Online course

Employment Effects of Renewable Energy Deployment - An Overview

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1 Introduction

1.1 Learning objectives of the course

Learning objectives: Upon completion of this course, you should be able to

- analyse the quantitative and qualitative employment effects of the energy transition[1]
- identify the main concepts and trends influencing renewable energy sector employment
- describe how to prepare the ground for future renewable energy employees
- apply the (policy) lessons learned about renewable energy deployment in three different countries

1.2 Introduction to the course

This course will train participants in how to identify, quantify, and communicate the employment effects of the energy transition from fossil fuels to renewables. You will learn about terminology, methods, concepts, trends and case studies, all of which will support you in assessing and quantifying employment impacts as co-benefits[2] of renewable energy. Ultimately, the course is intended to enable you to conduct analyses in your own country or region, and to put the tools and methodologies into practice.

In **chapters two and three**, the course focuses on analysing renewable energy employment categories and explaining the differences between various types of employment (i.e. direct, indirect and induced jobs) and effects (e.g. the quantity and quality of jobs available).

In **chapter four**, the course provides insight into how to prepare the way for future employment and employees in the renewable energy industry, including how to enhance existing educational programmes and how to reskill workers from the fossil fuel industry.

Finally, in **chapter five**, three case studies present the policy lessons learned in three different countries (India, South Africa and Vietnam), regarding how to maximise and enhance renewable energy employment as a co-benefit.

[1] From fossil fuels to renewable energy.
[2] The COBENEFITS project cooperates with national authorities and knowledge partners to develop key insights that will enable them to mobilise socio-economic benefits (co-benefits) of renewable energy in their countries and accelerate domestic processes aimed at achieving their international climate protection commitments.

2 Terminology and Methods: Analysing Renewable Energy Employment Effects

2.1 Renewable Energy Employment Categories: Direct, Indirect, and Induced[3]

Learning objectives: Upon completion of this page, you should be able to

- define the three main categories of employment within the renewable energy sector
- give some examples of (employment) activities related to each category

Employment in the renewable energy sector can be classified into three main categories: direct, indirect, and induced jobs (CEEW-NRDC, 2017; Juan José Cartelle Barros, 2017).

Direct jobs are required in the project deployment phase. Activities associated with this phase include plant design, site development, financial closure, project management, fuel supply, construction/installation, and the operation and maintenance of power plants.

Indirect jobs are found in the secondary industries which supply equipment to primary industries. The manufacture of equipment and materials that are used for the direct functioning of a power plant (turbines, generators, boilers, solar PV panels, and wind systems for power plants), and the fabrication of structural hardware, foundations, and electrical components, are both included in this category.

Induced jobs are created when people working in the primary and secondary industries spend their salaries. For example, when a power plant's employees pay their rent, or buy food at grocery stores, additional (induced) employment is created in the respective industries of real estate and retail.

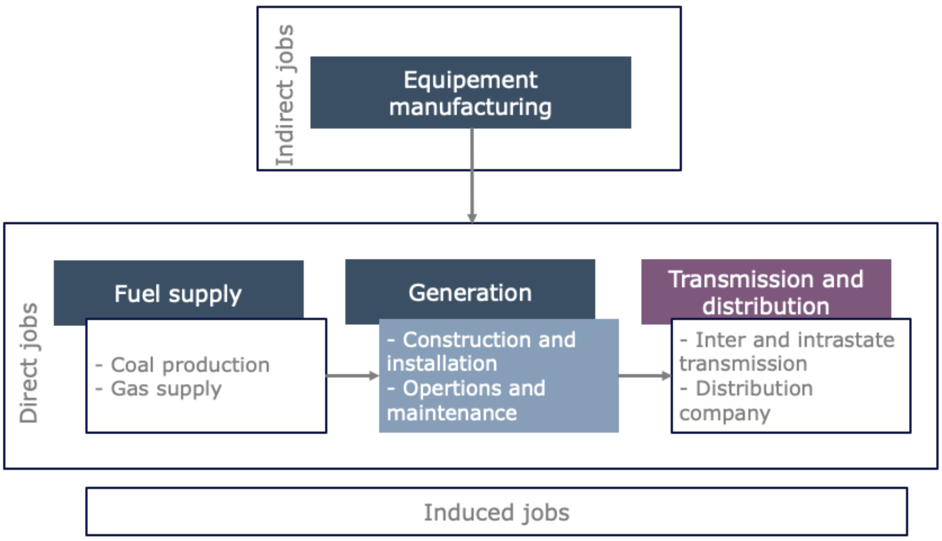

Figure 1: Power sector value chain and job classification (Source: COBENEFITS, 2019)

[3] Sources: COBENEFITS (2020), Future skills and job creation with renewable energy in India, https://www.cobenefits.info/resources/future-skills-and-job-creation-with-renewable-energy-in-india

2.2 Quantifying Employment: Full-time Equivalents (FTE)

Learning objectives: Upon completion of this page, you should be able to

- state why full-time equivalents (FTE) are necessary
- describe what is used to convert part-time and contract work into FTE
- give one or two examples of the problematic nature of FTE

To enable comparability across different sectors of the economy, labour inputs and job impacts are expressed in terms of full-time equivalents (FTE) (see figure below as an example).

One FTE job is equal to one person working full-time over the course of a year (specific definitions of how many hours per working week constitute full-time vary, depending on national legislation and local practice). Part-time positions and contract work are converted to FTE based on the inputs required, the actual hours worked, or the duration of an employment contract.

FTE calculations concern the number of hours worked, rather than the number of employees needed to perform a job. For example, 4 employees, each working a quarter of full-time hours, are equivalent to 1 FTE job.

FTE are conceptually linked to formal employment, which is characterised by regulated daily working hours and length of the working week. Jobs in the informal sector are typically not assumed to conform to full-time equivalency.

The duration of a given job is also significant. In terms of the energy supply chain, jobs in construction and installation are typically considered to be of limited duration; i.e. once a wind or solar farm is fully constructed, the specific job ends (unless a worker’s contract stipulates employment for multiple projects). Conversely, jobs in operations and maintenance are effectively ‘permanent’, because most energy-generating facilities have long lifespans.

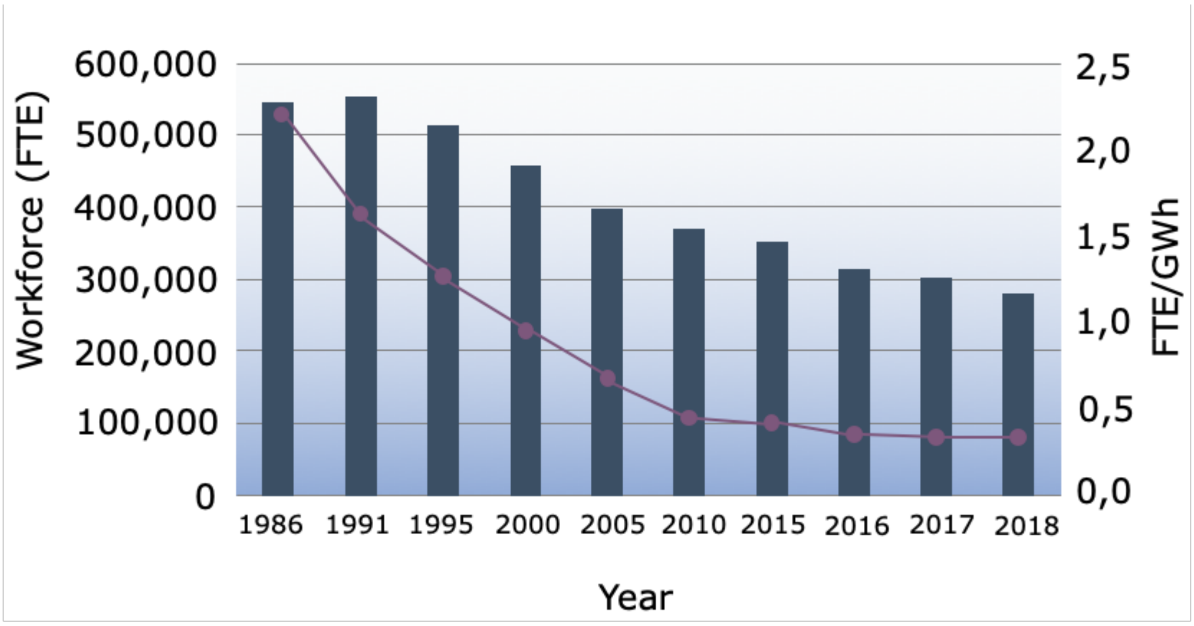

Figure 2: Employment trend at Coal India Limited (Source: CEEW-SCGJ analysis, 2019)

2.3 The Quality of Employment: Decent Jobs

Learning objectives: Upon completion of this page, you should be able to

- name aspects which can increase the quality of a job and/or workplace
- describe at least one definition of ‘decent work’
- summarise the consequential role that decent work plays in the context of renewable energy

In addition to the quantity of jobs available, the quality of those jobs is also of great importance. Jobs are increasingly understood to provide not just economic sustenance but meaning and satisfaction to people’s lives.

