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# CAN RENEWABLE ENERGY JOBS HELP REDUCE POVERTY IN INDIA?

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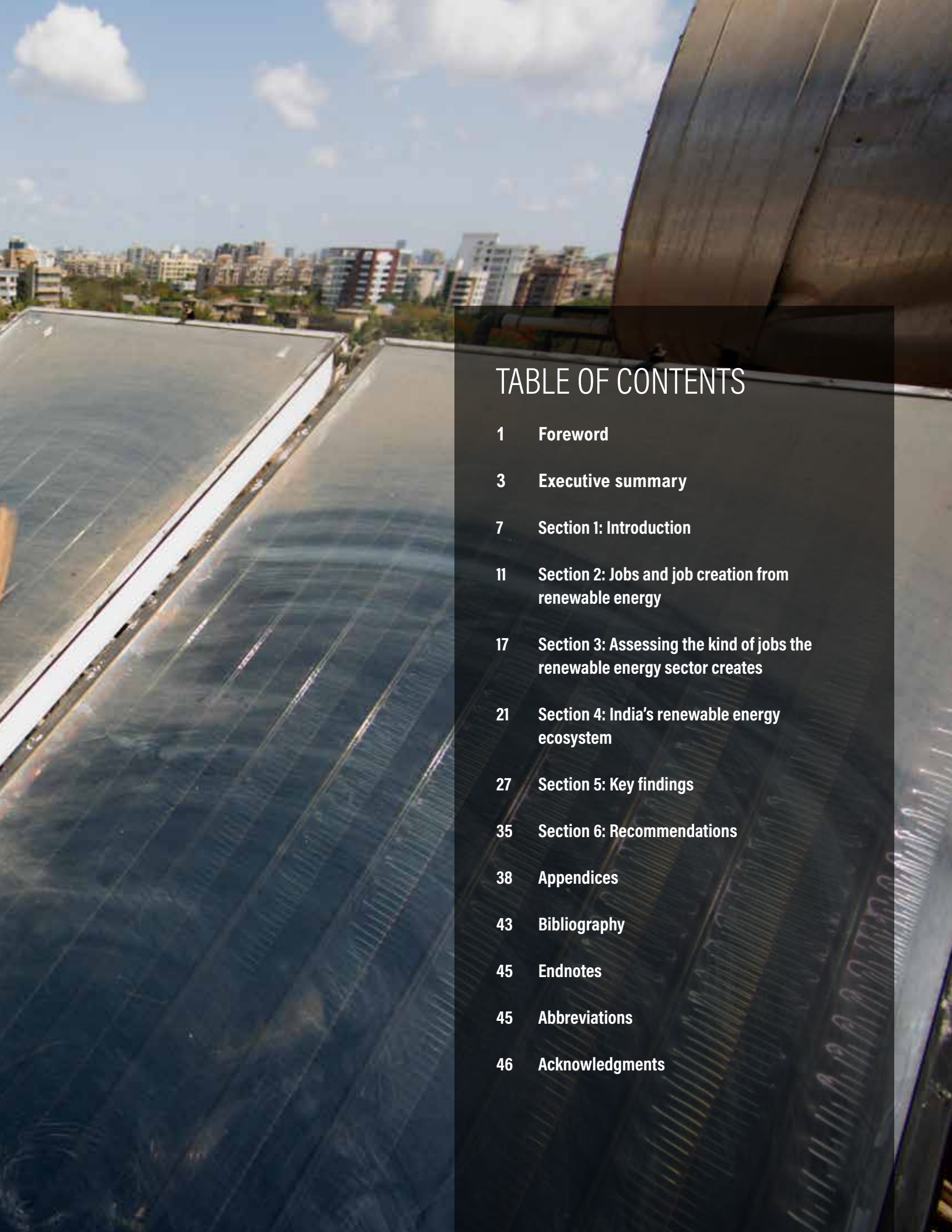

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# FOREWORD

India launched a massive push for clean energy in 2014, announcing ambitious targets to generate 160 gigawatts (GW) of wind and solar power by 2022, a 400 percent increase from previous targets. Studies have estimated that this renewable energy push could generate as many as 330,000 new jobs over the next five years. Can these jobs help reduce poverty in India?

The short answer is yes. Although direct employment benefits will not be large, relative to India's economy and its millions of poor citizens, the new jobs can make a difference to rural poor people, especially women, who have few formal sector employment opportunities. This report identifies steps that leaders of India's renewable energy push can take to maximize these benefits.

*Can Renewable Energy Jobs Help Reduce Poverty in India?* finds that many clean energy jobs in fields such as construction, installation, sales, and operations and maintenance will go to unskilled and semi-skilled workers—those who lack the formal training or educational background needed to secure well-paid, full-time employment. Some of these jobs will also emerge in less developed, rural communities, where few opportunities beyond smallholder farming exist.

Some clean energy enterprises provide a reliable source of income that enables employees to make smarter investments, save for unexpected expenses, and plan for their children's futures. Some positions also offer healthcare benefits, safety training, and capacity-building programs that give workers the technical expertise they need to secure a promotion. Even those with temporary employment can improve their circumstances by acquiring transferable skills on the job that help them start their own clean energy businesses.

Yet, as the report reveals, the quality of renewable energy jobs varies widely across India, with most positions offering few benefits and little stability. Poor people, especially women, still face entry barriers to the job market, and they are shut out from the training programs that could prepare them for employment. This report recommends a set of actions that government officials, private sector leaders, and civil society organizations can take to "tune" the renewable energy sector to reduce poverty. These actions range from investing in capacity-building initiatives for unskilled workers to promoting collaboration between training institutes and clean energy enterprises to align curricula with industry needs.

The benefits of transitioning to clean energy and electrifying rural communities will extend far beyond employment opportunities. For the world's poorest people, increased energy access means more time for children to study after school, greater productivity and income for families, and improved health outcomes. Creating good quality renewable energy jobs that will help reduce poverty in rural, underdeveloped regions is a less considered, but crucial added benefit. Adopting the report's recommendations will help decision-makers not only in India, but in developing countries around the world, secure a clean energy future and tackle poverty.

**Andrew Steer**
*President*
*World Resources Institute*

# EXECUTIVE SUMMARY

**In addition to improving energy security, enhancing energy access, and mitigating climate change, renewable energy may be able to help reduce poverty, by creating good jobs that poor people can perform.** Meeting India's ambitious target of generating 160 gigawatts (GW) of wind and solar power by 2022 may require 330,000 jobs in construction, project commissioning and design, business development, and operations and maintenance (O&M). Some of these jobs may have a direct impact on poverty reduction.

## HIGHLIGHTS

- For jobs in the renewable energy sector to have an impact on poverty reduction, they need to incorporate elements of "good" jobs, such as reliability of income, healthcare benefits, employee safety policies, and training opportunities.
- Some renewable energy sector programs and projects demonstrate that enhancing the quality of jobs can increase poverty reduction.
- When they employ the poor, permanent jobs in the renewable energy sector have the potential to reduce poverty.
- Lack of studies and baseline data make it difficult to assess the impact of renewable energy jobs on the poor.
- Various actions can foster the creation of good jobs for the poor in the renewable energy sector.

## About This Report

**This report looks at opportunities for reducing poverty by creating good-quality employment along the renewable energy supply chain.** By assessing the ecosystem for renewable energy in India, evaluating the extent to which it supports the generation of good jobs in poor and rural areas, and identifying ways to accelerate the creation of jobs that sustainably reduce poverty, it offers a first-pass assessment of how the renewable energy sector could be "tuned" to contribute more to poverty reduction as it meets India's development needs.

## The Research Problem

**Some studies have looked at the impact of renewable energy on employment, but few have looked at the quality of jobs—and even less attention has been given to the types of skills and employment opportunities that can be created along the supply chain of renewable energy development.** To fill this gap, this report examines opportunities for poverty reduction through employment generation along the renewable energy supply chain. Drawing lessons from programs and projects in India, it seeks to understand what is needed to develop programs, projects, and policies that lead to livelihood opportunities.

## Key Findings

**The findings reported here include (a) the majority of jobs in the sector are contractual and do not offer benefits or job stability; (b) permanent jobs in the sector have the potential to reduce poverty, but they need strengthening before they become good jobs; (c) most poor people face barriers to entry to training and the job market; (d) few programs include features that help reduce poverty, such as capacity building, development of ownership opportunities, and the inclusion of women; and (e) the absence of data makes it difficult to establish connections between jobs in renewable energy and poverty reduction.**

## Recommendations

**The report presents a set of recommendations for "tuning" the renewable energy sector to provide poverty-reducing jobs for the poor.** Its recommendations include the following:

- Focus capacity building on empowerment of the poor, particularly training in operations and maintenance (O&M) services.
- Develop and introduce training programs for people with very little education and training, who do not qualify for current programs, preventing them from working in the sector.
- Focus on localized training of women to enhance their inclusion in the renewable energy workforce.
- Strengthen links between training institutes and renewable energy enterprises across the supply chain in order to ensure that (a) trained personnel are placed in relevant jobs during and after completion of the training program and (b) training programs meet the needs of the industry.
- Embed poverty impact assessments in program design to understand how programs lead to poverty reduction and whether and how they reach their target audience.
- Create a sense of ownership and contribution to the growth of renewable energy projects among the poor.
- Collect data, including information about the types of jobs being offered (part time, full time, contractual); the levels of skills required (skilled, semi-skilled, and unskilled); who is being employed; and employees' socioeconomic status.
- Conduct studies, supported by field surveys, to understand the impact renewable energy jobs have on poverty reduction and changes in livelihoods.

SECTION 1

# INTRODUCTION

As the impacts of climate change compel global growth strategies to move in the direction of lower-carbon and lower-emission economies, innovative industries, such as renewable energy, are expanding. Delivering products and services that seek to resolve the energy trilemma of achieving energy security and energy access for all while ensuring sustainability will be challenging, but doing so will also create new opportunities.

The transition to more sustainable growth patterns has the potential to create new employment opportunities and expand economic activity across geographies.

