COBENEFITS STUDY

October 2019

Future skills and job creation through renewable energy in Vietnam

Assessing the co-benefits of decarbonising the power sector

Executive report

GreenID   IASS POTSDAM   IET International Energy Transition   COBENEFITS

COBENEFITS Study Vietnam

This study has been realised in the context of the project "Mobilising the Co-Benefits of Climate Change Mitigation through Capacity Building among Public Policy Institutions" (COBENEFITS). This print version has been shortened and does not include annexes. The full version of this report is available upon request.

This project is part of the International Climate Initiative (IKI). The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supports this initiative on the basis of a decision adopted by the German Bundestag. The COBENEFITS project is coordinated by the Institute for Advanced Sustainability Studies (IASS, Lead) in partnership with the Renewables Academy (RENAC), Independent Institute for Environmental Issues (UfU), International Energy Transition GmbH (IET) and in Vietnam the Green Innovation and Development Centre (GreenID).

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INTERNATIONAL CLIMATE INITIATIVE (IKI)

COBENEFITS of the new energy world of renewables for the people in Vietnam

Vietnam is in the midst of an energy transition, with important social and economic implications depending on the pathways that are chosen. Vietnam's chosen energy pathway will define the basis for its future development, including economic prosperity, business and employment opportunities as well as people's health. At the same time, current policy and investment decisions in Vietnam's energy sector will have a substantial impact on combatting global warming and securing the livelihoods of people in Vietnam and elsewhere.

In view of the social and economic implications of the course set by the Government of Vietnam, political decisions on Vietnam's energy future link the missions and mandates of many government departments and agencies beyond energy and power, such as environment, health, labour as well as green industrial development and investments. Hence, the timely debate on Vietnam's energy future boils down to a single question:

How can renewables improve the lives of the people of Vietnam?

Employing scientifically rigorous methodologies and the most recent technical data, the study at hand contributes to answering this question. It also provides guidance to government departments and agencies on further shaping the enabling political environment to unlock the social and economic co-benefits of the new energy world of renewables for the people of Vietnam. Under their shared responsibility, the Green Innovation and Development Centre (GreenID), as the COBENEFITS Vietnam Focal Point, together with the Institute for Advanced Sustainability Studies (IASS) invited ministries and government agencies such as MONRE, MOIT, MPI, MOLISA, MoH and VUSTA to join the COBENEFITS Council Vietnam to provide guidance to the COBENEFITS Assessment studies along with the COBENEFITS Training Programme and Enabling Policies Roundtables. Since its constitution in August 2017, the COBENEFITS Council Vietnam has guided the programme in framing the topics of the COBENEFITS Assessment for Vietnam and in ensuring their direct connection to the current political deliberations and policy frameworks of their respective ministries.

We are also indebted to our highly valued research and knowledge partners, for their unwavering commitment and dedicated work on the technical implementation of this study. This COBENEFITS study was facilitated through financial support from the International Climate Initiative (IKI) of Germany.

Vietnam, among 185 parties to date, has ratified the Paris Agreement to combat climate change and provide current and future generations with opportunities to flourish. With this study, we seek to contribute to the success of this international endeavour by offering a scientific basis for harnessing the social and economic co-benefits of building a low-carbon, renewable energy system while facilitating a just transition, thereby *making the Paris Agreement a success for the planet and the people of Vietnam.*

We wish the reader inspiration for the important debate on a just and sustainable energy future for Vietnam!

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Executive Summary

COBENEFITS

Future employment in Vietnam's power sector

Assessing the co-benefits of decarbonising the power sector

Vietnam has the opportunity to transition towards low-carbon planning pathways within the power sector that emphasise the uptake of renewable energy technologies – especially solar and wind, which are experiencing rapid cost declines in Vietnam and globally. However, the impact on employment, both in the power sector and more widely, needs to be effectively understood and prepared for by various actors and decision makers in the country.

