

Harnessing India's Productive Potential through Renewables and Jobs

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INTRODUCTION

The blackout in July 2012 that left over 600 million people without electricity highlighted India's inability to meet its economy's voracious appetite for energy. Yet with the enormous challenge of meeting India's growing energy demand comes an opportunity to leverage the production of renewables - biomass, mini-hydro, solar, and wind - to expand the country's energy supply while helping to address the employment challenges also plaguing the nation.

Flagging economic growth in recent years, coupled with joblessness and underemployment, has created the dual imperative of generating more employment and enhancing productivity. Renewables hold the potential to help address both these aims.

- First, investment in renewables spurs new jobs in grid construction and upgrading to smart grids, production of small-scale renewables, distribution, installation, and maintenance.
- Second, by improving energy supply, renewables can stimulate greater productivity across sectors.
- Third, renewables offer the possibility of better working conditions, healthier and more productive liveli-

hoods, especially when compared to non-renewable energy sectors such as the coal industry.

Renewables are not a panacea. Scaling up production of renewable energy in India is constrained by factors such as cost, pricing, and diffuse geography.¹ Yet renewables can be part of the solution in generating more and better employment, raising productivity and shifting the nation onto a cleaner, more sustainable growth trajectory.

These potential dividends should further strengthen the new government's resolve to scale up the production of renewables and maximize their potential to generate good employment in the process.

THE JOBS, POWER, AND PRODUCTIVITY DEFICIT

Despite India's average annual growth rate of 8.5% between 2005 and 2010,² employment only grew at approximately 1 million per year³ - an alarming trend given that India's working age population is growing at

¹Rahul Tongia (2012) "Renewable Energy in India: For Now or in the Future?" in *Empowering Growth: Perspectives on India's Energy Future*. (Economist Intelligence Unit Limited).

² World Bank, *World Development Indicators*.

³ Abhishek Shaw (2013) "Employment Trends in India: An Overview of NSSO's 68th Round" in *Economic and Political Weekly*, vol. 48, No. 42.

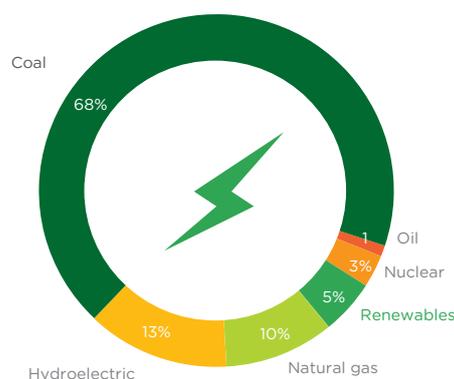
roughly 1 million per month.⁴ Capital-intensive growth did not deliver jobs. Moreover, while employment elasticity increased slightly over the couple of years since, annual Gross Domestic Product (GDP) growth halved from a peak of 10% in 2010 to 5% in 2013⁵ - a downward trend that has deepened the employment deficit.

Reversing this trend requires a larger and more reliable power supply. The power shortfall in India between 2011-2012 was pegged at 10.3%,⁶ and projections suggest that the country's demand for energy could grow by up to 54% by 2020, exacerbating the power deficit.⁷ India's shortage of electricity is in part the result of waning supplies of coal, an inadequate grid, and inefficient distribution of existing supplies stemming from leakage or outright theft.

Electric power transmission and distribution losses amounted to 21% of total output in 2011.⁸ Access to grid power continues to be low with an electrification rate of approximately 55%.⁹ Some 35,000 villages and one in four people still lack access to electricity.¹⁰ This energy gap compounds India's employment challenge.

A lack of power results in a substantial loss of productivity across sectors and at the individual level, stifling economic activity. A study by the Federation of Indian Chambers of Commerce and Industry notes that Indian companies can lose up to INR 40,000 (about US\$ 700) per day in revenue as a result of power shortages.¹¹ Services, from communications and finance to transport, are heavily energy dependent. Power outages that disrupt these basic services have ripple effects throughout the economy.