Jobs which require more extensive or refined skills, and which attract higher salaries, have a higher multiplier value in the economy, i.e. greater disposable income translates into greater demand. The quality of the workplace itself also contributes to overall job quality in a variety of ways, including working hours, communication between employers/managers and employees (and their representatives), work-life balance, job security, career trajectory, gender balance, etc.

The desire for high-quality employment is expressed in the terms ‘good work’ or ‘decent work’, each of which attract varying definitions. The International Labour Organization (ILO) has developed a definition of ‘decent work’. The definition includes work that “is productive and delivers a fair income”, workplace security and family support, “better prospects for personal development and social integration”, freedom for people to participate in decisions affecting them directly, and “equality of opportunity and treatment for all women and men.”[4] Key aspects of the decent work agenda are also embedded in the targets of many other SDGs, including the SDG8[5].

In the context of renewable energy, decent work plays an essential role. Skilled, experienced, and satisfied workers are essential to a successful energy transformation. As mentioned above, well-remunerated jobs are better able to support a vibrant economy, because they create greater demand for goods and services, and either generate or maintain beneficial economic cycles. Decent work typically means that employees are better trained and remain longer in their jobs. The result is that they accumulate critical experience and knowledge, and gain greater work satisfaction. Such circumstances raise the likelihood that the work carried out in the different segments of the renewable energy value chain will be of higher quality, e.g. well-crafted solar panels and wind turbines, careful construction and installation, and well-maintained generation facilities. Projects will function more smoothly and reliably, and will be able to match nameplate capacity with actual output closely. Societal acceptance of renewable energy also receives a boost.

[4] Source: International Labour Organization, https://www.ilo.org/global/topics/decent-work/lang--en/index.htm.
[5] Sustainable Development Goals: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. Source: https://sdgs.un.org/goals/goal8.

Figure 3: Decent work characteristics (Source: European Commission, 2006)

2.4 Models for Quantifying Jobs: Employment Factor, Supply Chain, or Input-output

Learning objectives: Upon completion of this page, you should be able to

- describe how the employment factor, supply chain and input-output models work
- match each of the three models to the most appropriate category/categories of job(s)

Regardless of the method used, estimating the total number of jobs in a sector, or the total change in jobs across an economy is highly complex. However, the following models represent various ways to quantify jobs[6]:

The **employment factor model** estimates the average number of jobs per unit of capacity installed or energy generated, and multiplies that number by total capacity or generation. Factors are specific to the technologies used, and to the various stages in the value chain. This method is usually used to estimate direct jobs.

The **supply chain model** maps out the supply chain details for a specific technology, and estimates the material and labour costs, and profit margin, at each link in the chain. The labour requirements can then be quantified and used to determine employment factors. This model can be used to estimate direct and indirect jobs, depending on the extent to which the chain is mapped out (see Figure 4).

[6] N.b. The models all tend to give aggregated numbers, rather than a full picture of labour market effects.

Input-output models predict macroeconomic outcomes, by tracing linkages across the entire economy. These models can therefore provide an estimation of direct, indirect, and induced employment benefits in all sectors.

Figure 4: Construction of RE value chains (Source: COBENEFITS, 2019)

3 Concepts and Trends: Employment factors, etc.

3.1 Employment Intensity for the Energy Transition

Learning objectives: Upon completion of this page, you should be able to

- explain what 'intensity of investment' means, and how it applies to renewable energy technologies
- discuss the current opportunity for high intensity of investment in the energy transition

'Intensity of investment', when applied to employment, means the employment that is generated for each unit of investment. Intensity of investment varies from one technology to the next. Investing in energy transition technologies creates almost three times more jobs than investing in fossil fuels, per million dollars of spending. Figure 5, below, shows that both renewables and energy flexibility have an intensity of more than 25 jobs/USD million, with energy efficiency at about 10 jobs/USD million invested.

Currently, policy makers have an opportunity to raise the ambition of their energy transition plans, in order to strengthen the associated value chains, by merging energy transition plans with economic recovery programmes. Doing so will increase the positive employment impact of the energy transition.

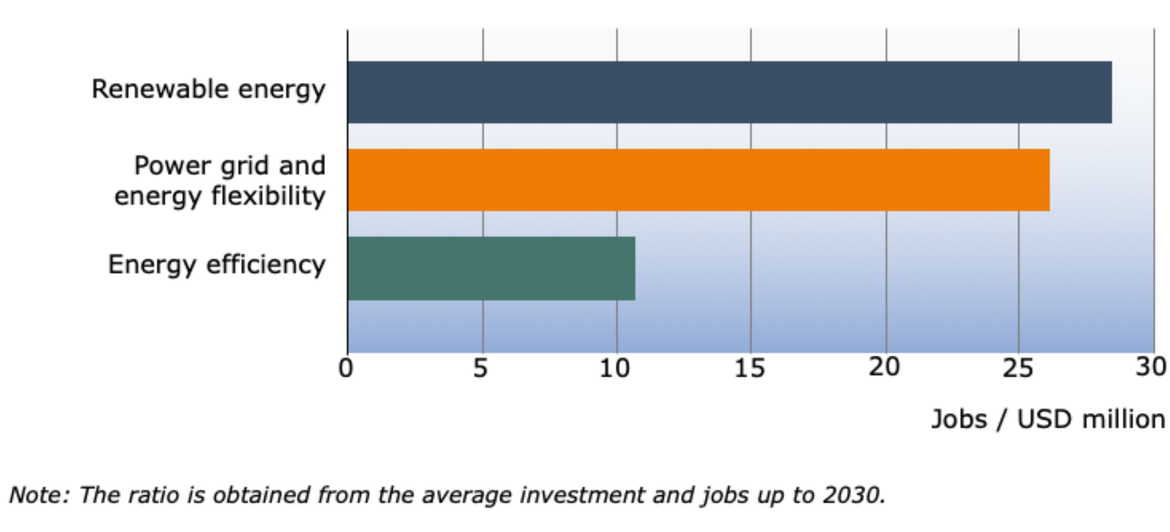

Figure 5: Global average employment intensities of investments in renewable energy, energy efficiency, and energy flexibility (IRENA, 2020)[7]

[7] Source: IRENA (2020), Global Renewable Outlook: Energy Transformation 2050.

3.2 The Renewable Energy Employment Factor: The Pivotal Role of Distributed Generation

Learning objectives: Upon completion of this page, you should be able to

- recognise how residential and commercial distributed generation can help transform the power sector from fossil fuels to renewables
- demonstrate how small hydro, biomass, and solar energy are all good examples of the advantage distributed generation holds

Investment in distributed generation for residential and commercial uses is crucial to the transformation of the power sector. Small, modular technology solutions can be scaled relatively quickly, and can provide a timely, scalable stimulus that will have a real impact across the economy. Investment in distributed generation can trigger many new jobs over a short time span. Therefore, establishing new programmes or targets for distributed generation can prove an important ingredient in recovery programmes.

An analysis from India (in Figure 6, below) shows that the employment factor from the rooftop solar sector is about ten times higher than that from large-scale solar PV and other large-scale power generation technologies. The deployment of smaller-scale PV projects is slightly more expensive, due to reduced economies of scale. However, when deciding on shares of large-scale renewable energy procurements versus distributed generation, policy makers should also take into consideration the high labour intensity of the latter.

