar energy employment by technology, 2012-20
Source: (IRENA, 2021)

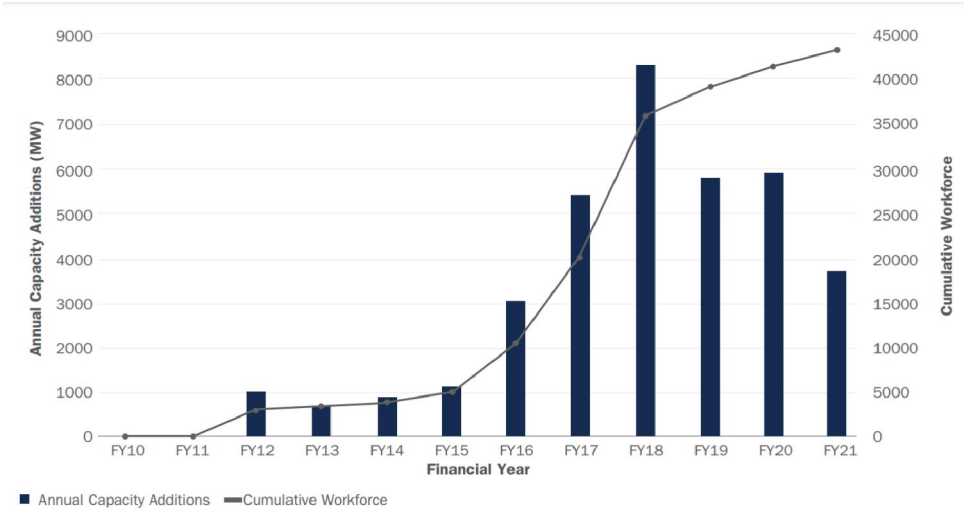

Figure 5: Employment trends in the utility-scale solar between FY10 and FY21.
Source: (Tyagi, Nagarwal, Lata, Korsh, & Rai, 2022)

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, October 2022
Impact Factor: 6.252

The solar energy industry has grown tremendously during the past ten years. The sector's total capacity increased to around 15 MW in 2010 and has increased to about 40 GW during the last 11 years. Utility-scale and rooftop solar segments split this capacity, with the former accounting for the lion's share. Since FY10, the utility-scale solar market has gradually increased. About 35 GW of utility-scale solar capacity was installed between FY10 and FY21, creating an estimated 42,900 new jobs. On the other hand, the rooftop solar market has grown poorly over the past ten years and has only been able to install 6.5 GW of capacity. Nevertheless, this capacity employed roughly 43,000 people, significantly more than utility-scale solar.

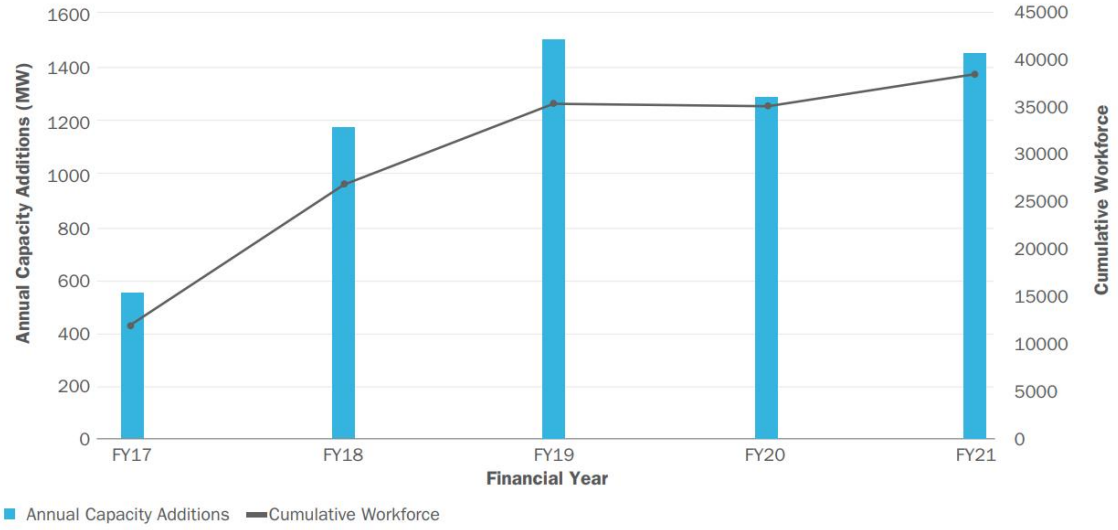

Figure 6: Employment trends in rooftop solar between FY17 and FY21
Source: (Tyagi, Nagarwal, Lata, Korsh, & Rai, 2022)