FIGURE 1: Electricity Production (2011)



Added Benefit of Renewables



Source: World Development Indicators

⁴ India will add 245 million people to its working-age population between 2010 and 2030, roughly 1 million people per month. See: David Lam and Murray Leibbrandt. 2013. *Global Demographic Trends and Their Implications for Employment*.

⁵ World Bank. *World Development Indicators*.

⁶ Rahul Tongia (2011), "A Smart Solution to Power Shortage: Smart Grid Technologies Can Revolutionise Electricity Management in India". *Business Standard*, July 5, 2011.

⁷ Martin Adams (2012), "India's Energy Future: The EIU View" in *Empowering Growth: Perspectives on India's Energy Future*. (Economist Intelligence Unit Limited).

⁸ World Bank, *World Development Indicators*.

⁹ World Bank and Energy Sector Management Assistance Program (2010), *Unleashing the Potential of Renewable Energy in India*. (Washington, DC: World Bank).

¹⁰ Neha Pahuja et al. (2014), *CHG Mitigation in India: An Overview of the Current Policy Landscape*. (World Resources Institute, TERI, and IFMR Research).

¹¹ Federation of Indian Chambers of Commerce and Industry (2013), *Lack of Affordable and Quality Power: Shackling India's Growth Story*.

Agriculture's value added as a share of GDP was only 17% in 2012; yet almost one in two – 47% – employed people worked in agriculture, underscoring the need to improve the sector's productivity. Greater use of technology would help achieve that goal, but this requires a reliable source of energy. Renewables offer a triple advantage: (i) a better power supply supports greater deployment of technology increasing productivity, (ii) off-grid renewables can help enhance access in areas where last mile delivery is a challenge, and (iii) the development, installation, distribution, and maintenance of renewables could help offset employment losses arising from productivity gains.

Moreover, a more reliable power supply would facilitate the expansion of rural non-farm activities, especially those that link agriculture with industry such as agro-processing and packaging, giving a boost to both agriculture and manufacturing as well as generating employment.

India's organized manufacturing sector, and its employment elasticity, remains small relative to the size of its economy.¹² Manufacturing value added as a share of GDP has remained relatively stagnant over the last decade, standing at 13% in 2013.¹³ A vast majority of those in the manufacturing sector report working in facilities that lack a steady supply of electricity, hampering production. Studies suggest that power shortages reduce average output of manufacturing firms by about 5%.¹⁴ About 60% of Indian firms depend on expensive captive or backup generation.¹⁵ Small and medium enterprises, where job expansion is likely to occur, are the most adversely affected by energy shortages because they often lack these expensive back-up systems.

On his first Independence Day address, Prime Minister Narendra Modi emphasized the need to expand manufacturing to improve employment and reinvigorate the nation's slowing economic growth with minimal impact on the environment.¹⁶ But manufacturing cannot expand without a reliable supply of energy to power it. Minimal impact on the environment means that industry - the consumer of a third of all electricity - will have to clean up its act and rely less on dirty coal and more on renewables.

At the individual level, a lack of electricity limits the ability of children to study and of adults to engage in income-generating activities. India's labor productivity, relative to global figures, remains low and has grown at a very slow rate between 2002 and 2012.¹⁷

The development of renewables facilitates the expansion of economic activity to ultimately generate more, and more productive, work. Greater productivity implies that more can be produced with fewer inputs, including labor; but more energy to power an expansion of economic activity will generate new jobs that will help offset job losses from productivity gains.

India's renewable energy generation - 31.7 GW as of mid-2014 - has been rising consistently over the last decade, constituting 12.7% of total installed energy capacity.¹⁸ This positive trend will continue, especially as India depletes its coal reserves, projected to run out in the next 45 years.¹⁹ The challenge for the new government lies in realizing the capacity of renewables to generate power in a way that also creates as many good jobs as possible.

¹² Ajit Ghose (2005), "High Wage - Low Productivity, Organized Manufacturing and the Employment Challenge in India" in *Indian Journal of Labor Economics*, vol. 48, No. 2.

¹³ World Bank, *World Development Indicators*.