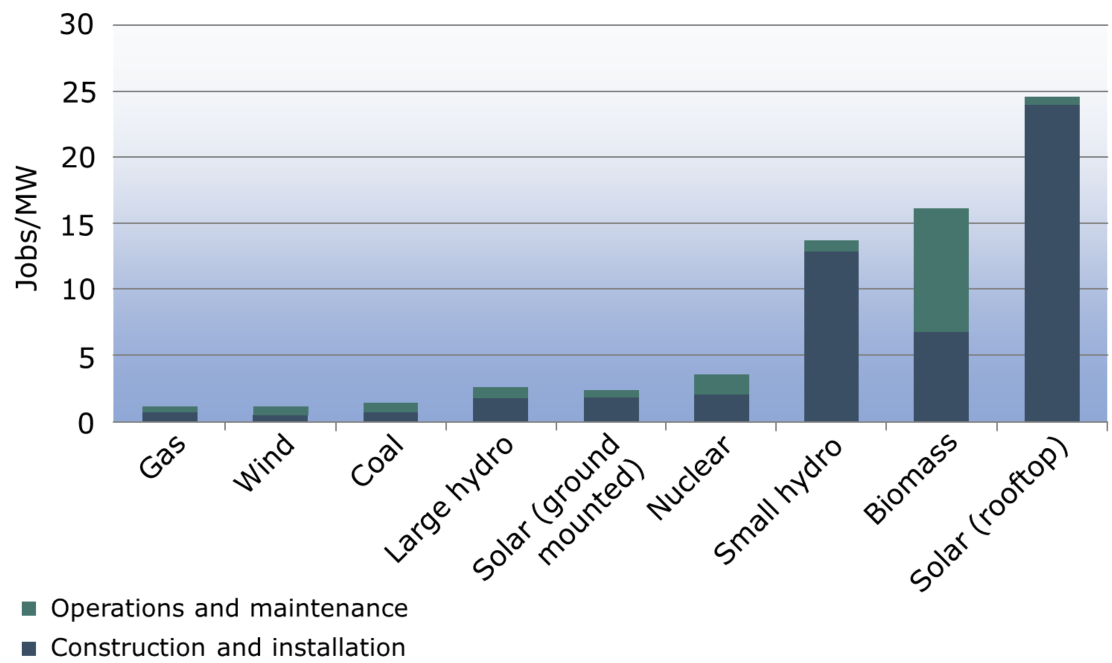

Figure 6: Employment coefficients for different electricity-generating technologies (Source: COBENEFITS, 2019)[8]

[8] Source: Future skills and job creation with renewable energy in India, https://www.cobenefits.info/resources/future-skills-and-job-creation-with-renewable-energy-in-india.

3.3 Employment Opportunities and Distribution along the Renewable Energy Value Chain

Learning objectives: Upon completion of this page, you should be able to

- establish why quantifying the number of potential renewable energy jobs along each segment of the value chain is important
- list types of jobs, according to their human resource segment of the value chain for the solar PV, onshore wind, and offshore wind sectors
- illustrate how different jobs are distributed across the solar PV, wind, and bioenergy sectors

In order to design green recovery programmes which maximise regional and national value creation, policy makers must quantify the number of renewable energy jobs that can be created along each segment of the value chain. Renewable energy projects entail a broad range of activities, and the renewable energy sector draws on a wide variety of occupational groups and skills sets (see section 4, below), thereby offering opportunities to many different people.

An IRENA analysis has shown (see Figure 7, below) the human resource requirements of segments of the value chain for solar photovoltaic (PV) plants, onshore wind farms, and offshore wind farms. A large-scale 50 MW solar PV project provides a total of 230,000 person-days of employment, along all segments of the PV value chain. The highest concentration is in operations and maintenance (O&M), which requires 56% of the total human resources available, followed by manufacturing (22%), then construction and installation (17%). For a large 50 MW onshore wind project, a total of 144,000 person-days is needed. Again, O&M is the leading segment (43%), followed by construction and installation (30%), then manufacturing (17%). A 500 MW offshore wind farm yields a total of 2.1 million person-days of employment. Here, manufacturing and procurement represents the largest segment (59%), followed by O&M (24%), then installation and grid connection (11%).

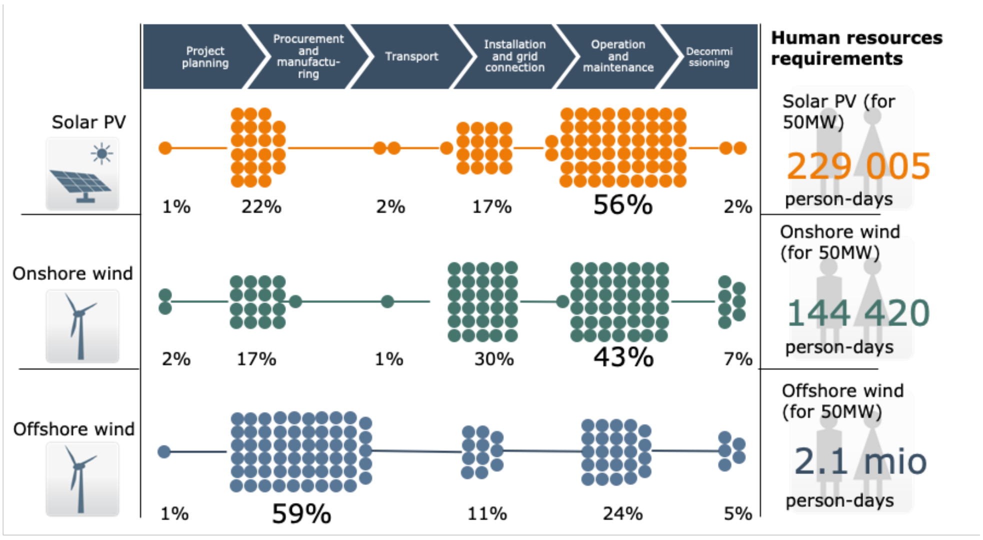

Figure 7: Employment along several important renewable value chains (Source: IRENA, 2020)[9]

[9] Source: IRENA (2020), Post-COVID recovery: An agenda for resilience, development and equality, https://www.irena.org/publications/2020/Jun/Post-COVID-Recovery

The distribution of jobs across segments of the renewable energy value chain depends on both technology and location. Figure 8, below, shows this distribution for solar PV, wind, and bioenergy.

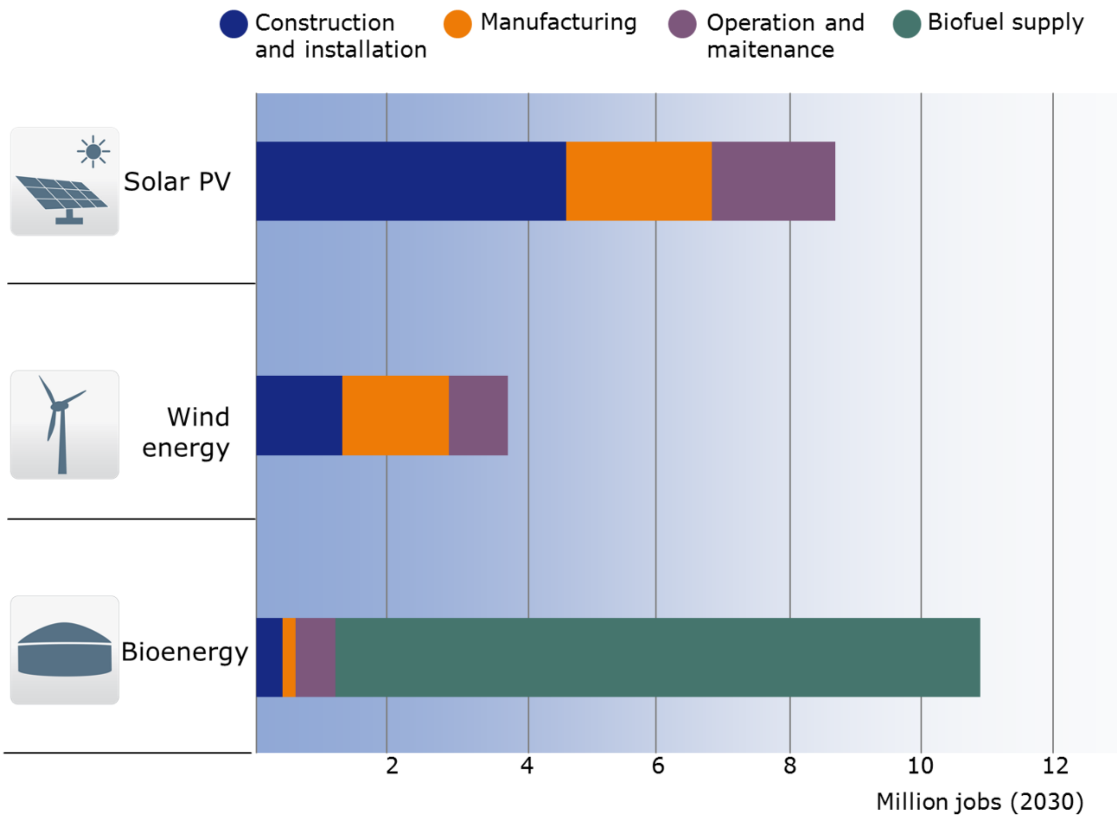

Figure 8: Distribution of jobs in solar PV, wind and bioenergy, by segment of the value chain: Transforming Energy Scenario 2030 (Source: IRENA, 2020)[10]

[10] Source: IRENA (2020), Global Renewables Outlook: Energy Transformation 2050, https://www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020.