This study analyses the employment impacts of various scenarios for expanding electricity generation in Vietnam's power sector; this was carried out in the context of the COBENEFITS project with the aim of assessing the co-benefits[1] of a low-carbon energy transition in the country. Four scenarios are analysed for the future development of the power sector in Vietnam: Ministry of Industry and Trade (MOIT) revised seventh Power Development Plan (PDP 7 (rev)); Danish Energy Agency Stated Policy (DEA Stated Policies); Asian Development Bank "Pathways to low-carbon development for Vietnam" low-carbon scenario (ADB Low-Carbon); and the Green Innovation and Development Centre (GreenID) Base and Renewable Energy (Base & Renew En) scenario.

This report presents the resulting employment effects, presuming that the electricity sector focuses on all power generation technologies outlined in the government's official power sector plan. It also provides an initial assessment of the skill requirements, attainment levels and technical training required for Vietnam's present power sector plans and future low-carbon power sector ambitions. The four scenarios consider timelines consistent with MOIT's reporting of the PDP 7 (rev) scenario, which is between the years 2015 and 2030.

- **Key policy message 1:** With the decision by the Vietnamese Government to increase the share of renewables from 6% to 10.7% in the current power sector plan (PDP 7 rev), the government paved the way to creating 315,000 job-years through the power sector by the year 2030. With renewables creating twice as many jobs as the fossil-fuel sector per average installed MW, the government can further boost employment by adopting a more ambitious low-carbon power sector plan.
- **Key policy message 2:** For wind and solar, around 25% of jobs created are for high-skilled workers. The tendency for high-skilled workers in the power sector is expected to further increase over the next decade in Vietnam. Therefore, the training capacities at universities and technical schools need to be reconciled with this development, in order to create employment in Vietnam and to meet the expected demand in the country.
- **Key policy message 3:** The government can actively manage a just transition to low-carbon energy sources by redeveloping vocational training curricula and university programmes towards the new energy world of renewables while supporting affected workers and communities domiciled in the coal-power-generating regions of the country, such as the Mekong Delta.

[1] The term "co-benefits" refers to simultaneously meeting several interests or objectives resulting from a political intervention, private sector investment or a mix thereof (Helgenberger et al., 2019). It is thus essential that the co-benefits of climate change mitigation are mobilised strategically to accelerate the low-carbon energy transition (IASS 2017b).

KEY FIGURES:

- Replacing coal power plants with solar or wind will more than double the number of jobs per average MW capacity. Replacing coal with gas alone will lead to job losses of around 0.5 job losses per average installed MW.
- Up to 1.94 million job-years can be created in the country through the power sector transformation between 2015 and 2030.
- Over that 15-year period, solar and wind will create 3.5 jobs and 2.8 jobs respectively per average installed MW capacity, whereas coal creates only 1.4 jobs.
- Across all scenarios, around 80% of the jobs created in the power sector by the year 2030 are in construction and installation.

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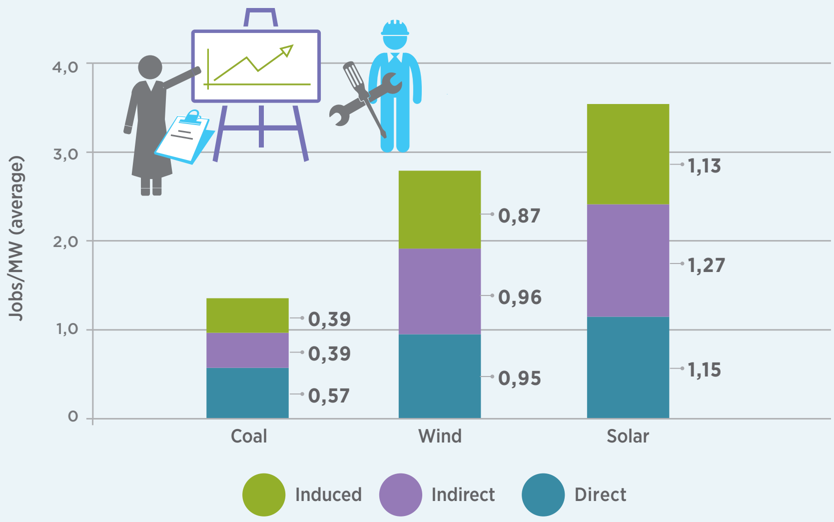
Future skills and job creation through renewable energy in Vietnam.
Assessing the co-benefits of decarbonising the power sector

available on www.cobenefits.info

KEY FINDINGS:

- **For each direct job created in the power sector in Vietnam, two additional jobs (indirect & induced) are created in the country irrespective of the scenario assessed.** More than 60% of jobs created through changes in the power sector are positive-increase employment opportunities in the broader Vietnamese economy.
- **In the ambitious renewable energy (RE) scenario by GreenID, solar and wind power contribute over 20% of the jobs created in the power sector by 2030**; coal and hydropower are established technologies in Vietnam and are projected to constitute about 60% of gross employment in the power sector.
- **A shift to Green ID's ambitious RE scenario (Base & Renew En) will increase gross employment in the RE sector to approximately 434,000 job-years between 2015 and 2030**, a 38% increase from the PDP 7 (rev) scenario of 315,000 job-years. These jobs are created in the solar, wind and biomass sectors.
- **By the year 2030, the demand for higher-skilled workers in the power sector is expected to grow by 31% for jobs during the construction and installation phase, and 25% for jobs in operation and maintenance.** This change is partially associated with the growth in demand for RE sources, especially solar and wind, which have lower demand for unskilled or low-skilled labour during the construction and installation phases.
- **There is still limited availability of local technical expertise in the solar and wind power sector.** To meet the present demand, project developers in the power sector currently recruit engineers who are not specifically trained for the renewable energy sector, or else rely on foreign-trained experts. However, RE companies are willing to recruit skilled local workers if training at Vietnamese universities and technical schools is aligned with the technical skills demanded in the RE sector.

Replacing coal power plants in Vietnam with solar or wind will more than double the number of jobs per average MW capacity.



*Results are based on Vietnam-specific assessments.

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1. Initiating a discussion on employment impacts of various power sector plans in Vietnam

KEY POINTS:

- The Vietnamese Green Growth Strategy (VGGS) and Nationally Determined Contributions (NDC) to the implementation of the Paris Agreement, amongst other national economic planning documents, suggest and establish the need for a transition in the country's energy sector to a low-carbon pathway.
- Changing the structure of the power generation mix is, therefore, a key factor for a broad energy transition. Understanding the employment impacts of this shift to low-carbon power generation (especially with the use of renewable energy sources) is, hence, imperative to mobilising efforts for a just energy transition.
- This study therefore assesses the gross employment impacts of various power generation scenarios based on differing contributions of renewable energy. It also provides a comprehensive case study analysis of the skills required to drive this transition in the power sector.

Climate change and the search for appropriate strategies and measures for mitigation and adaptation have become a major worldwide concern in recent years. As also seen in many other countries, the power sector in Vietnam has grown to become the country's largest source of greenhouse gas (GHG) emissions, and must be considered when proposing necessary mitigation actions or measures (cf. Figure 1).