¹⁴ Hunt Allcott, Allan Collard-Wexler, and Stephen D. O'Connell. (2014), *How Do Electricity Shortages Affect Productivity? Evidence from India*. Accessed on October 1, 2014. http://pages.stern.nyu.edu/~acollard/ACO_Electricity_Shortages_in_India.pdf.

¹⁵ World Bank and Energy Sector Management Assistance Program, *ibid*.

¹⁶ Narendra Modi (2014), *Speech on 68th Independence Day*.

¹⁷ Boston Consulting Group (2013), *People Productivity: Key to Indian Manufacturing Competitiveness*.

¹⁸ Ministry of Power. Accessed on September 12, 2014. http://powermin.nic.in/indian_electricity_scenario/introduction.htm.

¹⁹ World Bank and Energy Sector Management Assistance Program, *ibid*.

INDIA IN THE GLOBAL SIX ON RENEWABLES EMPLOYMENT

India ranks fifth in the world in total installed renewable capacity; and it is in a cohort of six countries where the bulk of renewable energy employment is concentrated.²⁰

TABLE 1: Employment in Renewable Energy

(THOUSANDS)								
COUNTRIES	WORLD	BRAZIL	CHINA	INDIA	U.S	GERMANY	SPAIN	OTHER EU
Biomass	753		266	58	152	57	39	178
Small Hydro	109			12	8	7	2	18
Solar Photovoltaic	1360		300	112	90	88	12	212
Solar heating/ cooling	892		800	41	12	11	1	20
Wind power	753	29	267	48	81	118	28	124

SOURCE: International Renewable Energy Agency 2013. *Renewable Energy and Jobs*. (Abu Dhabi: IRENA)

Table 1 depicts the distribution of direct and indirect jobs Brazil, China, India, the United States, Germany, and Spain generated in their respective renewables sectors. Direct jobs are those generated by core activities related to renewables. Indirect jobs refer to employment generated in upstream industries that provide inputs, supply, and support to core activities.

These nations constitute the major manufacturers of renewable energy equipment, producers of bioenergy feedstock, and installers of production capacity.²¹

Despite the growing number of jobs in India's renewable energy sectors, China's ability to leverage renewables to generate employment outpaces that of India's. China has been very successful in incentivizing the growth of labor-intensive manufacturing and exports through several means, many of which are controversial - such as subsidizing priority sectors through State-owned en-

terprises, holding down the value of its currency, encouraging 'indigenous innovation' through domestic content requirements and limiting foreign competition and investment.

India must explore how it can incentivize the growth of labor-intensive renewables manufacturing within internationally accepted parameters. Initial evidence on domestic content requirements in India's solar industry suggests that they raise the cost of inputs constraining the expansion of the sector.²² Moreover, the current process of obtaining government subsidies to develop solar products, for example, is fraught with inefficient bureaucratic procedures requiring large amounts of paperwork and time.²³

The central government must therefore undertake a combination of tax incentives, rebates, and subsidies and expand the availability of low-cost financing for

²⁰ International Renewable Energy Agency (2013), *Renewable Energy and Jobs*. (Abu Dhabi: IRENA).

²¹ *Ibid.*

²² Council on Energy, Environment and Water & Natural Resources Defense Council (2014), *Solar Power Jobs: Exploring the Employment Potential in India's Grid-Connected Solar Market*.

²³ Sanjay Dutta (2014), "Govt may rejig subsidy for solar projects". *The Times of India*, June 12, 2014.

renewables-related businesses, especially small and medium enterprises. And it must streamline current processes to encourage new businesses and the expansion of existing businesses in the renewables sector.

In the near term, scaling up renewables in India is likely to serve the domestic market rather than cater to export demand. The country must first meet its own rising demand for energy. Moreover, India's renewable energy industry needs to grow and innovate before it can compete with the major players in manufactured environmental technologies and inputs - solar, for instance. Domestic production for domestic consumption plus distribution and servicing activities, rather than exports, will drive renewables job creation in the near term.