4 Preparing Future Employees: Training and Skills Development

4.1 The Global View (The IRENA Study[11])

Learning objectives: Upon completion of this page, you should be able to

- list the skills base factors which are necessary to support the energy transition from fossil fuels to renewables
- discuss how renewable energy can be taught effectively, at different levels of education
- illustrate one way in which training initiatives are critical to the deployment of renewable energy

As the renewable energy workforce continues to expand, education, training, reskilling, and upskilling are all increasingly important (see figure 9). Building the skills base necessary to support the ongoing global energy transition from fossil fuels to renewables requires policies and programmes which centre on more vocational and teacher training, stronger curricula, the expanded use of information and communications technology (ICT) for remote learning, public-private partnerships, and the recruitment of women and workers from other under-represented groups.

Renewable energy can be better integrated into national curricula – not only in science and technology, but also in social studies – for students in primary, secondary and tertiary education, as well as for technical and vocational students. At all levels, effective teaching requires that teachers and trainers have good knowledge of the renewable energy sector. Industry leaders can play a major role in imparting such knowledge, and in educating the workforce of the future.

In the area of expanding access to modern forms of energy, the chronic shortage of skilled workers could constitute a major barrier to the deployment of renewables. Installations which are built by unskilled workers can result in performance issues, and (ultimately) a negative perception of renewable technologies. Training initiatives are critical to avoiding such outcomes.

[11] Source: IRENA (2020), Renewable Energy and Jobs – Annual Review 2020, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Sep/IRENA_RE_Jobs_2020.pdf

Figure 9: Global renewable energy employment by technology, 2012-2019 (Source: IRENA, 2020)

4.2 Existing Demand for Different Types of Renewable Energy Jobs and Qualifications

Learning objectives: Upon completion of this page, you should be able to

- recognise which types of jobs and qualifications are most needed in the renewable energy industry
- classify types of jobs and qualifications, according to their demand within the solar PV energy sector
- summarise how these job and qualification patterns can be used by governments

The renewable energy sector offers employment to people from a wide range of professional backgrounds and experience. Although there is demand for professionals trained in the science, technology, engineering and mathematics (STEM) fields, and for other highly qualified individuals (e.g. lawyers, logistics experts, marketing professionals, financial analysts, and regulation and standardisation experts), most jobs (e.g. construction and factory work) do not require a university degree.[12]

The greatest demand from the renewable energy sector as a whole will be for factory workers and technicians. For solar PV and onshore wind facilities, over 60% of the workforce needs only minimal training, including factory and construction workers (see the figure, below). A smaller proportion of STEM degree professionals (30%) is required. Non-STEM professionals account for 5%, and

[12] Source: IRENA (2017), Renewable energy benefits: Leveraging local capacity for solar PV, International Renewable Energy Agency, Abu Dhabi. IRENA (2018), Renewable energy benefits: Leveraging local capacity for onshore wind, International Renewable Energy Agency, Abu Dhabi; IRENA (2018), Renewable energy benefits: Leveraging local capacity for offshore wind, International Renewable Energy Agency, Abu Dhabi.

administrative personnel for 1-4%. In offshore wind, the distribution is similar: those with less formal skills and training again represent the largest share of employment (47%). The low threshold of skills for many of these jobs opens doors to employment for many people, particularly where on-the-job training is available. Furthermore, certain skill sets can be leveraged from other domestic industries, with some retraining.

These skills and occupational patterns are important markers that can guide governments as they allocate public investment budgets, shape the contours of industrial policy measures, and try to match the demand and supply of skills via labour market policies – all to accelerate the energy transition.

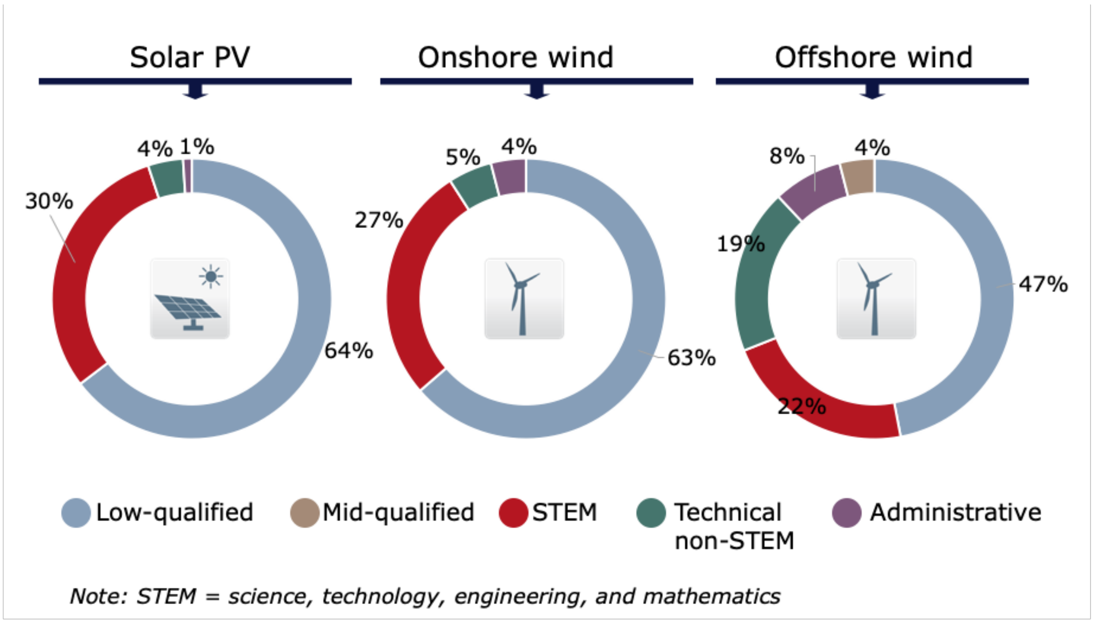

Figure 10: Human resource requirements for workers in solar PV and wind energy (IRENA, 2017; IRENA 2018)[13]

[13] Source: IRENA (2017) Renewable energy benefits: Leveraging local capacity for solar PV, International Renewable Energy Agency, Abu Dhabi; IRENA (2018), Renewable energy benefits: Leveraging local capacity for onshore wind, International Renewable Energy Agency, Abu Dhabi; IRENA (2018), Renewable energy benefits: Leveraging local capacity for offshore wind, International Renewable Energy Agency, Abu Dhabi.

4.3 Creating Future Renewable Energy Jobs

Learning objectives: Upon completion of this page, you should be able to

- identify which types of renewable energy jobs are most likely to be created in future
- describe how the types of jobs most likely to be created for solar technologies differ from those for wind technologies

An IRENA analysis has shown that the energy transition must also take into account existing skills and potential skill gaps.[14] Figure 11, below, shows the types of jobs which are likely to be created – classified into broad occupational requirements. Information is provided for a subset of renewable energy technologies (solar PV, solar water heaters, onshore wind, offshore wind, and geothermal) in 2030, under the Transforming Energy Scenario. Combining the technologies, a total of 15.5 million created jobs can be broken down into: workers and technicians (77%), experts (10%), engineers and others with advanced degrees (9%), and marketing and administrative personnel (3%).

For both solar technologies, 80% of jobs would be for workers and technicians, 9% for experts, 8% for engineers and others with advanced degrees, and less than 3% for marketing and administrative personnel. There are significant differences between the two solar technologies, with workers and technicians accounting for 95% of jobs related to solar water heaters and 76% for PV.

The share of workers and technicians for wind and geothermal is 68% and 86%, respectively. Comparing wind with solar PV, the share of workers and technicians is lower (68% versus 76%), whilst share of experts is higher (14% versus 11%), as is that of engineers and those with higher degrees (12% versus 11%) and marketing and administrative personnel (6% versus 3%).