More than 270 million people in India lived in extreme poverty in 2012. They had either severely limited or no access to education, healthcare, water and sanitation, and energy (Narayan and Murgai, 2016). About 237 million people in India have no access to electricity, and almost 840 million still rely on traditional biomass for cooking (IEA, 2015).

## Renewable Energy and the Potential for Job Creation

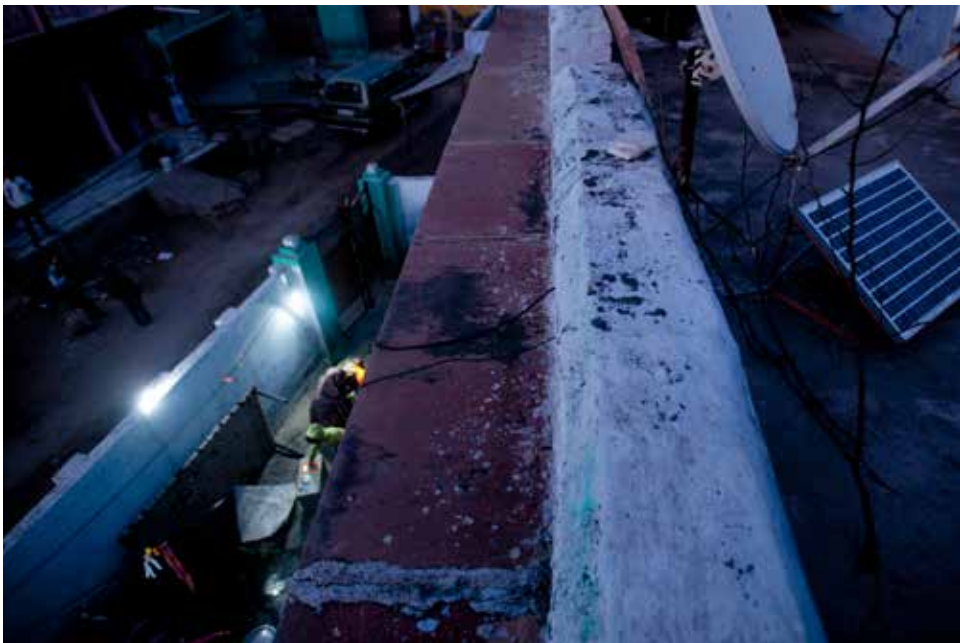
India has laid out ambitious targets for expanding renewable energy and developing a renewable energy industry, including both products and services. It expects to install 100 GW of solar (utility scale, distributed, and off-grid/mini-grid); 60GW of utility-scale wind; 10GW of bioenergy; and 5GW of small hydro by 2022 (NITI Aayog, 2015). Do these ambitious targets have the potential to help India achieve its environmental, economic, and developmental mandates? Could the act of providing energy, specifically through good-quality employment in the growing renewable energy sector, help reduce poverty?

The transition from an economy heavily reliant on fossil fuels to one that uses cleaner energy resources will generate a shift in employment, especially in the energy sector. In the United States, for example, in 2016 an estimated 800,000 Americans were employed in low-carbon emission generation technologies, including renewables, nuclear, and low-emission natural gas. By contrast, only 160,000 Americans worked in coal (U.S. Department of Energy, 2017). In 2016 alone, the number of solar jobs increased by 25 percent, and the number of wind jobs increased by 32 percent in the United States. Is a similar shift likely to take place in India? How would such jobs affect poverty?

Grid-based and off-grid decentralized renewable energy creates jobs that require a range of skill sets—unskilled, semi-skilled, and limited high skilled—in poor regions (Cabraal et al. 2005; Hammond et al. 2007; NSSO 2011). For example, on an average, a 10–25 megawatt (MW) solar photovoltaic plant requires roughly 40 skilled and 80 unskilled employees throughout the project's lifecycle (CEEW and NRDC, 2014). Such grid-based plants are often located away from towns and cities, in areas where people have fewer renewable energy skills.

## About This Report

Many studies have assessed the impacts of renewable energy on consumption, productivity, health, and education (IRENA, 2012). Some have looked at its impact on employment or the creation of new enterprises, but few have looked at the quality of employment or have examined the types of skills and employment opportunities that can be created along the renewable energy supply chain. To fill this gap, this report examines opportunities for poverty reduction through employment generation along



the renewable energy supply chain. Drawing lessons from programs and projects in India, it recommends what is needed to develop sector programs and policies that lead to livelihood opportunities that reduce poverty.

This study offers a first-pass assessment of how India's renewable energy sector could be "tuned" to contribute more to poverty reduction by creating good-quality jobs. It does so by (a) defining and assessing the ecosystem around renewable energy, (b) evaluating the extent to which this ecosystem supports the generation of good jobs that poor people can perform, and (c) identifying ways to accelerate the creation of such jobs in a way that results in sustainable poverty reduction.[1] The study aims to build an evidence base that will contribute to designing the larger ecosystem around renewable energy programs and initiatives to accelerate poverty impacts through the supply side.

The study offers a first-pass assessment of how India's renewable energy sector could be "tuned" to contribute more to poverty reduction by creating good-quality jobs.

Evidence regarding the impact of renewable energy on the creation of employment opportunities exists, but it is not disaggregated. It is often concentrated in certain geographical areas (Europe and the United States), fails to distinguish between full-time and part-time jobs created, and focuses on utility-scale projects.

This study builds on earlier work that examines what makes a job a good job and how good jobs can contribute to poverty reduction. It examines renewable energy providers' experience with hiring, especially employees trained in renewable energy-related programs, in order to gain insight into how the renewable energy ecosystem could be "tuned" to facilitate more poverty-reducing employment as it grows. The study focuses on the quality of jobs, highlighting examples where improving job quality has poverty-reducing attributes.

This study is intended for a range of stakeholders. The primary audience includes policymakers in India. It also includes training institutes in India that provide training in renewable energy technologies; international agencies, including international financial institutions and investors promoting renewable energy and livelihood creation by supporting training for poor people; and renewable energy policy makers, program designers, and training institutes in other developing countries.

The report focuses on semi-skilled and unskilled jobs in rural areas, because poverty in India is still predominantly rural. It looks at solar, wind, and to a lesser extent biomass and hydro technologies (time constraints prevented it from assessing other renewable technologies or considering renewable energy jobs in the manufacturing and logistics sectors).

The study's findings are based on interviews with and a survey of policymakers, renewable energy program designers, representatives of training institutes and off-grid enterprises, project developers, and company employees. Although the findings are not representative of India's renewable energy market, they offer a first-pass snapshot of India's energy ecosystem and the potential for job-linked poverty reduction.

The report is organized as follows. The next section shows the potential for job creation in the renewable energy sector. The third section assesses the kinds of jobs the sector creates. Section four describes India's renewable energy programs, training institutes, and recruitment platforms. The last two sections report the study's key findings and make recommendations based on them. The recommendations are based on the study of India but may be relevant for other developing countries.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SECTION 2

# JOBS AND JOB CREATION FROM RENEWABLE ENERGY

175GW of Renewable Energy by 2022 will create several new jobs in the solar photovoltaic (PV) and wind sectors. The skills required for these jobs vary, with a large number of them going to semi-skilled and unskilled workers.

## Current and Potential Global Employment in the Renewable Energy Sector

The International Renewable Energy Agency estimates that 9.8 million people were employed in the renewable energy sector in 2016 (IRENA, 2017). It estimates that doubling the share of renewables in the global energy mix would result in more than 24 million jobs worldwide by 2030 (IRENA, 2016). However, its studies concentrate on large or utility-scale technologies; limited evidence is available on other segments of the supply chain, particularly in rural and poor areas (IRENA, 2012). Little is known about the skill levels and educational qualifications of people performing renewable energy jobs.

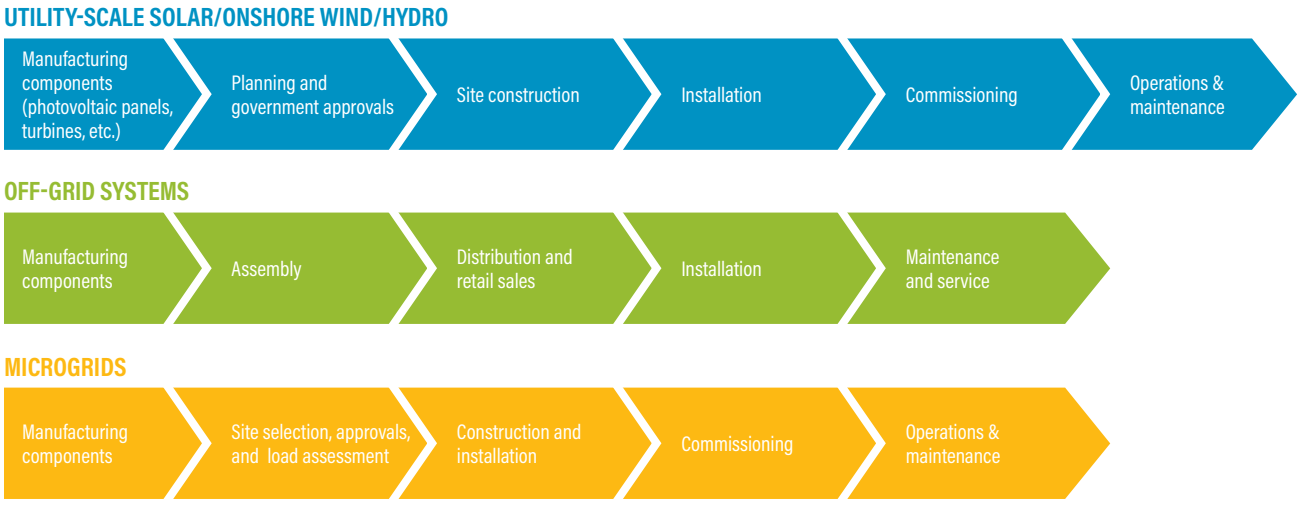
Since 2012, IRENA has been developing methodologies to estimate job creation related to renewable energy at the national level. In its 2016 annual review, it estimates that employment in the sector reached 3.5 million in China, 918,000 in Brazil, 760,000 in the United States, 388,000 in Japan, and 355,000 in Germany. IRENA also reports on employment from off-grid systems. In Bangladesh, for example, where an estimated 4.5 million solar home systems have been installed, the workforce for stand-alone solar reached 127,000 jobs, mostly in manufacturing (IRENA, 2016).