EMPLOYMENT ACROSS RENEWABLES

Renewables - from equipment manufacturing and grid construction to installation and operations - have significantly higher employment elasticities relative to fossil or nuclear alternatives. This applies per unit of investment, per unit of installed capacity, and per unit of output.²⁴ Within renewables, solar generates the most employment per unit of output (measured in megawatts) followed by biomass, small hydro and wind power. Calculations in Table 2 provide a rough estimate of the employment in renewable energy production per megawatt in existing plants, not jobs created in the construction of new plants, which would be higher.²⁵

TABLE 2: Drivers for a Smart Grid in India

COUNTRIES	EMPLOYMENT (Thousands)	GRID-INTERACTIVE POWER (Capacities in MW)	OFF-GRID/CAPTIVE POWER (Capacities in MW _{EQ})	EMPLOYMENT (per MW)
Biomass	58	1264.8	473.95	33
Small Hydro	12	3671.25		3
Solar Power	112	1759.44	124.67	59
Wind Power	48	19317.05		3

SOURCE: Employment estimates for 2012 taken from: International Renewable Energy Agency 2013. *Renewable Energy and Jobs*. (Abu Dhabi: IRENA). Power estimates from: Ministry of New and Renewable Energy - Government of India. 2013. *Physical Progress (Achievements)*. *Off-Grid Captive Solar Power refers to SPV.

Each type of renewable lends itself to a range of functional activities: business development, manufacturing, fabrication, installation, operations and maintenance, and marketing.²⁶ These activities create direct and indirect jobs that span different geographies, differ in duration, and range from low to high labor and skill intensities.

Renewables production is geography dependent; therefore, the employment impact varies from place to place. By 2010, Tamil Nadu, for instance, had realized nearly 78% (4304 MW) of its potential capacity for power generation from wind, translating into some 11,000 new jobs. Mini-hydro is one of the few indigenous sources of renewable energy for states such as Haryana. By 2010, Haryana had an installed capacity of 57% of

²⁴ Worldwatch Institute (2007), *Preliminary Report: Green Jobs - Towards Sustainable Work in a Low-Carbon World*. (Washington, DC: Worldwatch Institute).

²⁵ The enormous disparity for wind versus solar is because (i) these numbers appear to be steady state employment, and not, during construction, and (ii) solar is likely a mix of different scales and locations. If there were a very large single solar farm, it would offer lower long-term employment. These are however global estimates, and one needs Indian data, especially given India's lower labor costs and high capital costs might lead to different labor-automation ratios than in other countries.

²⁶ Ministry of New and Renewable Energy and Confederation of Indian Industry (2010) *Human Resource Development Strategies for Indian Renewable Energy Sector*.

its potential to generate 110 MW, creating roughly 206 new jobs.²⁷

The potential capacity for wind is concentrated in four States: Karnataka, Gujarat, Andhra Pradesh, and Tamil Nadu. Small hydro-power has the highest potential in Himachal Pradesh, Uttarakhand, Jammu & Kashmir, and Arunachal Pradesh. The potential for renewable energy from biomass spans the nation, but is most concentrated in Maharashtra, Tamil Nadu, and Madhya Pradesh. Potential capacity for solar power is most pronounced in parts of Jammu & Kashmir, Rajasthan, and Gujarat.

Beyond the potential to generate direct employment in these particular States, expanding renewables production also gives rise to indirect jobs such as producing steel or plastics, which could be located in other States

But beyond the potential to generate direct employment in these particular States, expanding renewables production also gives rise to indirect jobs such as producing steel or plastics, which could be located in other States. Solar and wind energy, in particular, have resulted in increased activity in plastics, semiconductors, and electronics industries.

Small-scale off-grid renewables production is becoming an increasingly viable means of delivering energy to rural communities, expanding opportunities for income-generating activities. Off-grid renewable supply

chains allow for highly localized employment and facilitate skills development and the creation of micro-entrepreneurs. Companies, for instance, sometimes train unskilled workers from rural areas to sell and perform basic maintenance on their products.