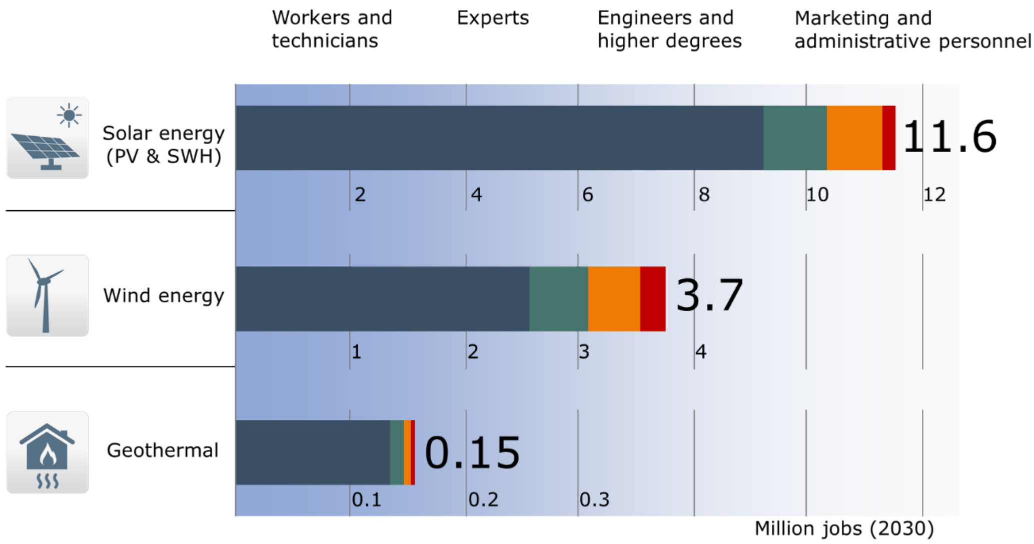

Figure 11: Distribution of solar, wind and geothermal energy jobs in 2030, under the Transforming Energy Scenario – by occupational requirements (IRENA, 2020)[15]

[14] Source: IRENA (2020), Global Renewables Outlook: Energy Transformation 2050, https://www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020.
[15] Source: IRENA (2020), Global Renewables Outlook: Energy Transformation 2050, https://www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020.

4.4 Enhancing Education and Training for Renewable Energy Jobs

Learning objectives: Upon completion of this page, you should be able to

- summarise the necessary factors to develop high quality education and training programmes
- specify how skills development can meet the needs of the renewable energy sector via technical and vocational education and training (TVET)
- identify how renewable energy education and training could be enhanced further, using the example of Vietnam

The development of adequate education and training programmes can help minimise skills gaps in the renewable energy industry. Such development includes monitoring how skills profiles evolve and identifying potential skills gaps. It also involves educational institutions working together with the renewable energy industry, in order to address any mismatches between skill-building profiles and the inventory of skills required by the energy transition.

TVET institutions need financial and technical support, to ensure a high degree of training quality. Curriculum standards must keep pace with the skills needed in a continuously evolving renewable energy sector. Instructors must receive training as needed. Equipment must be kept up to date, and information and communications technologies must figure prominently. To ensure that skills development meets the needs of the renewable energy sector, TVET training in manufacturing, in particular, should move beyond skills such as metal working and welding to train workers in areas such as advanced material development and digital design.

A COBENEFITS study has shown that Vietnam is a good example of renewable companies emphasising that they are willing to recruit skilled local workers, if the training provided by universities and technical schools is aligned with the technical skills demanded by the renewables sector (see figure 12).[16] In Vietnam there is currently a lack of appropriate formal training for the sector. Although many electrical engineers are graduating from Vietnamese universities, they still frequently lack the requisite knowledge to work with renewable energy technologies and systems. Vocational training schools are also not yet equipped to provide specialised renewable energy training.[17] A periodic update of curricula and university programmes is necessary, in order for Vietnam to keep pace with the skills needed in a continuously evolving renewable energy sector.

[16] Source: COBENEFITS (2020), Future skills and job creation through renewable energy in Vietnam, https://www.cobenefits.info/resources/future-skills-and-job-creation-through-renewable-energy-in-vietnam.
[17] Source: COBENEFITS (2020), Future skills and job creation through renewable energy in Vietnam, https://www.cobenefits.info/resources/future-skills-and-job-creation-through-renewable-energy-in-vietnam.

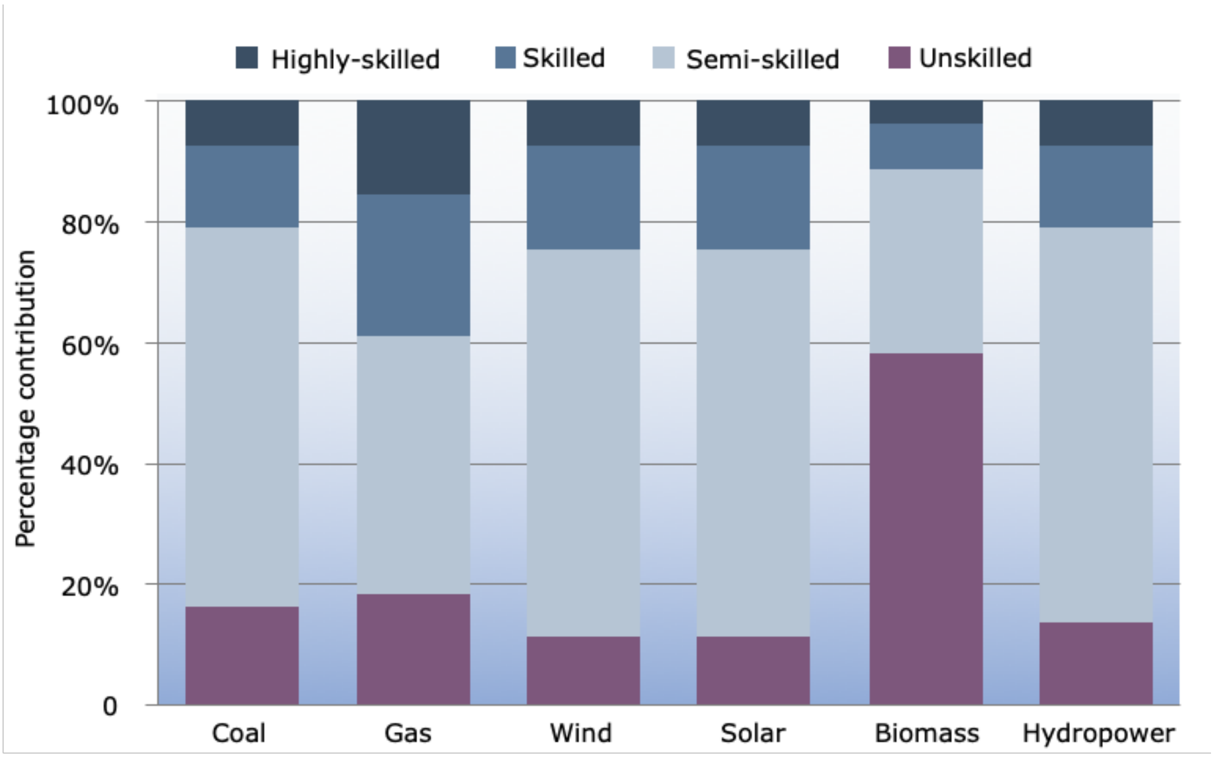

Figure 12: Expected skill attainment levels for each prower generation source during the O&M phase in Vietnam (COBENEFITS, 2019)

4.5 Reskilling Workers from the Fossil Fuel Industry

Learning objectives: Upon completion of this page, you should be able to

- explain why the reskilling of fossil fuel workers is important
- describe what is involved in evaluating the reskilling needs of fossil fuel workers
- identify how South Africa would benefit from the reskilling of its fossil fuel workers

Although the energy transition from fossil fuels to renewable energy will have an overall net-positive impact on employment, millions of fossil fuel workers will need to find new jobs (see figure 13).

Policies for a just transition can facilitate the process of retraining fossil fuel workers at risk. To enable this, the reskilling needs of fossil fuel workers must be evaluated so that financial support can be provided to help them acquire new skills. Evaluation should include assessments of skills that are transferable from fossil fuel industries to the renewable energy sector. This will help to determine how many workers could switch careers within the energy sector. Some skills are readily transferable (e.g. from offshore oil and gas to offshore wind), but reskilling assistance may still be needed.