Sector growth has the potential to create new jobs along the renewable energy supply chain, including employment in manufacturing, assemblage of small-scale systems, construction of on- and off-grid plants, installation of small-scale systems, sales and distribution, and operations and maintenance (O&M) (Figure 1).

## Current and Potential Employment in India's Renewable Energy Sector

India's solar industry employs an estimated 103,000 people, including 31,000 in grid-connected and 72,000 in off-grid applications; another 48,000 people work in the wind sector (IRENA, 2016). The Council on Energy, Environment and Water (CEEW) and the Natural Resources Defense Council (NRDC) estimate that 300,000 full-time equivalent (FTE) jobs will need to be created—in construction, project commissioning and design, business development, and O&M—to meet India's 100GW solar target by 2022 (CEEW and NRDC, 2017).

Figure 1 | **Project Life Cycle for Various Renewable Energy Technologies**




Source: Adapted from IRENA, 2012.

Table 1 | **Estimated Number of Jobs Created by Ground Mounted and Rooftop Solar by 2022**

| PHASE | GROUND MOUNTED | ROOFTOP | TOTAL |
|---|---|---|---|
| Business development | 550 | 13,770 | 14,320 |
| Design and preconstruction | 2,000 | 79,650 | 81,650 |
| Construction and commissioning | 27,000 | 124,560 | 151,560 |
| Operations and maintenance | 29,147 | 20,000 | 49,147 |
| Total | 58,697 | 237,980 | 296,677 |

*Source*: CEEW and NRDC, 2017.

India seeks to produce 100GW of solar photovoltaic power by 2022, through rooftop (40GW) and large-scale (60GW) projects. The CEEW-NRDC study projects that doing so would require 237,980 FTE jobs in rooftop solar and 58,697 in ground mounted solar (Table 1). Combined jobs between ground mounted and solar is the greatest in the construction and commissioning phase.

Reaching India's target of producing 60GW of wind power by 2022 would create an estimated 34,583 FTE jobs with 29,963 jobs in operations and maintenance alone (CEEW and NRDC, 2017).

## Poverty-Reducing Employment in the Renewable Energy Sector

The link between employment and poverty reduction is well documented.[2] Employment-related mechanisms for reducing poverty include workfare programs, subsidies and tax breaks to encourage industries to move to poor areas, and impact investing in clean energy enterprises that provide access to services and solutions otherwise inaccessible to people living in remote areas.

## BOX 1 | DEFINING SKILLED, SEMI-SKILLED, AND UNSKILLED LABOR

The definitions of skilled, semi-skilled, and unskilled labor for non-agriculture sectors used in this paper are adapted from India's Ministry of Labour and Employment (2017).

**SKILLED LABOR** involves skill or competence acquired through experience on the job, training as an apprentice in a technical or vocational institute, or completion of a university degree and multiple years of experience in an area of work. Skilled laborers have transferable skills. Minimum daily wages for skilled labor in the non-agriculture sector in India are INR 494–INR 693 (roughly US$7.55–US$10.59).

**SEMI-SKILLED LABOR** involves some degree of skill or competence acquired through experience on the job that can be performed under the supervision or guidance of a skilled employee. It includes supervisory work. It can also involve skill and competence acquired through completion of Standard 10 or Standard "10+2" (two years of schooling after completion of grade 10) and training in a specific technology or work area that yields a skill set required for a job. This category may include people who have not completed their formal education but have acquired skills on the job. Minimum daily wages for semi-skilled labor in the non-agriculture sector in India are INR 410–INR 579 (roughly $6.25–$8.85).

**UNSKILLED LABOR** is labor that involves simple operations requiring little or no skill or experience. Unskilled workers have not attended formal schooling or received formal training in any specific technology or work area. They can work across industries in jobs involving manual labor. Minimum daily wages for unskilled labor in the non-agriculture sector in India are INR 350–INR 523 (roughly $5.35–$7.99).

Not all types of employment reduce poverty, however. The informal sector lacks the stability and safeguards against losses that full-time formal employment provides. It tends to create low-productivity, low-quality jobs. Higher-productivity employment yields higher wages, but obtaining such jobs requires higher skills and education, creating a vicious cycle of low education and skills ▸ low productivity ▸ poverty (ILO, 2014). To access the type of employment that has the propensity for poverty reduction—the jobs offering better wages and social protections—poor people need basic and remedial education, quality training and recognition, and refinement of skills they may already have acquired (Commission on Growth and Development, 2008).

Not all types of employment reduce poverty...The informal sector lacks the stability and safeguards against losses that formal employment provides.

Both grid-based and off-grid decentralized renewable energy generate unskilled, semi-skilled, and a few high-skilled jobs, including in poor areas (Box 1). Grid-based renewable energy plants are often located outside towns and cities, in areas with few job opportunities. For example, 20 percent of the 438 full-time jobs created by the Gamesa-Renew Power's 85 megawatt (MW) wind power project in Maharashtra, were semi-skilled and unskilled. Kiran Energy's 20 MW solar power plant in Rajasthan created 180 full-time local jobs, of which about 65 percent were unskilled.

Do these jobs lead to inclusion of poor people and people with low-level skills? Evidence from Bangladesh and Tanzania suggests they can (Box 2).

### BOX 2 | IMPROVING THE LIVELIHOODS OF THE POOR IN BANGLADESH AND TANZANIA

Grameen Shakti in Bangladesh trained and hired local youth and women to install, repair, and maintain solar systems. Their earnings allowed them to invest in solar systems themselves, and improved the social and economic value of the women in their communities (Islam et al. 2011).

In Tanzania, where 46% of the population live below the international poverty line of $1.9/day (in purchasing power parity terms), renewable energy has led to employment creation and income generation (UNDP HDR, 2016). Employees at enterprises like Off Grid Electric earn three times what they earned before joining the company (Bezner, 2014). The enterprise has been lauded for creating good employment conditions for staff and agents.

SECTION 3

# ASSESSING THE KIND OF JOBS THE RENEWABLE ENERGY SECTOR CREATES

The International Labour Organization (ILO) defines a good job as one that provides decent income, health benefits, stability and security of employment, a safe working environment, fair working hours, professional and personal life balance, and opportunities for promotion and progression of skill development (ILO, 2013a).[3]

Employment with these characteristics is likely to contribute to poverty reduction and sustainable economic and social growth.

The ILO definition has been used as a standard for evaluating and quantifying the social impact of employment in a variety of areas. It was part of the Global Impact Investing Network (GIIN) Impact Reporting and Investing Standards (IRIS) labor and the employment metrics framework (Gelfand, 2012).

Government initiatives and training programs in the renewable energy sector focus primarily on the number of jobs created. Although such data is important, it does not capture the quality of the jobs—and their potential for reducing poverty.

To identify good jobs in India's renewable energy sector, this study adapted the IRIS metrics, using four of its measures:

- Reliability of income is an indicator that employment provides some stability, allowing employees to plan for their future.
- Healthcare benefits (example, on-site clinic access, medical coverage, accident coverage for loss of life or accident on the job) are particularly important in India, given the large share of private expenditure on healthcare and medicine. Health crises are a well-documented and often catastrophic burden for workers and their families (Reddy et al., 2011; Seddon et al., 2015).

- Employee safety policy ensures that employees are performing tasks in ways that reduce the risk of injury, allowing employees to remain physically active for longer.
- Training opportunities equip employees with the skills they need to take on better-paying jobs, and introduce unskilled and semi-skilled workers to the job market. Training can focus on specific skills in the renewable energy sector or on literacy, communications, basic accounting, and soft skills.

Reliability of income is an indicator that employment provides some stability, allowing employees to plan for their future.

SECTION 4

# INDIA'S RENEWABLE ENERGY ECOSYSTEM

The report defines the renewable energy ecosystem as comprising renewable energy programs, training institutions, and recruitment platforms. This section examines how well this ecosystem is addressing poverty reduction through employment or inclusion of the poor in renewable energy programs, providing the poor with sector-related skills, connecting the trained poor with jobs in the sector, and ensuring that the poor benefit from these efforts.

## Impact of Renewable Energy Programs

Multiple policies, programs, and projects in India have promoted renewable energy (Table 2 and Table A.1 in Appendix A). Capacity building is an important feature of some of these programs, some of which include the poor, people in rural areas, and women.

Local capacity building increases the sustainability of programs after the implementer exits. The Energy and Resources Institute's (TERI) LABL program uses a multiphased training approach in which strong hand-holding is initially provided to entrepreneurs participating in the program but gradually reduced. In the initial phase, enterprises required TERI's support to identify technologies and suppliers. With experience, they started identifying technologies and suppliers by themselves. Once TERI exited the program, entrepreneurs introduced new products into their businesses and started handling products other than solar options. TERI helped during the transition by introducing them to new suppliers.

Under, the Odisha Tribal Empowerment and Livelihoods Programme (OTELP), young women received training on assembling and selling solar products. They worked with the Maa Thakurani Women's Self Help Group in Mohoraguda village to assemble and market 910 solar lanterns and solar torches, earning an average of 400 Indian rupees (INR) a day. OTELP sought to produce 6,000 pieces a year, generating 1,500 days of annual employment. The program however, lacked local technical and marketing knowledge.

Because of lack of reporting and data collection by program implementers, it is difficult to determine whether either program created entrepreneurs or jobs or reduced poverty. Embedding impact assessments in program design is important for understanding poverty reduction impacts and how and when programs need to be improved.