While solar manufacturing entails working in a factory that may or may not be local, the other activities in the supply chain - from assembly, distribution and sales, to installation and servicing - can drive local job creation in rural communities where employment opportunities are lacking. What's more, access to power also enables individuals to engage in a more productive economic activity. With the advent of electricity, a female artisan, for instance, can turn to her embroidery in the evening after fulfilling family and farming obligations. Children have more time to study after dark. Street lights boost economic activity by extending working hours. Photovoltaic lighting allows factories to operate for longer hours, and potentially even operate in multiple shifts. Initial construction and grid upgrading creates temporary jobs, while other ancillary activities generate ongoing employment. Yet as long as the sector continues to grow both in scale and in production, those employed in construction, grid upgrading, and installation will continue to find employment opportunities - though some might be limited by location.

Of the four main renewables in India, biomass²⁸ is likely to create the steadiest stream of employment. Biomass (mostly wood and dung-cakes) is India's largest renewable source, accounting for a quarter of the nation's total energy consumption.²⁹ A case study of a dairy cluster in Jabalpur, Madhya Pradesh by the International Labour Organization found that productive use of India's total available dung could generate up to 2 million full-time permanent positions.³⁰ Biomass such as cow-dung-cakes entails a range of labor-intensive activities, from initial collection to processing in plants. Activities be-

²⁷ Author's calculations based on data from: World Bank and Energy Sector Management Assistance Program. 2010. *Unleashing the Potential of Renewable Energy in India*. (Washington, DC: World Bank).

²⁸ The potential environmental benefit of greater reliance on biomass as an energy source is also complicated by some of its negative environmental impacts. Wood collection can drive deforestation, and burning wood and dung-cakes produces air pollution, which is especially unhealthy if used in indoor kitchens. Further, bioenergy can also compete for agricultural land, hampering food production.

²⁹ Rahul Tongia, 2012. *Ibid.*

³⁰ Marek Harsdorff (2014), *The Economics of Biogas: Creating Green Jobs in the Dairy Industry in India*. (Geneva: ILO).

come more skill-intensive as one moves from collection to processing phases.

Although the range of activities related to renewables has the potential to engage labor with varying skill sets, a dearth of certain skill-sets can lead to bottlenecks in renewables expansion. The initial stages of business development and pre-construction for wind and solar projects, for instance, call for skilled personnel capable of procuring land, conducting resource assessments, developing technical proposals, designing mechanical and electrical systems, and various other skill-intensive tasks.³¹ Having a skilled workforce capable of managing these tasks lays the foundation for the rest of the project that then utilizes semi-skilled and unskilled labor in the construction, operations and maintenance phases. A lack of consistent data on the potential employment impact of renewables expansion makes it particularly hard to assess the quantity of skilled, semi-skilled, and unskilled personnel that will be needed.

RENEWABLES AND WORKING CONDITIONS

Renewables not only offer the potential to create more jobs, but also better jobs. India's employment challenge is as much about the poor quality of employment as it is about a lack of employment.

Electricity production from coal sources constituted 68% of the total in 2011. From Jharkhand to the unregulated mines of Meghalaya, India's coal mines have some of the country's most exploitative working conditions. In addition to the significant health risks - silicosis, coal workers' pneumoconiosis, noise-induced hearing loss - a high demand for coal has spawned a number of illegal mines, many of which deploy child labor. Estimates suggest some 70,000 children work in 5,000 mines.³² A report by the Indian Ministry of La-

bour and Employment's working group on occupational safety and health for the twelfth five-year plan notes: "Mining, particularly coal mining, is recognized as one of the most hazardous peacetime occupations and cannot be compared with other industries in terms of occupational safety and health mainly because of highly unpredictable and varying nature of working conditions in the mines."³³

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As an alternative to coal, renewables - especially renewables-related manufacturing - offer an opportunity to create employment with a lower incidence of child labor and better working conditions. Renewable industries, such as solar, are better regulated and involve fewer health hazards of the kind inherent to coal mines.

Nevertheless, estimates suggest that India's coal industry directly employs over 600,000 workers, and this figure does not account for employment in smaller, unregulated mines. As India depletes its coal resources and renewables fill the energy gap, retraining mineworkers and cultivating livelihoods in areas where coal mines are the primary source of employment is a looming challenge.