According to Das (2019), In India, 17,749 jobs have been estimated to be currently employed in the solar energy sector. In addition to the construction and operations & management stages of ground-mounted & rooftop solar power installations, this also refers to jobs generated in domestic module manufacturing (Das, 2019).

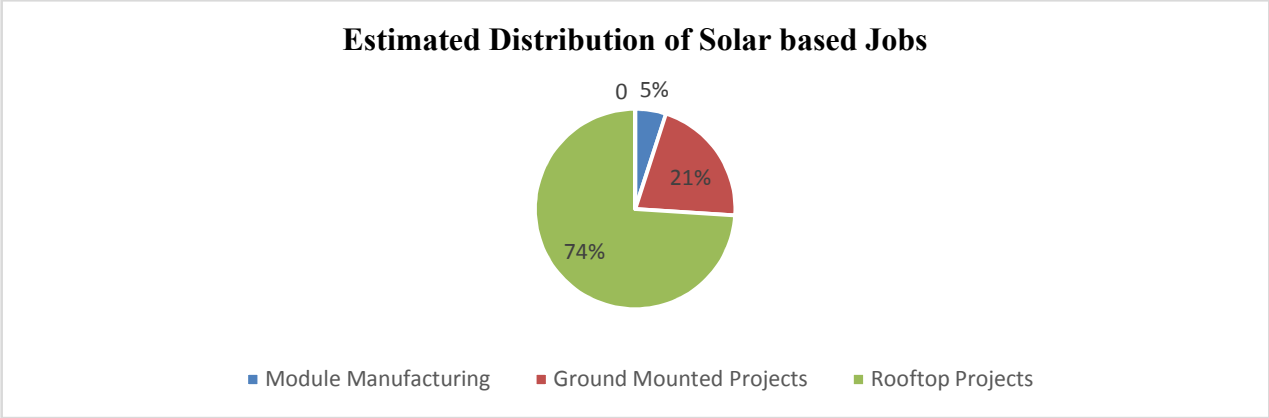

Figure 7: Estimated Distribution of Solar based Jobs
Source: (Das, 2019).

According to the estimations used in this report, the solar power industry will probably expand to employ 278,428 people in total by 2022. Due to the labour-intensive installation process, the rooftop deployment sector will account for the majority of these newly created jobs (205,848). For ground-mounted and rooftop solar projects, the estimated number of jobs in 2022 includes those created during project construction, operation, and management. The construction employment are computed on an annual basis, meaning that they are temporary and will end once the capacity augmentation is finished. The number of construction jobs that would be created in a given year was calculated using an estimate of the MW capacity that would be built during that year. The jobs in operations and management, however, are measured cumulatively because they won't disappear over time if a given amount of capacity is added.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, October 2022
Impact Factor: 6.252