One program that includes impact measurement is the Self Employed Women's Association (SEWA) Hariyali program. Hariyali members are required to answer questions, including some that seek to measure job creation and economic impacts (how many

Table 2 | **Renewable Energy and Poverty Alleviation Programs and Projects in India**

| PROGRAM | DESCRIPTION |
|---|---|
| Akshaya Urja (formerly known as the Government of India's Aditya Solar Shops) | In existence from 1995 to 2017, this program set up shops that sold solar energy products and provided after-sales repairs in rural areas. It helped create local rural enterprises that generate income from selling renewable energy products. |
| Barefoot College | Barefoot is a 40-year old social enterprise with operations in 13 states in India. Its "build, operate, and sustain" model empowers rural communities to provide their own electricity. Barefoot trains women between the ages of 35 and 50 from nonelectrified tribal areas to assemble, install, operate, and maintain 40W solar home systems and 300W solar systems for community centers that support livelihood-generation activities. A community fund supports the expenses, including the women's monthly salaries, which meet minimum wage standards. |
| The Energy and Resources Institute's (TERI) Lighting a Billion Lives (LABL) initiative | To provide efficient and sustainable energy solutions to energy-poor communities, TERI created a delivery model that operates through local energy enterprises. As of December 2014, 250 energy enterprises had been set up for last-mile delivery of electricity at the block level in districts across India. |
| Hariyali Program of the Self Employed Women's Association (SEWA) | The Hariyali program trains rural women to market, sell, and service essential products, including solar lanterns, cookstoves, and solar pumps, in order to make them self-reliant. |
| Odisha Tribal Empowerment and Livelihoods Programme (OTELP), initiated by the International Fund for Agricultural Development (IFAD) | Although agriculture is the main intervention for livelihood generation under this program, it also includes some renewable energy activities. OTELP engages with DESI Technology Solutions to train young women as entrepreneurs to disseminate solar technology. |

*Source*: Interviews with organizations and organizational websites

people are employed, how their income increased, whether they became self-reliant individually or as a group, etc.). Other questions assess their access to basic goods and services (food and nutrition, child care, better housing facilities, health, education). A few questions measure how individual status improved, by asking about changes in asset ownership, leadership roles, and organizational strength.

Assessment of the programs operated by India's Ministry of New and Renewable Energy (MNRE) listed in Table A.1 in Appendix A shows that learning from the experiences of earlier programs is important. The MNRE and the United Nations Development Programme (UNDP) jointly implemented two programs: the original Renewable Energy for Rural Livelihood (RERL) project and the more recent Scale Up Access to Clean Energy project. The RERL project implemented in 14 poor and remote villages had a livelihoods generation component. Rural women grew plants on plantations and nurseries to generate biomass that gasification plants could use to run irrigation pumps for farmers. The program focused on both the consumption and the supply side of renewable energy and sought to increase farmers' income. It was deemed successful, although many of its activities had ceased by the time the program ended.

Lessons learned from the RERL program were applied in designing the Scale Up Access to Clean Energy project. Its design seeks to build a sense of ownership among the poor in the project. Workers are trained in O&M activities; the initial effort will be to demonstrate how they can receive remuneration for the services they provide. The project includes a user contribution (a monthly charge to create funds for O&M), and the project is of longer duration than the RERL program. Unlike RERL, it is technology neutral (RERL focused on biomass gasification) and supports all livelihoods in which energy is the key component (RERL focused on generating electricity for irrigation).[4]

The MNRE's mandate is not to create jobs but to increase the absorption of renewable energy power and the penetration of renewable energy solutions. Nonetheless, its pilot programs show that training, gender inclusion, and employment generation can be integrated in the design of renewable energy programs. Job opportunities will be created by the renewable energy industry, not the government—but government support to fine-tune the ecosystem to support the inclusion of the people who need the jobs will help enhance the poverty-reducing impacts of the jobs.

### BOX 3 | TRAINING INITIATIVES BY THE GOVERNMENT OF INDIA

The Government of India sponsors a variety of training initiatives, including the following:

- Industrial Training Institutes (ITI): The MNRE has been working to integrate renewable energy curricula and modules into the coursework of these institutes (CEEW and NRDC, 2015). ITIs offer technical training for industrial jobs. The duration of these trainings ranges from one year (certificate course) to three years (industrial diploma course).
- The National Institute of Solar Energy (NISE) and the Solar Energy Training Network (SETNET): NISE was established as an autonomous institution under the MNRE in 2013. Its objective is to assist the MNRE in achieving the National Solar Mission. Under NISE, SETNET, created by the MNRE and NISE in collaboration with the U.S. government, seek to unify India's solar energy trainers to achieve greater communication, collaboration, and consistency across programs.
- The Skill Council for Green Jobs (SCGJ): The MNRE created the SCGJ in May 2015, to advance the development of renewable energy skills in India. In collaboration with the Confederation of Indian Industry, the Ministry of Skill Development and Entrepreneurship (MSDE), and the National Skill Development Corporation (NSDC), the SCGJ will help draft skill development plans for the renewable energy industry.
- Suryamitra Training: The MNRE sponsors a 600-hour course that includes free board and lodging for eligible students at more than 150 institutes. The effort is intended to help create a pool of 50,000 solar technicians between 2015 and 2020. People who have completed Standard 12 and are at least 18 years old are eligible to apply. The program places emphasis on attracting candidates from rural backgrounds, unemployed youth, women, and members of the Scheduled Castes/Scheduled Tribes. As of March 2016, 119 training institutes across India offered this training (see http://mnre.gov.in/file-manager/UserFiles/Suryamitra-Institutes-NISE.pdf).

## BOX 4 | TRAINING INITIATIVES BY THE PRIVATE AND SOCIAL ENTERPRISE SECTORS

Private sector-led training programs for semi-skilled jobs in the renewable energy sector include the following:

- Vocational training institutes offering renewable energy-specific vocational training courses: Gujarat's Institute of Solar Energy, Delhi's Jamia Millia Islamia University, and Uttar Pradesh's Lucknow University offer three-year programs granting Bachelor's of vocation degrees for students who have completed their Standard 12. Jamia Millia and Lucknow University have exit options at the end of year 1 and year 2 (with certification provided).
- Private organizations like the Selco Foundation and ONergy have their own training arms. They offer a mix of renewable energy training programs.

Some skills developed in other vocational training programs are transferrable to the renewable energy industry. Vocational institutes like the Art of Living Foundation, Don Bosco Technology, Ramakrishna Mission, Schneider Electric Foundation, and Vivekananda Kendra provide vocational training courses for the underserved sections of society. However, the number of people getting trained in such institutes is still very small.

The 18 Art of Living centers have trained 400 youth for electrical jobs. The courses are open to students who have studied only until Standard 7, 8, or 9 and do not have any certification. Many of these students come from remote areas in Assam, Jharkhand, and Chattisgarh, where they have limited access to training and job opportunities. After graduating, these students are eligible to work as electricians, including in the solar and wind industry.

Schneider Electric India Foundation (SEIF), with its partners, including the Art of Living, Don Bosco Technology, IL&FS Skills, ICICI Foundation, and Aide et Action, among others, runs electrician training centers in India. It has trained 24,600 unemployed youth in 21 centers across the country and operates one center for women in Chennai. Training also covers entrepreneurship, teaching electricians how to run their own businesses, and provides employment support to graduates seeking jobs.

## Impact of Training Institutes

The ambitious renewable energy targets adopted by India require the creation of a workforce that can deliver 175GW of renewable energy by 2022. To help meet the target, the Government of India has introduced various renewable energy training programs (Box 3) and supported training initiatives developed by the private sector and NGOs (Box 4).

Questions remain about whether these programs are adequate for building capacity within poor populations and lead to jobs in the renewable energy sector. Some of the flagship training programs (such as Suryamitra) are relatively new, making it difficult to assess their impact. A few observations can be made based on our research, however:

- Given India's size, the number of renewable energy-specific training programs is small. Because training institutes are in towns and cities, they are not easily accessible to people in rural areas, where most of the poor live.
- The minimum educational qualification to apply for most training programs is Standard 12. Based on 2011 census data, 60 percent of rural Indian households had no one in the family with at least a Class 10 certificate (final year of high school or Secondary School Certification); in comparison, the figure in urban areas was 31 percent (Ministry of Home Affairs, 2011).
- Training institutes do not collect information on the economic conditions of participating candidates. The absence of this data limits analysis of whether the institutes are attracting the poor and how many people are trained and get placed.
- Some government-led trainings are designed for people with higher levels of education. People without strong educational backgrounds cannot apply for these trainings.
- The renewable energy enterprises interviewed believe that their own in-house training is more relevant than the more generic trainings provided by ITIs and other training initiatives. They prefer to hire their own trainees rather than graduates of these institutes.

- Most women cannot attend training or look for jobs outside their villages while managing a household. Although many renewable energy jobs are local, training programs are often held in cities or district headquarters. For example, the Suryamitra training program requires participants to stay at the training center for three months. This requirement makes it difficult for many women to enroll. This situation could be remedied with more localized training centers or mobile training programs that include women from nearby villages.

## Impact of Recruitment Platforms

Even people with relevant training and skills may not be able to find good renewable energy jobs. To understand why, it is important to understand how renewable energy enterprises recruit and hire.

Smaller enterprises recruit employees directly at the local level. Some work with local NGOs they trust to recruit and work directly with local employees.

Larger companies have well-established human resources (HR) policies and systems; they typically have a dedicated HR team that oversees the recruitment process. Larger utility-scale independent power producers and project developers outsource most of their site-based workers, whom contractors and local subcontractors recruit and manage.

Social dynamics in rural India influence the way people network and recruit for jobs. Most employees are identified by word of mouth or references from the village *panchayats* (councils), local leaders, and middlemen. Labor contractors, who play a crucial role in recruitment in the grid-connected space, draw on their local connections and networks to help them recruit unskilled labor. Some consumers with solar installations have approached the enterprise doing the installation, seeking jobs. In all cases references and trust in a personal network are important for both employers and employees.

Despite these social dynamics—and the lack of faith in training institutes that many enterprises possess—job platforms and discussion forums for renewable energy jobs are slowly emerging. The Suryamitra mobile phone application and the Clean Energy Access Network are examples (Box 5).