Capitalizing on the potential of renewables to deliver good jobs also means hedging against the risk for ex-

³¹ Council on Energy, Environment & Water and Natural Resources Defense Council (2014), *Solar Power Jobs: Exploring the Employment Potential in India's Grid-Connected Solar Market*; Council on Energy, Environment and Water & Natural Resources Defense Council, 2014. *Creating Green Jobs: Employment Generation By Gamesa-Renew Power's 85 Megawatt Wind Project in Jath, Maharashtra*.

³² Gardiner Harris (2013), "Children Toil in India Mines, Despite Legal Ban". *New York Times*, February 25, 2013.

³³ Ministry of Labour and Employment Government of India (2011). *Report of the Working Group on Occupational Safety and Health for the Twelfth Year Plan (2012 to 2017)*. (New Delhi: Government of India).

exploitation in the renewable energy sector itself. For instance, the labor-intensive rural activities in the initial stages of the biomass value chains tend to be carried out by unpaid family workers, placing a disproportionate burden on women and children. As India looks to harness the potential of a biomass industry, it must regulate working conditions not only for the skilled workers in processing facilities, but also the unskilled workers engaged in collection.

CONCLUSION

Scaling up renewables in India offers the dual advantage of improving the energy supply while creating more and better employment. If India can leverage the opportunity before it, the result will be more sustainable, more broad-based economic growth.

The task will not be easy. Even though renewables' share of overall electricity production has risen consistently over the last decade, constituting 12.7% of total electricity production in the middle of 2014, this share remains well below capacity. Reaping the job gains from renewables entails addressing the constraints on the expansion of the industry. A number of factors - from cost to the availability of land - continue to inhibit the development of renewable energy.

A decentralized approach means that the onerous of growing the renewables sector and leveraging it to generate direct and indirect employment is on States, many of which lack the vision, organization, and capacity to deliver. Inconsistent enforcement of national policies implemented at the State level, for instance, means that renewables purchase obligations - targets specifying the share of renewable energy in the overall energy purchased by distribution utilities - have not been effective, with some States consistently failing to achieve their targets while others surpass them year after year. Since the launch of renewable energy certificates - tradable

renewable energy credits - in November 2010, not a single State distribution company has purchased RECs, notwithstanding laws mandating that they do so.³⁴

Still the combination of the need to enhance energy supply for businesses and households coupled with the need to reduce the nation's carbon footprint means that the renewables sector is likely to continue to expand, though perhaps not at the speed and efficiency it is capable of. Policies aimed at expanding the renewable energy sector must be accompanied by measures that ensure the industry's growth creates the maximum number of good jobs.

In order to reap the potential employment gains from renewables, the government must:

- *Define metrics* and systematically gather time series data on the impact of renewables expansion on the quantity and quality of employment. Existing research, much of which is based on anecdotal evidence, is woefully inadequate and inconsistent, making it difficult to paint an accurate picture of the current renewables and employment nexus.

A handful of sources derive employment figures for the renewables sector from industry surveys, or by generating an employment coefficient (jobs per unit of production, for instance). In order to ensure policymaking is backed by reliable data, the government should develop a standard method for regularly measuring and reporting the impact of renewable energy production on job creation.

- *Incentivize renewables-related, labor-intensive manufacturing activity* through a combination of tax incentives, rebates and subsidies, gradually redirecting fuel subsidies toward renewables manufacturing.
- *Streamline government processes* to make it easier for entrepreneurs and businesses to access government support for renewables ventures.

³⁴ Pahuja et al, 2014. *Ibid*.

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- Take measures to *expand low-cost financing* through low-interest loans to renewables-related businesses, especially small and medium enterprises that are engines of job growth. To this end, the government must significantly improve its administration and oversight of the National Clean Energy Fund, the repository for the

cess on coal, which can serve as a vehicle to provide low-interest loans and potentially issue bonds to enable investments in renewables-related entrepreneurial ventures and technologies.

- *Upgrade weak and unstable grid infrastructure* and transition to ‘smart grids, which will create direct jobs of varying skill levels and durations in the process.
 - *Map the varying activities and associated skill requirements* in the renewables supply chain. Then ensure that workers have access to appropriate training in manufacturing, installation, and maintenance of renewable energy systems.
-