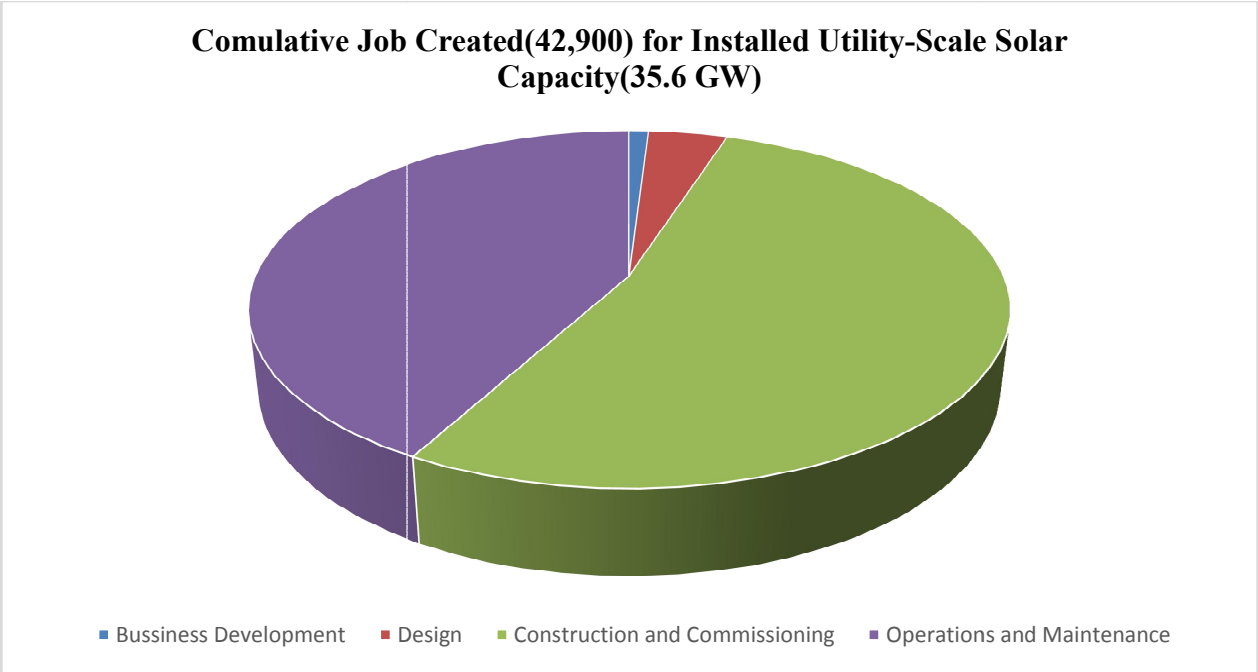

Figure 8: Comulative Job Created(42,900) for Installed Utility-Scale Solar Capacity(35.6 GW)
Source: (Tyagi, Nagarwal, Lata, Korsh, & Rai, 2022)

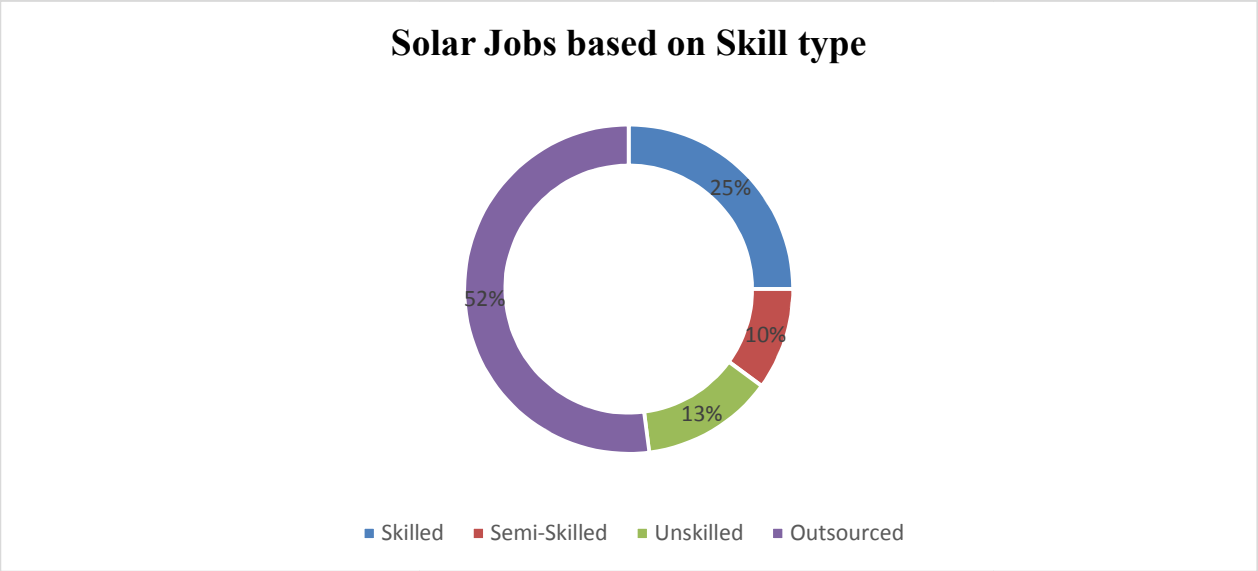

Figure 9: Solar Jobs based on Skill type
Source: (Das, 2019)