### BOX 5 | POSTING JOB OPPORTUNITIES IN RENEWABLE ENERGY

The Suryamitra mobile phone application connects employers with employees, reducing the transaction costs for one-time jobs while giving employees an opportunity to apply for permanent jobs in the industry. It is downloadable on any phone device and can be updated in real time to reveal job openings and solar technicians in each locality. Employers, training institutes, and trainees are still learning about this application. Some employers have observed that such applications may be more useful for people in towns and cities, who are more adept with smartphone technology. Whether the application will benefit poor and rural workers remains to be seen.

The Clean Energy Access Network (CLEAN) was created in 2014. Its members include both training institutes and renewable energy enterprises in India. CLEAN allows employers to post job openings and training institutes to post the availability of trained candidates. Off-grid enterprises can benefit from such information by knowing when and where trained people will be available. Only a few organizations currently use this platform.

SECTION 5

# KEY FINDINGS

Interviews with renewable energy enterprises, independent power producers (IPPs) and project developers, and their employees led to several observations and findings about jobs in the renewable energy sector in India—and what can be done to create good jobs that help reduce poverty. This section highlights the number and types of jobs being created, the qualifications required, and local recruitment initiatives for the three types of enterprises interviewed: off-grid enterprises, IPPs, and project developers.

## Off-Grid Enterprises Are Creating Jobs, Many of Them Semi-Skilled

The off-grid enterprises interviewed have operations across multiple locations; two have operations in multiple states. Some enterprises have a project-based model and a core team of centrally located staff. Others use a model that requires a new team for every new district where work is expanding. There is also variation in the level of experience and qualification of the staff that make up these teams.

New jobs are being created as operations scale up and enterprises expand to new areas. Table 3 shows the number of people employed per location by the off-grid enterprises interviewed. The most significant finding is that many jobs are semi-skilled technical and sales positions.

All but one of the enterprises interviewed recruits directly; ONergy partners with local NGOs to hire some of its technicians. The off-grid market creates fewer jobs than utility-scale operations do, but the jobs are permanent and can qualify as good jobs.

The off-grid market creates fewer jobs than utility-scale operations do, but the jobs are permanent and can qualify as good jobs.

## Most of the Jobs Created by Independent Power Producers and Project Developers are Temporary

IPPs and project developers rely on contractors and subcontractors for recruitment at every project site. Subcontractors determine how many people are contracted locally and how many are drawn from their pool of workers, which is rotated across project sites. The majority of jobs created during the project execution phase do not require skilled labor or renewable energy–related skills (Table 4). Employment generation varies through the project life cycle for grid connected renewable energy projects (Box 6).

### BOX 6 | EMPLOYMENT GENERATION IN GRID-CONNECTED RENEWABLE ENERGY PROJECTS

Project installation and execution typically require more workers than the later phases of projects. However, the jobs created are for a shorter duration. Jobs include civil work (land clearing and construction), installation, electrical work, and commissioning. The project execution stage can last from two to seven years. A 50MW solar plant typically requires 200–500 people and 400–800 person-days of work per MW. However, new jobs are not necessarily created for every new project, as many workers, particularly workers employed by contracting companies, are rotated across projects. These jobs make up roughly 20–30 percent of the total jobs at the project execution stage. If 600 person-days of employment are created per MW during project execution and 70 percent of the jobs are new and one-time jobs, 420 days of employment are created per MW of solar installation. For 60GW of installations, this is equivalent to 25.2 million person-days of employment during project execution stage, spread over five years.

The average life span of a grid-connected solar project is 25 years. O&M contracts generally run from 1 to 10 years. Interviews with IPPs and project developers suggest that 4,500–8,000 person-days of employment per MW is generated during O&M. O&M jobs include panel cleaning and shifting, on-site security, and technical work. A 50MW solar plant employs 20–30 people for module cleaning for about one or two days a month. A similar number of people are hired twice a year to tilt the solar panels. About 20–25 people are employed on a continuous basis to take care of the vegetation growth below panels and within the boundaries of the project site. About 4–5 security guards are required to be on the project site throughout the year. These jobs are unskilled. In addition, four to five ITI diploma holders are employed as on-site technicians. They work in shifts and are present throughout the year.

Table 3 | **Job Creation by Off-grid Enterprises**

| COMPANY | DESCRIPTION | NUMBER OF JOBS CREATED | TYPES OF JOBS | QUALIFICATION REQUIREMENTS | LOCAL RECRUITMENT |
|---|---|---|---|---|---|
| E-Hands Energy India Private Limited | Installs hybrid wind/ solar systems in 14 states | 25–30 staff rotate across project sites | Installation, commissioning, and annual maintenance | Industrial Training Institute (ITI) diploma holders | Recruited from rural areas but located at head office |
| Gram Power India Private Limited | Installs microgrids serving 20–50 households per village; started operations in Rajasthan (Western India), expanding into other states | 25–30 staff rotate across project sites, including senior staff for micro-grid and technicians | Installation and solving of problems escalated by plant technicians | ITI diploma holders with previous experience and solar training | Recruited from rural areas by EPC (engineering, procurement, construction) vendor and Gram Power but located at head office |
| | | One plant technician for each new grid | O&M, payment collections, redress of customer issues | ITI diploma holders optional; some employ-ees have not completed their schooling | Recruited from village where grid is |
| Omnigrid Micropower Company Private Limited | Installs minigrids serving 30kW–50kW in remote villages in Northern India, where unemployment rates reach 40–50 percent | Installation outsourced to EPC contractors; 3 people per plant for each new minigrid | O&M and security at plant level, payment collections, redress of customer issues | ITI diploma holders for O&M; no educational qualification for security personnel | Recruited from villages within 40 kilometers of the minigrid (not from village itself) |
| ONergy Solar (Punam Energy Private Limited) | Provides decentralized solar energy solutions in villages across four states (West Bengal, Jharkhand, Orissa, Assam); works with local NGOs to scale up operations | 10–20 staff at branch office in state capital, 5 technical people, and 3 salespeople | Installation, O&M, sales | At least completed 10th Standard with some wiring or electrical experience for technical roles | Recruited from nearby villages |
| | | 5–6 technicians employed by local NGOs across one state | Installation and maintenance | | |
| | | Technicians hired on contractual basis as needed | Installation | | |
| Selco Solar Light Private Limited | Installs and sells solar home systems and stand-alone solar products through 60 branches across Karnataka, Tamil Nadu, Bihar, Maharshtra, and Kerala | 5–10 staff at each branch office at district or *taluk* level; mix of technical and sales people | Installation and maintenance, sales | Emphasis on willingness to learn and social skills over formal qualification or education | Recruited from nearby villages |
| Simpa Energy India Private Limited | Installs pay-as-you-go microgrids from eight branch offices in Uttar Pradesh | 300 full time employees; sales and technical staff at each branch office | Sales, installation, and payment collections | Sales staff are graduates in commerce or arts with one or two years of experience; technical staff have diploma or engineering certificate plus one to three years of experience. Salespeople have additional qualifications. | Recruited from nearby villages |
| | | Village-level entrepreneurs in villages (number varies and depends on demand of Simpa solutions and capacity of VLEs (Village Level Entrepreneurs)) | Customer identification | No educational requirements; entrepreneurs have some business activity in the village and a strong network of connections. | Recruited from village where the microgrid is located |

*Source*: Interviews with organizations (see Table B.2 in Appendix B for the details).

Table 4 | **Job Creation by Independent Power Producers**

| COMPANY | DESCRIPTION | NUMBER OF JOBS CREATED PER PROJECT | TYPES OF JOBS | QUALIFICATION REQUIREMENTS | LOCAL RECRUITMENT |
|---|---|---|---|---|---|
| Bhoruka Power Corporation Limited | Independent producer of wind, solar, and hydro power | 260 full-time staff, 300 contract staff | Installation, O&M, land maintenance, and security | Half of contract staff have no education | Policy is to recruit locally; 130 engineers recruited from remote areas |
| Tata Power Solar Systems Limited | Developer of 50MW-size projects | 200–300 staff during project execution | Civil work, installation | Unskilled jobs, including assistants to contractors' technicians, require no qualifications | 60 percent of staff are local |
| | | Few staff after execution | Technicians for O&M | ITI training or diploma required | Most workers are recruited locally, but company prefers some non-local workers to avoid local issues |
| | | 30–40 workers once a month | Cleaning and seasonal tilting of solar panels | Unskilled labor | |
| | | 20–25 contract staff | Cutting of vegetation | Unskilled labor | |
| Gensol Solar | Developer of small-scale installations | 40–50 staff for 10MW solar plant | Project execution, O&M | Unskilled and semi-skilled workers. Unskilled workers clean solar modules, cut vegetation for ground-mounted solar projects, and handle security and housekeeping. | n.a. |
| | | 5–7 contract workers for 2–3 weeks for 100kW rooftop solar installation | Project execution, O&M | Unskilled and semi-skilled workers. Unskilled workers clean solar modules, cut vegetation for ground-mounted solar projects, and handle security and housekeeping. | n.a. |
| ReNew Power Ventures Private Limited Power | Independent producer of 50MW plants | 500–600 staff during project execution; 100–150 hired twice a month for cleaning; 3–4 technical staff per site | Project execution, O&M | ITI training required for technical positions | Recruits hired from within 30-kilometer radius |
| Sunshot | Project developer | 120 workers under subcontract at any given time; additional 25 labor contractors for O&M | Project execution | People working on contract basis with subcontractors are unskilled; project developer employs ITI graduates in project design stage as draftspeople. | Recruits ITI graduates from rural backgrounds |

*Source*: Interviews with organizations (see Table B.2 in Appendix B for the details).

Project execution jobs are not permanent; they end once the system has been installed. Based on the size of the project, the duration of project execution jobs ranges from two months (solar installation) to two years (hydropower project). The construction workers engaged in these jobs do not receive the benefits that come with permanent jobs, such as job security, medical benefits, professional development, and promotions. Semi-skilled workers employed by contractors often have more job certainty, because they move with the contractor to new project sites.