South Africa, for example, will need detailed age and skills-profile data on power station and coal mine workers, in order to reskill them. This is because most workers will be reaching retirement age around the same time that the majority of coal-fired power plants are reaching the end of their assumed lifespans, and the associated mines will be facing closure. Therefore, redeployment, early retirement, and retraining costs can only be assessed via more detailed information, and by acknowledging the pending loss of coal infrastructure employment. South Africa could assess the renewable energy potential of its coal-producing regions, as deploying renewables there could generate employment and economic activities. Policy makers could plan location-specific renewable energy auctions in former coal regions, and create economic incentives to strategically move future industries to these areas.[18]

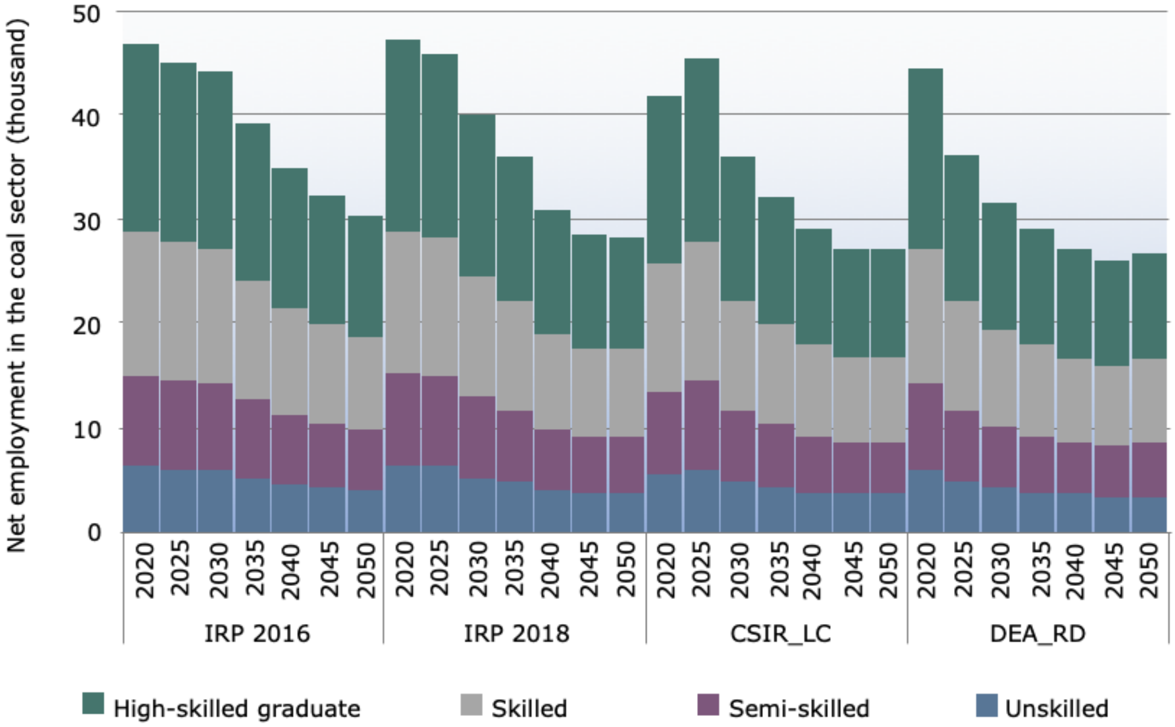

Figure 13: Evolution of the total net employment in the coal sector for four different scenarios (IRP 2016, IRP 2018, CSIR_LC and DEA_RD) (including mining and transport) by skill attainment level (COBENEFITS, 2019)

[18] Source: COBENEFITS (2020), Future skills and job creation through renewable energy in South Africa, https://www.cobenefits.info/resources/cobenefits-south-africa-jobs-skills.

5 The Employment Effects of Renewable Energy Deployment in Selected Countries: Three Case Studies

5.1 Introduction: COBENEFITS Analysis to Quantify Employment Benefits[19]

Learning objectives: Upon completion of this page, you should be able to

- discuss country-specific assessments of employment impacts of renewable energy
- list four reference policy scenarios used in the co-benefit assessment studies

The COBENEFITS project details the country-specific co-benefits of climate policies, with an emphasis on the opportunities presented by renewable power generation in the target countries. The project also connects the social and economic opportunities of renewable energy to climate change mitigation roadmaps. Studies on renewable energy related employment benefits were carried out in Vietnam, South Africa, Turkey[20], Mexico[21] and India. A set of reference policy scenarios (RPS) was compiled for each target country, to serve as a basis for the co-benefit assessment studies being carried out (see figure below). In this course we will have a look at the three case studies India, South Africa and Vietnam.

The RPS were selected and compiled based on four criteria:

1. Connecting power generation capacities (i.e. energy policy) with the greenhouse gas emissions pathways (i.e. climate policy) that are relevant to NDC implementation and re-formulation.
2. Checking the connectivity and comparability between official climate change and energy policies (existing or being considered), strategies, or roadmaps, in order to ensure that the resulting assessments are relevant.
3. Comparing an array of ambition levels in national climate and (renewable) energy policy, including how high(er)-ambition NDC implementation and re-formulation perform socio-economically.
4. Ensured suitability as a basis for the calculation of scientifically sound quantitative socio-economic impact assessments.

The process also included the definition of time periods and reference years for the RPS set in each country, based on respective policy cycles and planning periods until 2050, with a focus on shorter-term effects (up to 2035).

[19] Source: COBEFITS (2020), Future skills and job creation with renewable energy in India, https://www.cobenefits.info/resources/future-skills-and-job-creation-with-renewable-energy-in-india/
[20] Source: COBENEFITS (2020), Executive Report in Turkey, https://www.cobenefits.info/wp-content/uploads/2019/11/COBENEFITS-Turkey_Employment_ExecReport_200611.pdf

[21] Source: COBENEFITS (2020), Executive Report in Mexico, https://www.cobenefits.info/wp-content/uploads/2020/04/CoBeneficios-Espanol-200330.pdf

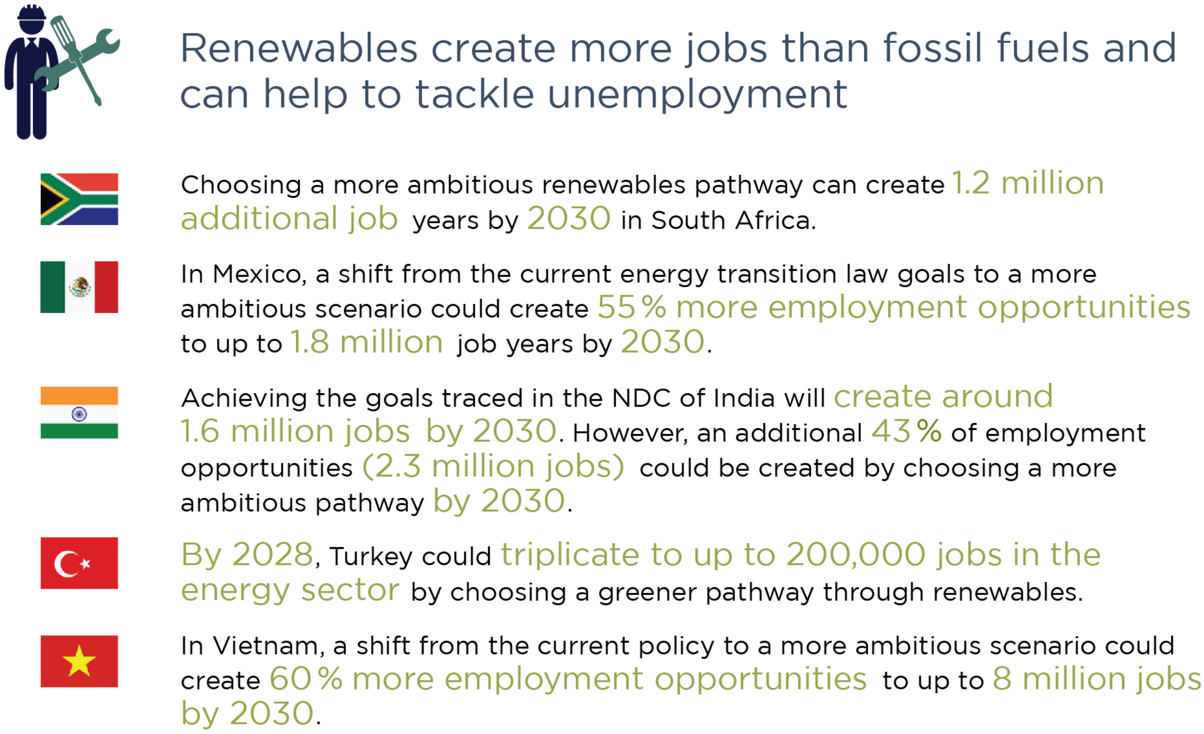

Figure 14: Important results from the assessment studies in the target countries (Source: COBENEFITS, 2019)

5.2 Case Study One: India[22]

Learning objectives: Upon completion of this page, you should be able to

- state where most of the recent renewable energy employment potential has occurred, globally
- recognise how distributed renewable energy technologies are most likely to create employment in India
- demonstrate why the Indian solar energy sector, in particular, will benefit from the reskilling of the fossil fuel work force

In 2019, employment in renewable energy worldwide was estimated at 11.5 million (up from 11 million in 2018). Women hold 32% of these jobs. Most jobs have been created in a small number of countries, but employment benefits are emerging more widely, especially regarding the deployment of solar PV technologies. Asia now accounts for 63% of the total jobs in renewables, globally.[23]

Within the context of the COBENEFITS project, a study was carried out in India which analysed the employment effects of various power generation expansion plans, nationally. The aim was to assess the co-benefits[24] of a low-carbon energy transition in the country.