Based on the three main skill types of skilled, semi-skilled, and unskilled employment in the various sorts of solar power installation professions. The segmentation of solar energy jobs according to these various skill sets. According to research analysis, the majority of the occupations that will be produced, would fall under the category of "uncategorized/outsourced." The majority of these employment, which will be temporary or outsourced, will be created in the rooftop installations industry. This is a noteworthy discovery because, given that contractual employment is frequently transient, it may signal uncertainty for employment in the sector.

V. Theoretical Analysis and Interpretation

Renewable energy technologies are seen as investments that can provide direct and indirect economic benefits by reducing dependence on imported fuels, improving local air quality and safety, advancing energy access and security,

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, October 2022
Impact Factor: 6.252

fostering economic development, and creating jobs. Renewable energy technologies are also seen as tools for improving energy security and mitigating and adapting to climate change. The use of renewable energy technology to produce electricity, heat and cool buildings, and power vehicles is now widespread, and recent trends point to continued growth on a global scale. Renewable energy technologies had a significant attraction to individuals who wanted to switch from conventional fuels for environmental grounds ten years ago. They primarily inhabited an environmental niche. Today's renewable energy sources show that they not only serve the environment but also the economy by generating jobs, assisting in the diversification of revenue sources, and promoting new technical advancements.

Rapid expansion in the renewable energy industry has been largely attributed to considerable drops in manufacturing and installation costs. The economy of renewable energy includes several different job categories and is spread out throughout all states. 80% of jobs in the solar energy industry are demand-side services (such as installation, sales, etc.), the majority of which are locally based jobs that cannot be exported. Jobs in energy efficiency range from equipment installation and building retrofit to product creation and manufacture. Due to the on-site nature of efficiency work, the majority of the building and installation activities are regional (Environmental Defense Fund- Climate Corps, 2017).

5.1 Suryamitra Training

Workforce development in the clean energy sector depends on providing employees with the necessary education and training. The Ministry of New and Renewable Energy introduced the Suryamitra training programme in 2015. It is one of these programmes that develops qualified solar technology technicians for installation, commissioning, operation, and maintenance. The country's 450 GW RE objective necessitates raising solar energy usage knowledge among all consumers and asks for a sizable pool of skilled personnel to meet the sector's expanding and changing demand. More than 78,000 trainees have received certification from the Indian government since the program's commencement through mid-2021. This is done as part of the Suryamitra training programme, which is funded by a number of federal and state-sponsored programmes (Tyagi, Nagarwal, Lata, Korsh, & Rai, 2022).