O&M contracts or project maintenance positions post execution are often more permanent. They typically range from a year to 10 years. Job creation at the O&M stage exists for local people on a continuous basis. Jobs involving monitoring and troubleshooting of plants often require at least semi-skilled people. The companies interviewed indicated that as they scale up, demand for local people will increase. All O&M jobs with IPPs and project developers interviewed are contracted through subcontracting agencies.

Some women in the renewable energy industry work in construction. Indeed, women represent 15–20 percent of Tata Power Solar's construction labor force. Women, however, do not appear to be working in semi-skilled or highly skilled jobs. Relatively few women in India pursue technical studies. At the tertiary level, less than 19 percent of students in science and less than 10 percent of students in engineering and technology were women in 2014/15 (UGC, 2015). This trend is also evident in the renewable energy sector interviews with training institutes reveal that very few women attend technical training courses.

## Good Jobs Provide Reliable Income, Healthcare Benefits, Employee Safety Policies, and Training/Capacity-Building Opportunities

Interviews provided insight into the quality of renewable energy jobs in India, job opportunities in the sector, and employee satisfaction. They are summarized under four proxy measures of good jobs: reliability of income, healthcare benefits, employee safety policies, and training and capacity-building opportunities.

### Reliability of Income

Certainty about income enables financial planning. It allows people to save and invest in ways that improve their lives.

The regular flow of income from renewable energy–related jobs often supplements household income from cultivable land. Workers use the extra income to buy items such as mobile phones and motorcycles; some have even built houses with their earnings.

The payment mode has implications for people in rural areas. The off-grid enterprises interviewed provide regular monthly salaries to their permanent employees, which are deposited directly into the bank accounts of their employees. Having a direct-deposit bank account gives their holders access to bank loans, which rural people use to cover expenses related to illness, weddings, and the purchase of household items.

IPPs tend to use a mix of payment mechanisms (cash, checks). They channel their payments through contractors. Daily wage laborers contracted for site clearing and civil work are paid in cash, daily or weekly.

Some off-grid enterprises and IPPs offer salary advances and interest-free loans to their permanent employees, though only one employee interviewed had taken such a loan. One IPP offered such support to contracted employees as well. Having access to financial support in emergencies is a benefit to employees, whether or not they actually take advantage of such support.

### Healthcare Benefits

All enterprises interviewed provide Employment State Insurance (ESI) to permanent employees who earn less than INR 15,000 per month, as required under the ESI Act.[5] In cases where ESI does not apply, some employers provide permanent employees with coverage for on-site accidents, and all companies provide them with access to some healthcare facilities. In a few cases, employers interviewed reported extending coverage to immediate family members as well. Coverage includes financial support to treat ailments developed when working and annual health check-ups. Although employees have coverage, they may not necessarily have access to check up-facilities in rural areas and need to travel in order to access them.

However, of the permanent employees interviewed, 25 percent were not aware of the medical benefits available to them. The ones who were aware had never used them but believed that they could do so in an emergency. The IPPs and project developers interviewed did not provide healthcare benefits to people working for a short period during project execution (other than medical support for injuries incurred on the job). Village-level entrepreneurs do not have access to healthcare benefits.

### Employee Safety

Staff at all the off-grid enterprises interviewed reported undergoing safety training when they joined the company. The only additional example of safety requirement noted was the requirement to wear helmets while traveling by motorbike from home to the office or site.

For grid-connected projects, companies provide continuous on-the-job safety training. Along with the contractor, someone from the IPP or project developer team monitors activity and intervenes immediately if safety norms are breached. The emphasis on safety and safety training on-the-job has helped reduce accidents.

### Training and Capacity-Building Opportunities

Enterprises can use the opportunity for promotion to retain and develop the capacity of permanent employees. The nature of many of the jobs created by off-grid enterprises working in rural areas, especially technical jobs, means that there is often limited room for growth, however. To retain staff, enterprises create opportunities to take on more responsibilities, lead teams, and coordinate work across multiple centers within the same district. They also provide monetary rewards and nonmonetary recognition for exemplary work.

All off-grid enterprises interviewed spoke of the need for training. One enterprise, Selco, has tapped into existing state- and district-level government training programs aimed at providing rural youth with skills. It believes that renewable energy training could be coupled with other types of technical training to enhance employment opportunities.

In addition to technical skills, enterprises also provide training on soft skills and communication, to help staff deal with banks and customers.

Enterprises develop their training modules in-house; senior technicians and managers provide the training. All employees interviewed confirmed that training had helped them perform their jobs and learn new skills.

### Additional Poverty-Reduction Features

Two other features of renewable energy jobs can contribute to poverty reduction. The first is the transferability of skills acquired on the job. Most people working at project sites did not have previous experience in the sector. They acquired skills on the job through in-house training and work experience that equipped them with a new set of skills that could be used at other enterprises in the renewable energy sector.

Some of the employees interviewed spoke about colleagues who had left to start their own enterprises or shops related to renewable energy or solar technologies and electrical services. The fact that they have done so suggests that the training and skills development offered by enterprises has a greater impact on the rural communities than simply providing jobs. It also develops entrepreneurship.

The second feature is the local nature of renewable energy jobs. Interviews with employees revealed that job opportunities near their homes and reliable wages are considered more attractive than slightly higher wages in cities and towns far away. Indeed, workers at solar energy enterprises reported being unwilling to relocate to take a higher position at the head office or at a new location. Employees cited a variety of reasons for the attractiveness of local jobs. About half of the permanent employees interviewed had joined their employers in order to work close to home. Working near home makes it easier to help with family livelihood activities, and living expenses are much lower than in towns and cities.

Renewable energy enterprises and companies see the value in employing local talent. For off-grid enterprises, local employees bring local knowledge and networks that help expand their business. One enterprise noted it would rather employ less skilled but local employees who have knowledge of local contexts and a willingness to learn than higher-skilled employees who are not local.

## The Poor Face Barriers to Work in the Renewable Energy Sector

Employers interviewed indicated that they could not hire poor people for semi-skilled jobs, because they lack the basic education and skills needed to perform the job. The kind of training programs available have not adequately addressed this gap. Training institutes echoed the challenges of training the poor. Neither employers nor training institutes can provide basic education. Training institutes perceive that training the poor and unskilled may require more complicated and longer training, which may pose revenue challenges for the institute. Given the multiplicity of languages and cultural differences across communities, training institutes also indicated that it would be difficult to design a one-size-fits-all program that is applicable across all locations.

Less-educated people are believed to lack the soft skills needed to deal with external stakeholders. The limited financial resources of small enterprises makes it difficult for them to afford lengthy training.

The burden of providing basic education cannot be passed on to the renewable energy sector. However, imposing entry requirements (such as a mandatory 10+2 school certificate) to access training institutes creates obstacles to poverty reduction. The Art of Living Foundation's electrician course targets people without 10+2 school certificates. Similarly, Don Bosco's training focuses on people who possess a willingness to learn and localized knowledge rather than qualifications. They provide ways for the poor to enter the formal job market.

## Contractual Jobs Do Not Necessarily Provide Benefits to Employees

The majority of employees in large-scale grid connected projects are unskilled. The small group of semi-skilled and skilled workers rotate across projects. Unskilled workers usually come from the local area. No new skill development takes place locally at the bottom of the pyramid. There is typically no investment in training for career development or opportunities for promotion in contract labor positions. This makes it hard to equip contract workers with skills that could enable them to find good jobs.

Workers at off-grid enterprises often begin work as contractors before being hired as permanent employees. This system allows enterprises to assess their performance before committing to hiring them.

Employers who hire workers as contractors are not subjected to the same labor laws that govern permanent workers, including job protection and security, union representation, and not hiring underage workers, as provided by the Industrial Disputes Act of 1947. This policy loophole, which many employers across sectors exploit, needs to be closed.

SECTION 6

# RECOMMENDATIONS

All jobs are not created equal—a distinction that past studies on renewable energy jobs have not made. "Tuning" jobs in the renewable energy sector could increase their impact on poverty reduction.

## Embedding Innovative Features That Encourage the Inclusion of the Poor

Training programs and policies will reach the poor only if they are designed in ways that explicitly enable their inclusion. The following actions can help ensure that they do so:

- **FOCUS CAPACITY BUILDING ON EMPOWERING THE POOR.** Focusing capacity building on empowering the poor helps ensure project sustainability, especially after a program ends. When technicians are not immediately available to address project issues, resolution becomes difficult, often leading to plant closure. Building local capacity for O&M can help prevent plant closures. TERI's LABL program has trained entrepreneurs in Uttam Urja Kendras to deal with suppliers and customers, identify technologies for selling, and provide after-sales support without regular interventions from TERI.
- **DEVELOP TRAINING PROGRAMS FOR LESS-QUALIFIED PEOPLE.** Most training programs have minimum requirements (10+2 Standard). Some institutes, however, such as the Art of Living Foundation, have trained people who have dropped out of school after the fifth to seventh Standard. The Art of Living Foundation's training is not specific to renewable energy, but its graduates are able to work in the sector. The Government of India should consider developing programs that train such people for entry-level renewable energy jobs. The training could be coupled with other types of technical training to enhance employment opportunities. The social responsibility arms of large firms could be accessed for financial support and technical assistance.
- **ALIGN TRAINING INSTITUTES WITH EMPLOYERS.** To make programs efficient and to cater to the needs of the industry, training programs should be designed in collaboration with enterprises. Efforts also need to be made to facilitate interaction among training institutes, trained people who are poor, and employers to place people in jobs. Training institutes are experimenting with new tools that can help place people, such as CLEAN's online energy platform, which allows institutes to post information about trained candidates. Placements and income data should be tracked, in order to assess the impact of training.
- **EMBED POVERTY IMPACT ASSESSMENTS INTO PROJECT DESIGN.** The impact of a program on the lives of the beneficiaries should be captured not just in the short term but also over a longer period, after the program ends. Inputs from such assessments would help program designers continually reevaluate where improvements, adjustments, and innovations are needed. The United Nations Development Programme's Renewable Energy for Rural Livelihood (RERL) program developed such an impact assessment report, which helped improve the next program introduced by the government.