[22] Source: Cobenefits (2020), What we do, https://www.cobenefits.info/our-work/what-we-do.
[23] Source: IRNEA (2020), Renewable Energy and Jobs – Annual Review 2020, https://www.irena.org/publications/2020/Sep/Renewable-Energy-and-Jobs-Annual-Review-2020
[24] The term 'co-benefits' refers to simultaneously meeting several interests or objectives via political intervention, private sector investment, or a mix of the two (Helgenberger et al., 2019). It is essential that the co-benefits for mitigating climate change are mobilized strategically, in order to accelerate the transition to low-carbon energy (Helgenberger et al., 2017).

The key policy messages of the study are as follows:

1: India can significantly boost its levels of employment by increasing its share of renewables. Renewable energy technologies tend to be more labour intensive than technologies for conventional energy, and by 2050 more than 3.5 million people could be employed in the renewable energy sector - five times the number of people currently employed in the Indian fossil-fuel sector.

2: Distributed renewable energy technologies - such as small hydro, rooftop solar, and biomass - create up to 25 times more employment, for every MW of installed capacity, than power generation based on fossil fuels. Policy makers should consider the strong advantage distributed renewable energy technologies hold, in order to accelerate employment creation in the renewable energy sector.

3: Reskilling the workforce is crucial to transitioning from a traditional economy to a green economy, in order to ensure employability in the emerging green power technologies. By 2050, the solar sector is expected to require a total of 256,000 skilled, 320,000 semi-skilled, and 570,000 unskilled people[25].

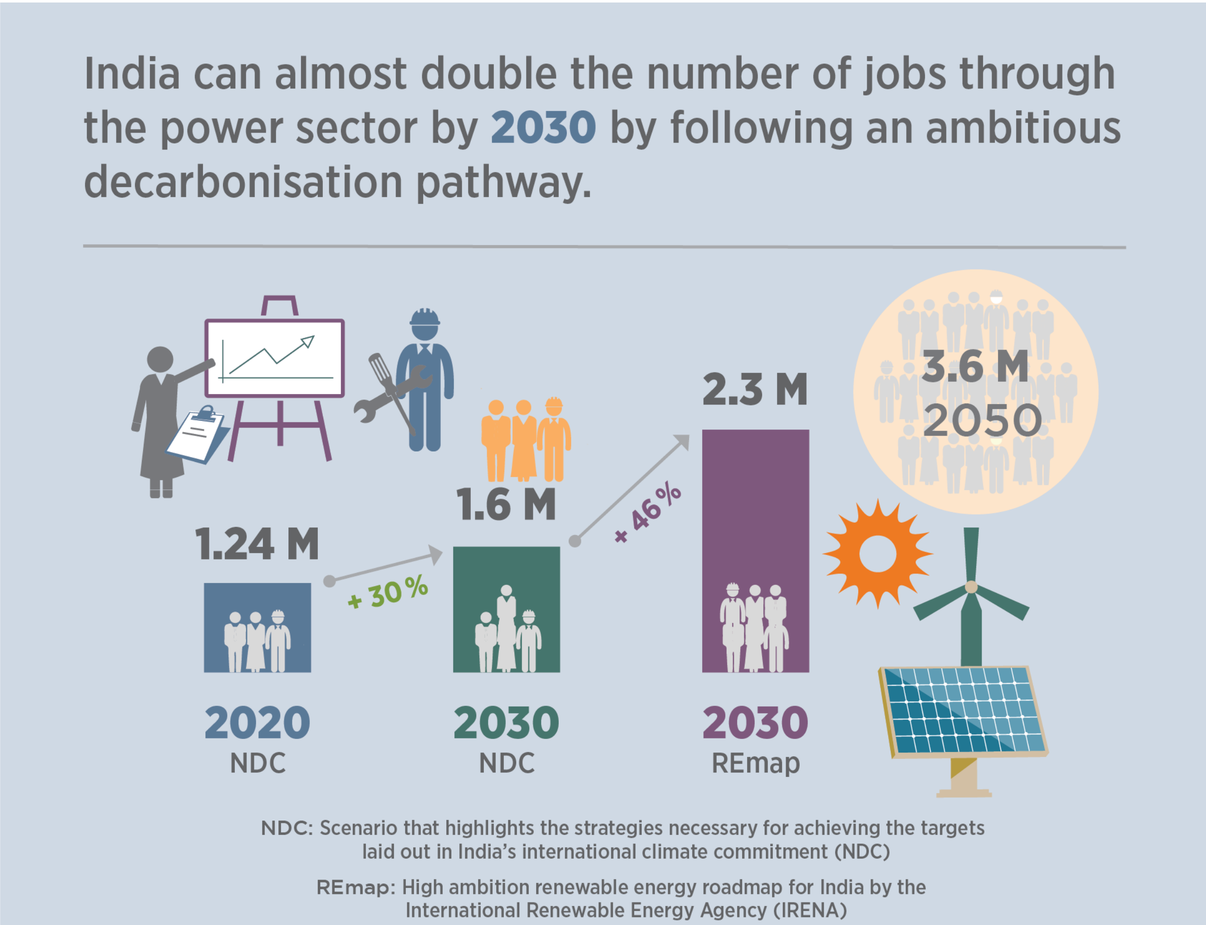

Figure 15: The renewable energy sector will be the largest employee in the future Indian power sector. (COBENEFITS, 2019)

[25] Under the REMap Scenario.

5.3 Case Study Two: South Africa[26]

Learning objectives: Upon completion of this page, you should be able to

- detail how South Africa can boost its employment levels by increasing its share of renewables
- identify the type of renewable energy work most likely to be created in South Africa
- examine how South Africa's declining coal sector should be managed during the energy transition

The key policy messages of the study are as follows:

1: South Africa can significantly boost its levels of employment by increasing its share of renewables. With its decision to scale up renewables, by moving from IRP 2016 to IRP 2018, employment (measured in job years) can be expected to increase by an additional 40% in the next 10 years. This number could even be doubled, by following CSIR's least cost pathway.

2: About 70% of jobs created by the shift towards renewable energy occur in fields which require a high level of skills (> Grade 12). This growth is most distinct in DEA's rapid decarbonisation pathway, and in CSIR's least cost pathway, both of which should reach a share of 76% in 2050.

3: Coal sector employment is expected to decline, regardless of the shift towards renewable power generation, with a 35-40% decline happening between 2020 and 2050. However, the transition process should be managed sensitively by policy makers, in order to mitigate the negative impacts on affected workers and communities.

[26] Source: COBENEFITS (2020), Future skills and job creation through renewable energy in South Africa, https://www.cobenefits.info/resources/cobenefits-south-africa-jobs-skills.