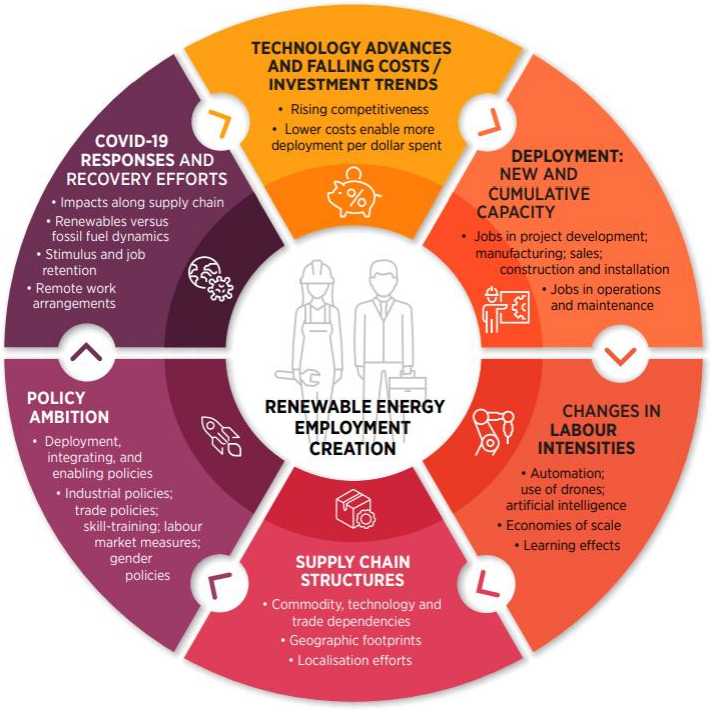

Figure 10: RE Employment Creation
Source: (IRENA, 2021).

The market for renewable energy still faces many difficulties. Financial incentives for renewable energy sources continue to be greatly outweighed by subsidies for fossil fuels and nuclear power. If the rise in global temperature is to be kept to two degrees Celsius above pre-industrial levels, more advancements and investment in renewable energy

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, October 2022
Impact Factor: 6.252

must be made, along with improvements in energy efficiency. To achieve the climate targets, the energy industry must quickly become carbon-free using renewable energy sources (REN21, 2014).

VI. Conclusion and Suggestions

The manufacturing, construction, and service industries account for the majority of jobs in the production of renewable energy. Although employment is also created in other skill categories, the majority of jobs created in renewable energy generation are in the high-skilled labour group, which is defined as employees with an educational attainment level. Approximately 70% of new jobs generated by renewable energy in the power sector are high-skilled jobs in all scenarios.

The availability of a skilled labour force affects the employment gains that can be made. Through updated and refocused education and training systems, this must be addressed. The "importation" of important high-skilled labour, while not ideal for localization, could be seen of as a stopgap approach to fill any potential serious skills shortfall. Higher education, training facilities, and sectoral skill programmes will eventually need to integrate their training curricula with the industry's skill requirements.

Key recommendations after the fruitful analysis of study include some specific points -

1. Economic incentives could be developed by policymakers to strategically relocate future industries to certain regions in order to generate new economic stimulation.
2. There are specific actions that can be implemented to lessen the societal effects of the energy transition in coal supply.
3. Creating more accurate predictions for the future job growth in module manufacturing. This may be based on more thorough and precise data regarding the expansion of the market share of the industry of module manufacturing.
4. Applying multipliers based on actual data allows one to estimate the amount of employment that has been induced.
5. Because of connections to other economic sectors, the off-grid solar sector generates indirect jobs.

In developing locations, the off-grid solar industry already creates a variety of job opportunities. In the upcoming years, this is anticipated to increase. The nature of these professions is changing as the industry creates more intricate service delivery models and as technical advancements open up new job opportunities related to larger systems and a wider range of intricate consumer goods.

ACKNOWLEDGMENT

Here, I would like to thank everyone who helped me in doing this research by generating an exhibit the best of the knowledge through a combined examination of in-person and online sources for personnel and stuff. Prof. Manish Sharma has helped me complete my study work with dedication, energy, and excitement. I would also like to convey my gratitude and appreciation to my parents, relatives, and friends for their constant support and encouragement.

References

[1] Akanksha, T. N. (2021). Employment potential of emerging renewable energy technologies: Insights from the floating solar industry . *Council on Energy, Environment, and Water Natural Resources Defense Council and Skill Council for Green Jobs*.

[2] Aktamis, H. (March 2011). Determining energy saving behavior and energy awareness of secondary school students according to socio-demographic characteristics. *Educational Research and Reviews Vol. 6(3)*, 243-250.

[3] Central Electricity Athority. (2022). *Renewable Generation*. Retrieved from Center for Energy Finance: https://www.renewablesindia.in/

[4] Chourasiya, R. (2022). Role of Solar Energy in Fulfillment of SDGs. *International Journal of Research Publication and Reviews*, 1889-1899.

[5] Czako, V. (2020). *Employment in the Energy Sector*. Eurapean Commission.

[6] Das, A. (2019). Growth of Solar Jobs in India: A Reality Check. University of Manchester.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, October 2022
Impact Factor: 6.252

[7] Deshmukh, V. V., & Rajput, P. (2016). Implementation of renewable energy (solar) for rural development. *Journal of Chemical and Pharmaceutical Research*, 130-135.