- **GIVE THE POOR A SENSE OF OWNERSHIP OF AND CONTRIBUTION TO OFF-GRID PROJECTS.** Policies and programs should be designed in ways that embed and foster community- and village-level project ownership. Project ownership also helps ensure that systems are maintained and operate smoothly, even after the enabling program ends. In the Barefoot model, a community owns the renewable energy system and uses it to support the livelihoods of villagers by running productive loads (example, milk chillers, rice mills, drying machines, spice-packaging machines) in community centers. People without the resources to invest themselves can co-invest in community-based projects. Such investment allows the poor to own the systems and generate financial benefits from them. Drawing on experience from previous programs, an MNRE-UNDP-GEF (Global Environmental Facility) program to scale up access to clean energy for rural production requires beneficiaries to invest in the project.
- **TARGET WOMEN AND TAILOR PROGRAMS TO THEIR NEEDS.** Local training programs aimed at engaging women must accommodate their needs regarding location, hours, safety, sanitation, and other issues. They must be established in a locally acceptable manner (by engaging with local leaders and raising community awareness). OTELP has trained young women in a remote village in Orissa to assemble and sell solar lanterns and torches, creating employment for 1,500 person-days per year. The program gives women the opportunity to earn money while continuing to manage their daily activities.

## Collecting Relevant Data and Assessing the Impact of Jobs on Poverty Reduction and Livelihoods

Many studies identify the job potential associated with the renewable energy sector, but most of them fail to identify the impact of these jobs. Policy makers and program designers should continue mapping projected jobs and progress on renewable energy expansion. Studies of jobs created should capture the nature of the jobs (permanent or temporary, new or recycled) across all subsectors. This information is essential for making informed estimates of the number of jobs that will reach the poor while meeting India's ambitious renewable energy targets.

Such studies should include information about the socio-economic status of employees and how it changed as a result of employment. Along with training institutes, enterprises should be involved in such studies. To make this kind of tracking possible, assessment practices should be mandated across enterprises. They can be made a part of the essential sustainability reporting for larger enterprises and part of the investor reporting mandate for off-grid enterprises or smaller grid-connected enterprises. Independent organizations could conduct surveys to understand the impact of renewable energy jobs on development and inclusive growth. This type of information is necessary to inform labor, industry, trade, environment, technology, and rural and urban development policies, as well as to strengthen existing training and skill development programs, and increase the quantity and quality of jobs.

# APPENDIX A: GOVERNMENT AND HYBRID RENEWABLE ENERGY PROGRAMS IN INDIA

Table A.1 | **Government and Hybrid Renewable Energy Programs in India**

| PROGRAM | KEY FEATURES |
|---|---|
| Integrated Rural Energy Program (IREP) (MNRE), 1981–2007 | Program provided framework for investment planning and optimal allocation of resources for meeting rural energy needs in most cost-effective manner through least-cost mix of various conventional and nonconventional energy resources. One component was training people in villages. Five biogas training facilities were developed. Regular wage earners, such as masons, as well as entrepreneurs received training. |
| Aditya Solar Scheme (MNRE), 1995 | Program supported establishment of one shop in each district, in order to create a network of retail outlets (Akshay Urja Shops) in all districts for the sale and servicing of solar energy and other renewable energy and energy-efficient products. Scheme led to creation of entrepreneurs, generated employment, and developed skills of technicians working in the shops. Program was operated by State Nodal Agencies and the Indian Renewable Energy Development Agency (IREDA). |
| Renewable Energy for Rural Livelihood (RERL) (MNRE/UNDP/ Government of Germany), 2003–2007 | Program implemented in 14 villages in Rajasthan and Uttarakhand sought to demonstrate potential of biomass gasification to increase income of farmers. Power generated was used to run pumps for irrigation. Women were mobilized to set up nurseries and plantations to provide feed for biomass gasifiers. Evaluation report released in January 2010 documents evidence of impact across multiple clusters (RERL MNRE, 2009). |
| Lighting a Billion Lives (LABL) (TERI), launched in 2008 | Initiative was designed to provide efficient and sustainable energy solutions to energy-poor communities. As of December 2014, 250 energy enterprises had been set up for last-mile delivery at the block level in districts across India. These enterprises started by selling products approved by TERI and providing maintenance services. The program led to the setting up of solar charging stations and labs for technical training. It supported ecosystem development for creating and sustaining livelihoods through training and relationship building with financial institutions and with NGOs for capacity building, empowering entrepreneurs to work on their own. |
| Implementation of Biomass Gasifier-Based Projects for Rural Areas (MNRE), 2009 | Project implemented several training programs, including an O&M technician course and a gasifier entrepreneur development course. Financial support was provided to train gasifier operators at selected engineering colleges (students received monthly stipends of INR 5,000 for two months). Financial support was provided to Entrepreneurship Development Programmes (EDP) for three months (the duration of the program). Stakeholders included State Nodal Agencies, energy service companies, co-ops, *panchayats*, self-help groups, NGOs, manufacturers, entrepreneurs, independent power producers, promoters, and developers. |
| Advanced Project Preparedness for Poverty Reduction, Gujarat Solar Vocational Training and Livelihoods Project (Asian Development Bank), 2011–2014 | Program trained technicians and provided other skills training for youth 17–25 who met minimum educational qualifications and poor women in order to create workforce for solar industry in Gujarat. |
| Odisha Tribal Empowerment and Livelihoods Programme (OTELP) solar assembling works, (International Fund for Agricultural Development [IFAD]), launched in 2011 | Program trains young women to disseminate solar technology in rural areas. Rural women receive training on assembling and selling solar LED lanterns and torches. OTELP uses a community-NGO-government-private-enterprise partnership model to engage with communities, build capacity through NGOs, seek government funding and subject matter experts, and work with private enterprises for technical and skill development support. |
| SEWA Hariyali Program (Self Employed Women's Association [SEWA]), launched in 2011 | Program focuses on creating full-employment opportunities and developing self-reliant women by training very poor women in sales, marketing, and servicing of essential products, including solar lanterns, cookstoves, and solar pumps. Key feature of program is requirement to measure impact: Participants must answer 11 questions that seek to assess impact of their activities on their livelihoods. |
| Microgrids under the Clean Energy Interventions for Livelihoods Generation program (TERI), launched in 2012 | Program set up direct-current-based microgrids for rural markets and a few households in 50 villages in Uttar Pradesh, providing the training needed to run the microgrids and facilitate interactions with the equipment supplier. Microgrid operators developed self-sustainable models and now run the microgrids themselves. |
| Self Employed Women's Association (SEWA) Hariyali Program, 2014 | Scheme sought to improve the welfare of farmers through irrigation provided by solar power development. It created opportunities for additional income generation for farmers by allowing excess power from solar pump sets to be pushed into the grid. Farmers with 10kW peak of solar power could earn almost INR 50,000 a year in addition to their self-consumption for irrigation. Loans helped farmers buy the pump sets. |
| Scale-Up Access to Clean Energy for Rural Productive Uses (pilot stage) (MNRE/UNDP/GEF), launched in 2015 | Program develops and implements renewable energy–based technology projects in Assam, Madhya Pradesh, and Orissa using multiple technologies; requires beneficiaries to make 35 percent of the investment. |
| Solar Power Projects for Unemployed Youth and Farmers (MNRE), not yet launched | Program encourages unemployed youth and farmers to install renewable energy power plants in order to increase employment and power generation. States identify beneficiaries, who undergo solar training. Government of India provides grants of INR. 5 million per MW; remaining funding to be raised from banks. |

# APPENDIX B: PEOPLE AND INSTITUTIONS INTERVIEWED

Table B.1 | **Titles of People at Training Institutes Interviewed**

| INSTITUTION | JOB TITLE |
|---|---|
| Art of Living Foundation | ■ Director of Solar Project |
| Barefoot College | ■ Member of Global Strategy, Implementation, and Development Team |
| Don Bosco Technology | ■ Placement Coordinator |
| Mahatma Gandhi Institute of Renewable Energy and Development (MGIRED) | ■ Deputy Director for Solar Energy<br>■ Assistant Director for Small Wind and Hydro Energy<br>■ Assistant Director for Solar Energy<br>■ Assistant Director for Bioenergy |
| National Institute for Solar Energy (NISE) | ■ Consultant |
| Skill Council for Green Jobs (SCGJ) | ■ Chief Executive Officer<br>■ Advisor for Biomass and Sustainable Livelihoods<br>■ Head of Assessment and Assurance |
| Uttar Pradesh Renewable Energy Development Agency | ■ Head of Training Center |
| One private training institute in Karnataka | ■ Assistant General Manager |
| Three private training institutes in Orissa | ■ Heads of Training |

Table B.2 | **Titles of People at Renewable Enterprises Interviewed and Descriptions of Their Companies**

| ENTERPRISE | JOB TITLE | COMPANY DESCRIPTION |
|---|---|---|
| AnthroPower Training Private Limited | ■ Founder and Chief Executive Officer | Develops animation-based training content for trainers in consultation with users. Assessment tool is available as app on tablets. |
| Bhoruka Power Corporation Limited | ■ Managing Director<br>■ General Manager of Operations and Maintenance<br>■ Senior Vice President for Finance and Company Secretary<br>■ Deputy General Manager for Human Resources and Administration | Develops grid-connected hydro, wind, and solar plants. Part of larger group of companies. |
| Dharma Systems Private Limited | ■ General Manager for Human Resources | Identifies rural entrepreneurs and trains them to become social change makers. Village-level entrepreneurs sell products including solar lights, clean cooking solutions, and water purifiers. |
| E-Hands Energy India Private Limited | ■ Vice President for Diversity and Sustainability | Government of India–impaneled enterprise provides decentralized renewable energy solutions. Product portfolio includes solar home systems and solar-wind hybrid systems. Has presence in 14 states. |
| Gensol Solar | ■ Director | Provides advisory services and installs, operates, and maintains solar systems. |
| Gram Power India Private Limited | ■ Head of Projects and Smart Metering | Installs prepaid solar microgrids, primarily in Rajasthan; expanding into other states. Smart meters for smart grids capture information on consumption patterns. |