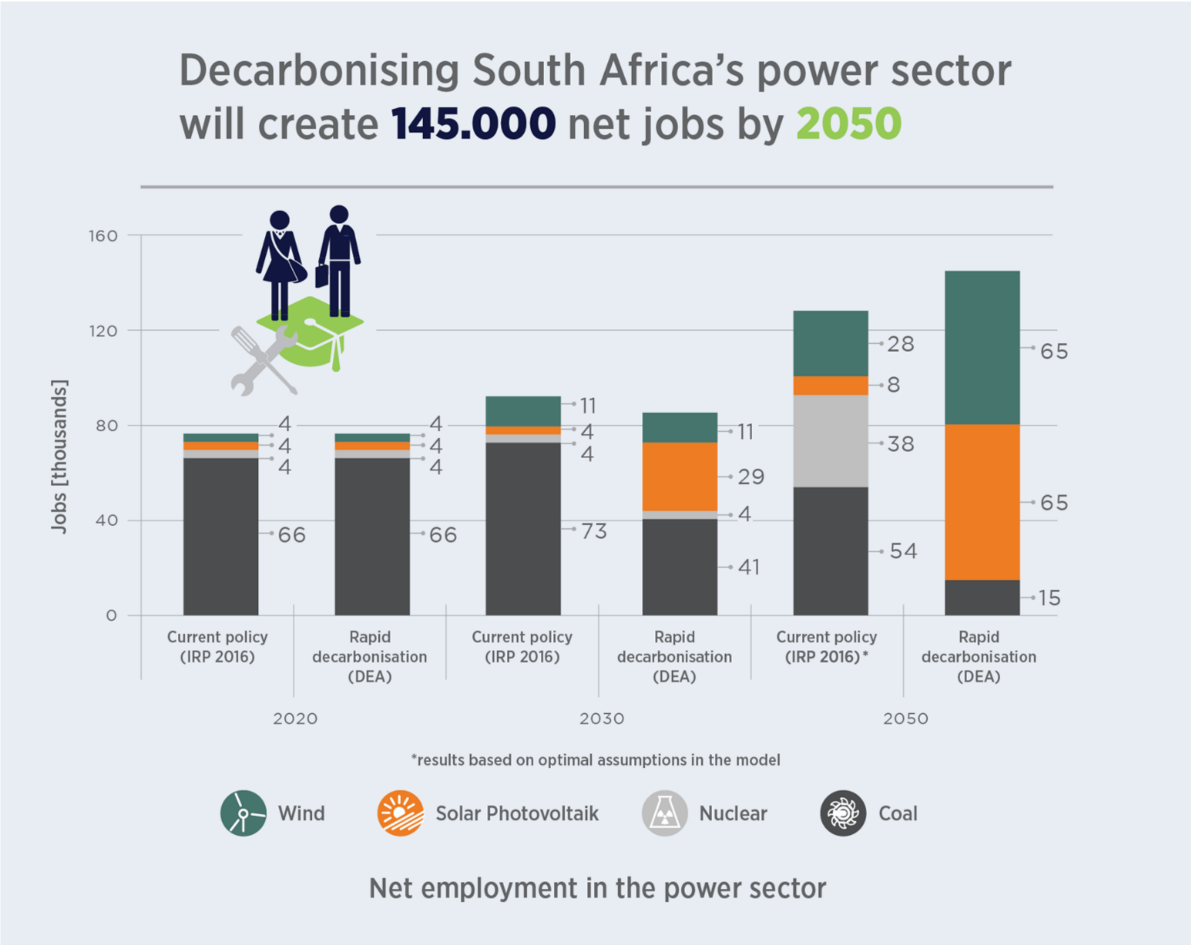

Figure 16: Decarbonising South Africa's power sector creates 145,000 net jobs by 2050 (COBENEFITS, 2019)

5.4 Case Study Three: Vietnam[27]

Learning objectives: Upon completion of this page, you should be able to

- list the steps required to fill jobs in the wind and solar sectors in Vietnam
- examine how the Vietnamese government can encourage a just transition to low-carbon energy
- illustrate how jobs per MW capacity will double in Vietnam, if coal power plants are replaced with solar plants or wind farms

The key policy messages of the study were as follows:

1: With the Vietnamese government's decision (in its current power sector plan: PDP7 rev) to increase the country's share of renewables from 6% to 10.7% by 2030, the way is paved to create 315,000 job-years via the power sector. With renewables creating twice as many jobs as the fossil-fuel sector, per

[27] Source: COBENEFITS (2020), Future skills and job creation through renewable energy in Vietnam, https://www.cobenefits.info/resources/future-skills-and-job-creation-through-renewable-energy-in-vietnam.

average installed MW, the government can further boost employment by adopting a more ambitious low-carbon power sector plan.

2: Around 25% of the jobs created in wind and solar are for highly skilled workers. Over the next decade, this tendency towards a need for highly skilled workers is expected to increase. Training capacity in universities and technical schools needs to be reconciled with this development, in order to create optimum employment and to meet the expected demand.

3: The government can actively manage a just transition to low-carbon energy sources, by reshaping vocational training curricula and university programmes to suit the new world of renewable energy, while supporting workers and communities situated in the coal power generating regions of the country, such as the Mekong Delta.

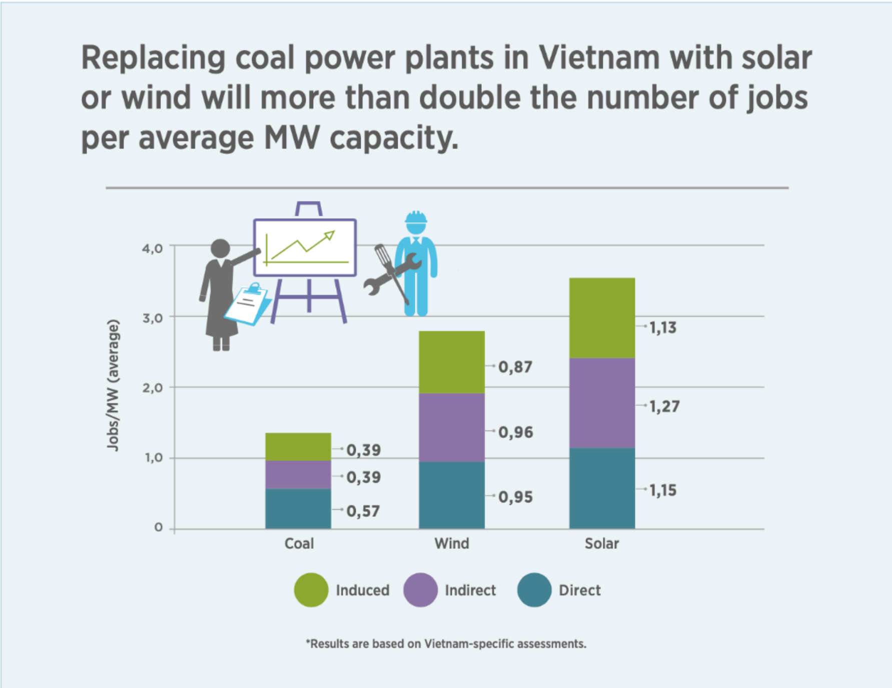

Figure 17: Jobs in Vietnam double, per average MW capacity, when coal power plants are replaced by solar or wind power installations (COBENEFITS, 2020)

6 Summary

The course has demonstrated the significance of employment impacts as a co-benefit of renewable energy, and has introduced methodologies for calculating these. An overview of the different renewable energy employment categories was provided in the first part of the course, and the importance of being precise and distinguishing between analytical levels in calculating employment impacts was shown. **Direct, indirect and induced employment effects** should be considered to account for job gains or losses arising directly from a renewable energy activity, indirectly in related input sectors, or as induced jobs in sectors not directly related to renewable energies.

An overview of how the energy transition to renewables can best be handled highlighted the importance of educating and training new workers, and reskilling or upskilling current fossil fuel workers. It also indicated how much benefit can be gained from sensitively managing the transition for fossil fuel workers with transferable skills, in particular.

Finally, the course provided insight into the COBENEFITS reference policy scenarios[28], as a tool for assessing the co-benefits of climate policies around the world. It also described three case studies carried out in three different countries, to demonstrate different ways of making a successful transition from fossil fuels to renewable energy, in terms of both employment and other socio-economic factors.

6.1 References (cited)

IASS/CSIR, 2019. Future skills and job creation through renewable energy in South Africa. Assessing the co-benefits of decarbonising the power sector. Potsdam/Pretoria: IASS/CSIR, 2019. DOI: 10.2312/iass.2019.009.

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IRENA, 2020: The post-COVID recovery: An agenda for resilience, development and equality. Abu Dhabi, https://www.cobenefits.info/wp-content/uploads/2019/03/COBENEFITS-Study-South-Africa-Employment.pdf

6.2 Further reading (recommendations)

IRENA, 2012. Renewable Energy Jobs and Access. Available in:

https://www.irena.org/publications/2012/Jun/Renewable-Energy-Jobs--Access-2012

[28] Source: COBENEFITS (2020), Future skills and job creation with renewable energy in India, https://www.cobenefits.info/resources/future-skills-and-job-creation-with-renewable-energy-in-india/

ILO, 2013. Methodologies for assessing green jobs, Policy brief, February 2013. Available in: https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_176462.pdf

6.3 Additional glossary terms

e.g.

term *(can be left blank in the case of an abbreviation)*	**abbreviation** *(if applicable)*	**definition**	**source**
	CSIR	Council for Scientific and Industrial Research	
	DAQ	Data Acquisition Module: The automatic collection of data from sensors, instruments and devices: in a factory, laboratory or in the field.	own definition *(only if no other source can be found, try to avoid this!)*
International Resource Panel	IRP		https://www.unenvironment.org/explore-topics/resource-efficiency/what-we-do/international-resource-panel
Nationally Determined Contribution	NDC	Nationally determined contributions (NDCs) are at the heart of the Paris Agreement and the achievement	https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs/nationally-determined-contributions-ndcs

		of these long-term goals. NDCs embody efforts by each country to reduce national emissions and adapt to the impacts of climate change.	
Technical and vocational educational training	TVET	Education, skills and skills development relating to a wide range of occupational fields, production, services and livelihoods.	https://unevoc.unesco.org/home/TVETipedia+Glossary/