[8] Ellabban, O., Abu-Rub, H., & Blaabjerg, F. (November 2014). Renewable energy resources: Current status, future prospects and their enabling technology. *enewable and Sustainable Energy Reviews*, 748-764.

[9] Environmental Defense Fund- Climate Corps. (2017). *Now Hirings: The Growth of America's Clean Energy & Sustainability Jobs.* Environmental Defense Fund.

[10] Gill, B., Gupta, A., & Palit, D. (2019). *Rural Electrification impact on Distribution Companies in India.* The Energy and Resources Institute.

[11] Girouard, N., & Elianna Konialis, C. T. (2011). *OECD Green Growth Studies.*

[12] IBEF. (2022). *Renewable Energy Industry in India*. Retrieved from India Brand Equity Foundation: https://www.ibef.org/industry/renewable-energy

[13] IRENA. (2021). Renewable Energy and Jobs Annual Review 2021. IRENA.

[14] Johns Hopkins School of Advanced International Studies. (2021, July). *Renewable Energy vs Sustainable Energy: What's the Difference?* Retrieved from Johns Hopkins School of Advanced International Studies: https://energy.sais.jhu.edu/articles/renewable-energy-vs-sustainable-energy/

[15] Joshi, G. D., & Yenneti, K. (2020). Community solar energy initiatives in India: A pathway for addressing energy poverty and sustainability? *Energy and Buildings*.

[16] Kumar, C. R., & Majid, M. A. (2020). Renewable energy for sustainable development in India: current status, future prospects, challenges, employment, and investment opportunities. *Energy, Sustainability and Society*.

[17] Kumar, M. (2020). Social, Economic, and Environmental Impacts of Renewable Energy Resources. In K. E. Okedu, *Wind Solar Hybrid Renewable Energy System.* IntechOpen.

[18] Ladislaw, S. E.-S. (2021). Industrial Policy, Trade, and Clean Energy Supply Chains . *Center for Strategic and International Studies and BloombergNEF*.

[19] Lu, Y., Khan, Z. A., Alvarez-Alvarado, M. S., Zhang, Y., Huang, Z., & Imran, M. (June 2020). A Critical Review of Sustainable Energy Policies for the Promotion of Renewable Energy Sources. *Sustainability*, 02-30.

[20] McGinn, A., & Schneer, K. (2019). Fact Sheet | Jobs in Renewable Energy, Energy Efficiency, and Resilience . *Ideas. Insights. Sustainable Solutions*.

[21] Mehra, M. K. (2018). An Assessment of India's Energy Choices: What it Means for the Economy, Jobs, and Energy Security. *Climate Policy Initiative & Indian School of Business*.

[22] MNRE. (2021). Installed Capacity of Various Renewable Modes of Energy. Retrieved from PIB: pib.gov.in

[23] MNRE. (2022). *Solar Energy* . Retrieved from https://mnre.gov.in/solar/current-status/

[24] Patil, S., & Memon, S. (2022). Solar Renewable Energy for Sustainable Development in India: Current Status, Future Prospects, Challenges, Employment. *International Journal of Advanced Research in Science, Communication and Technology*.

[25] REN21. (2014). The First Decade: 2004 – 2014 : 10 Years of Renewable Energy Progress. Renewable Energy Policy Network for 21st Century.

[26] Tiwari, A., & Chourasiya, R. (2022). UShA for Rural Development : ACritical Analysis. *International Journal of Research and Analytical Reviews*, 392-407.

[27] Tyagi, A., Nagarwal, A., Lata, C., Korsh, J., & Rai, D. (2022). *India Expanding Clean Energy Workforce opportunities in the Solar and Wind Eneregy Sectors.* Council on Energy, Environment and Water,Natural Resources Defense Council, Skill Council for Green Jobs.

[28] Zyadin, A. (December 2015). Prospects for renewable energy education (REE) inelevating youth energy and environmental awareness in Jordan. Joensuu: Finnish Society of Forest Sciences.