Table B.2 | **Titles of People at Renewable Enterprises Interviewed and Descriptions of Their Companies (Continued)**

| ENTERPRISE | JOB TITLE | COMPANY DESCRIPTION |
|---|---|---|
| Omnigrid Micropower Company Private Limited | ■ Head of Corporate Finance Head of Human Resources<br>■ Head of Operations and Maintenance | Builds, operates, and owns solar minigrids that provide power to telecom towers and rural communities in Uttar Pradesh. |
| ONergy Solar (Punam Energy Private Limited) | ■ State Head for Orissa | Provides decentralized energy solutions for off-grid solar applications (lanterns, home systems, water heaters, inverters, street lights, microgrids, irrigation systems). Operates in four states (Assam, Jharkhand, Orissa, and West Bengal). |
| ReNew Power Ventures Private Limited | ■ General Manager<br>■ Assistant Manager of Corporate Communications and Corporate Social Responsibility | Develops large-scale wind and solar power plants and rooftop solar systems. |
| Selco Solar Light Private Limited | ■ Head of Human Resources Core and member of operations team | 20-year-old enterprise provides decentralized solar-based products and solutions to underserved households and businesses and offers financing packages for consumers in Karnataka. |
| SEWA Hariyali | ■ Chief Executive Officer | Launched by NGO of poor, self-employed women workers (the Self Employed Women's Association), project provides green livelihoods to poor rural women. |
| Simpa Energy India Private Limited | ■ Senior Director of Human Resources and Training<br>■ Senior Sales Manager | Provides solar home systems with prepaid meters based on pay-as-you-go model in rural Uttar Pradesh. |
| Sun Terrace Energy | ■ Cofounder and Chief Operating Officer | Develops captive solar power plants for commercial and industrial clients. |
| Sunshot | ■ Director and Chief Executive | Designs, implements, operates, and maintains rooftop solar power plants in industrial and commercial areas. |
| Tata Power Solar Systems Limited | ■ Assistant General Manager | Integrated solar player with operations across India. |

# APPENDIX C INSTITUTIONAL SURVEY QUESTIONNAIRE

## Survey of Renewable Energy Training Programs

1. What is the structure of the entities offering this training program (e.g., is it a consortium of government players, all private, public-private partnership)? What is the role of each collaborator?
2. Who is supporting this training program financially, logistically (who is providing the setting and administration behind the training program), and substantively (who is designing the curriculum)?
3. What are the intentions of the providers of the training programs? From what perspective or mindset are providers of training programs conducting the trainings? Is this a short-term renewable energy training program designed to fill a very specific gap in renewable energy/solar/wind/etc. or a program designed to create overall knowledge or meet a longer-term purpose?
4. Can we receive a copy of the curriculum? What is the curriculum based on/what are the techniques for training (only classroom, experimentation with technology or technical aspects of renewable energy, field work, etc.)?
5. What are the criteria for selecting trainees? Are "poor persons" engaged in this training program? If not, why? How do you define poor constituents?
6. How many "poor persons" have you successfully trained (meaning how many are "passing" the program)? How are you monitoring what success or passing the program looks like?
7. What is the training model based on? Who designed the training model? Who is conducting the training?
8. What feedback have renewable energy companies given regarding the quality of the training, based on the trainee's performance in employment in the renewable energy supply chain?
9. Is this training program meeting the needs of the renewable energy sector, based on feedback from renewable energy companies that have employed trainees of this program? What is this training program doing to rectify any gaps or felt needs of the renewable energy sector?
10. What challenges has the training program faced in setting up, implementing, conveying training course subject matter, or other issues?
11. What feedback have (poor) trainees given about the trainings they received? What have they shared with the training program about their experience in finding a good/quality job?
12. What gaps or missing links does this training program have, based on the feedback of renewable energy (poor) trainees? What is the training program doing to rectify these gaps based on feedback from (poor) trainees?
13. Is the training program keeping records on employment placements after trainees graduate from the training programs? If not, why not? If so, what do the records say about the percentage of trainees who are employed in the renewable energy supply chain, where they are employed, in what part of the renewable energy supply chain they are employed, and how this training program played a part in their gaining this employment opportunity? Do you know what their salaries are or the average salaries of graduates of your training program?
14. Are (poor) employees learning how their work and their training fits into larger renewable energy supply chain narrative, or is this training curriculum/model designed narrowly to understand only what the employee's specifics task are and how to perform them?

## Survey of Renewable Energy Programs and Companies

1. What business model or strategy do you use for engaging/employing people in the renewable energy supply chain (and where in the supply chain)? Where is the program/company operating?
2. Are you engaging/employing poor rural people? How does the strategy differ from engaging/employing other demographics?
3. If you are not engaging/employing poor rural people, why not? Do you think of such employment as part of your strategy? Did you want to put in extra effort? Were there too many challenges? What kind of challenges?
4. What challenges have you faced in attracting, educating, and retaining poor rural beneficiaries/employees? Why do you think you are facing these challenges?
5. What internal barriers (such as capacity and time) contributed to these challenges? What external barriers (such as infrastructure) contributed to these challenges? What can be done to eliminate these barriers and challenges?
6. What do you need to help you scale your program/employment with respect to poor rural people?
7. What safety training did you provide? In what instances did you decide that safety training was required? What did this safety training consist of? Was protective gear (appropriate for the task and in functional condition) provided to beneficiaries/employees if it was deemed necessary by standard industry practices?
8. Did you provide any additional services to the beneficiaries/employees, such as transportation or meal/food staple allowances?
9. How many poor/rural employees have you hired? Have you benefited (in quality and quantity and in achieving company objectives or targets) from employing poor rural people, or has such employment hindered progress?
10. About renewable energy companies: If they are employing poor/rural persons, what is the total cost-to-company, fixed salary, and variable pay (if applicable) on a monthly basis? [May not apply to some companies]
11. What is the intention of your program? Are you looking at this program to enable program beneficiaries to acquire some additional income, or is your perspective that this additional revenue stream could be a significant or primary source of income in the future?
12. Are you keeping records of all program beneficiaries? Are you keeping records of how much (additional) income has been gained through this program so far? If so, can we have access to them? If not, why not?
13. What has been documented or what do implementers say about the successes and failures of the program? What feedback have you received from program beneficiaries?

# APPENDIX D: SEMI-STRUCTURED INTERVIEW QUESTIONNAIRE FOR EMPLOYEES OF RENEWABLE ENERGY ENTERPRISES

## Background Information on Employee

1. Name
2. Native village
3. Age
4. Number of people in the family
5. Primary occupation of head of household
6. Number of earning members
7. Occupation before joining this enterprise
8. Source of income and pattern of income prior to joining
9. Part of any government scheme, like the National Rural Employment Guarantee Act (NREGA) etc.

## Education Level of Employee

1. Highest level of education
2. College
3. Other training programs

## Recruitment and Role Performed in Renewable Energy Organization

1. Recruitment process
2. Source of information about the enterprise
3. Purpose of joining this enterprise
4. Current position and responsibility
5. Full time or part time
6. Contractual or on the payroll
7. Years spent at the company

## Professional Development after Joining Renewable Energy Organization

1. Role at the time of joining and growth since then
2. Mentorship on job
3. Feedback-process
4. Skills learned on the job
5. Next position/project
6. Options to work in other renewable energy companies

## Income Generated by Job

1. Contribution to household
2. Opinion about salary drawn
3. Process of payment (when, how)
4. Salary components

## Health Benefits Offered by Employer

1. Medical coverage
2. Medical checkup
3. Accident coverage
4. Information about how to use medical facilities in emergency

## Incentives Available for Employees

1. Bonus
2. Travel incentive
3. Financial incentives like loans from employer
4. Leave policy

## Training Facilities Provided or Supported by Employer

1. Induction training
2. Regular training at work and in the classroom
3. Soft skills training
4. Training process
5. External training programs
6. Transportation, accommodation, and meals during training
7. Learning from training

## Working Conditions

1. Hours and days of work in a week
2. Safety policies and how and where they are followed
3. Access to clean toilets at the office
4. Access to subsidized food
5. Access to place to stay
6. Access to mobile connection

## Impact of Job on Lives of Employees

1. Level of confidence now versus before
2. Investment in assets
3. Support in meeting expenses
4. Social impact

## Other Comments from Employee

1. Issues with the enterprise
2. General feedback

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## ENDNOTES

1. "Poor people" is defined in this study as people in the bottom third of the income distribution in India. "Poor areas" refers to districts that are in the lower third of India's per capita income distribution. Many of these districts are target areas for expansion of energy (and other infrastructure) access. These definitions are the Planning Commission of India's definitions of poverty.

2. Studies that document the link between employment and poverty reduction include World Bank (2012), IFC (2013), and UN (2013).

3. The ILO uses the term *decent work*. This study uses the term *good job* to mean the same thing.

4. Information gathered from personal communication with MNRE and UNDP

5. ESI is one of the first social security schemes launched in India. It covers job-related accidents.

## ABBREVIATIONS

| | |
|---|---|
| FTE | full-time equivalent |
| GW | gigawatt |
| IFAD | International Fund for Agricultural Development |
| ILO | International Labour Organization |
| IPP | independent power producer |
| IRENA | International Renewable Energy Agency |
| IRIS | Impact Reporting and Investing Standards |
| ITI | Industrial Training Institute |
| LABL | Lighting a Billion Lives |
| MNRE | Ministry of New and Renewable Energy |
| MSDE | Ministry of Skill Development and Entrepreneurship |
| MW | megawatt |
| NGO | nongovernmental organization |
| NSDC | National Skill Development Corporation |
| OTELP | Odisha Tribal Empowerment and Livelihoods Programme |
| RERL | Renewable Energy for Rural Livelihood |
| SCGJ | Skill Council for Green Jobs |
| SEWA | Self Employed Women's Association |
| TERI | The Energy and Resources Institute |

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World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

**Our Challenge**
Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

**Our Vision**
We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

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COUNT IT
We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT
We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT
We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.

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