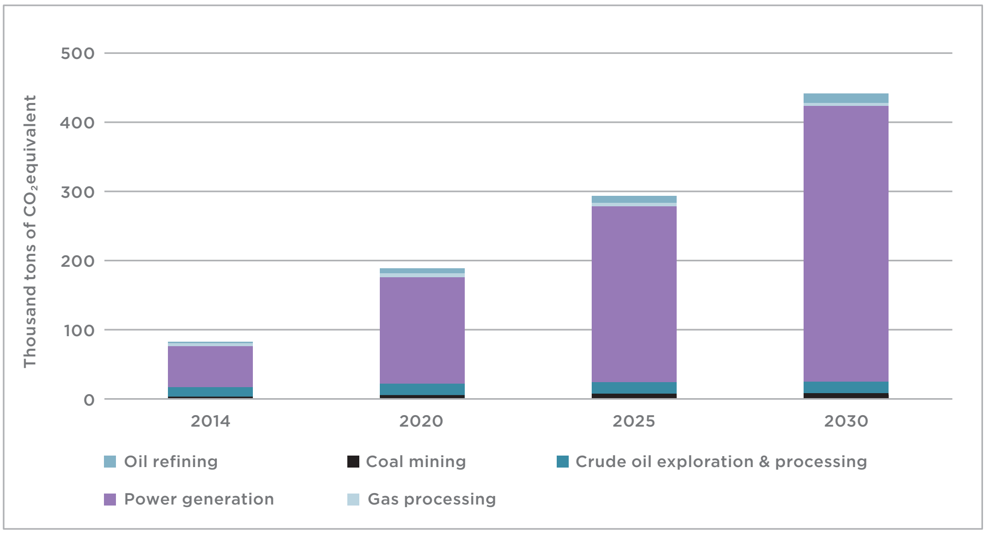

Figure 1: GHG emissions from energy supply in Vietnam in thousand tons CO_2eq

Source: Nguyen et al., 2018

Through various government ministries, the Vietnamese Government has shown commitment to reducing emissions from the power sector. Plans such as the Vietnamese Green Growth Strategy (VGGS), the Nationally Determined Contributions (NDC) to the implementation of the Paris Agreement and the specification and implementation of the Sustainable Development Goals (SDG) have been concretised to drive this transition further, irrespective of present setbacks. The first strategic task of the VGGS is to reduce the intensity of GHGs and promote the use of renewable energy (RE) in the power sector. Additionally, with the SDG plan, Vietnam currently aims to increase the share of renewables in the total national consumption of primary energies, more specifically to reach 32.3% by 2030. Furthermore, Vietnam's Updated NDC targets a 27% reduction compared to the Business As Usual (BAU) scenario, with international support (9% without). Achieving this, however, requires an increased share of low-carbon technologies (specifically REs) in the power sector.

Declining costs and technological improvements in renewable energy (RE) have driven a shift in the global energy sector in recent years, with renewable energy sources playing an ever-more prominent role in power generation. Thus, many questions are being raised within national and international discourse, concerning the impacts of increasing the share of RE in the energy mix. The benefits of RE for reducing CO_2 emissions are undisputed, with supporting numerical indices, whereas research into the socio-economic impacts, especially on job creation, remains sparse but must be explored. This study aims to fill this gap by assessing the employment impacts in Vietnam of a transition towards low-carbon, renewable energy. Building on methodologies documented by Borbonus by IASS (2017b), the study methodology utilises a linked Input–Output model, thus providing a consistent framework within which the renewable energy value chain in Vietnam is captured. Thus, the analysis focuses on changes in employment and skills requirements across competing power sector planning scenarios in Vietnam.

To this end, the study answers the following questions within the Vietnamese context:

1. What is the total job creation potential of differing power sector planning scenarios used in Vietnam? Do more ambitious low-carbon power development scenarios lead to job losses in Vietnam's most important power generation sectors of coal and hydropower?

2. Over time, do renewable energy sources create more jobs per unit of installed capacity compared to continued reliance on fossil sources?

In addition, the study identifies the skills and quality of jobs in the renewable energy sectors and the potential for Vietnam to plug the skill gap. Note that this study provides an initial analysis of these issues; more focused work (and data collection) should be considered to address these issues further.

BOX 1: DEFINING EMPLOYMENT EFFECTS

- One job is defined as a full-time equivalent person-year. The total number of jobs reported therefore reflects the total number of people employed for a specific year.
- The gross employment effect considers only the positive employment impact resulting from an activity. It generally includes the direct and indirect effects but can also include the induced effects.
- The IRENA (2014) definitions of direct, indirect and induced employment effects are used when reporting gross employment impacts:
  - Direct employment effect (direct jobs) is employment created due to changes in production of a given sector, which adjusts to meet the change in demand for a good or service.
  - Indirect employment effect (indirect jobs) is the change in employment in sectors linked to a given sector through its intermediate consumption of goods and services.
  - Induced employment effect (induced jobs) is the change in employment resulting from changes in demand due to direct and indirect employment effects.

2. Methodology

The assessment methodology includes a qualitative analysis of interviews conducted with key stakeholders in the renewable energy sector, as well as a review of the existing literature relevant to Vietnam. A quantitative analytical framework is used to estimate the gross impacts of increased renewable energy deployment arising from specific scenarios (cf. Figure 2).

Furthermore, a case study analysis is conducted of the solar and wind value chains in Vietnam, to understand the skill requirements for achieving the energy transition, which will be dependent on progress in both solar and wind energy. The quantitative analysis relies on an input–output table, expanded for the Vietnamese context, to assess the gross employment impacts.

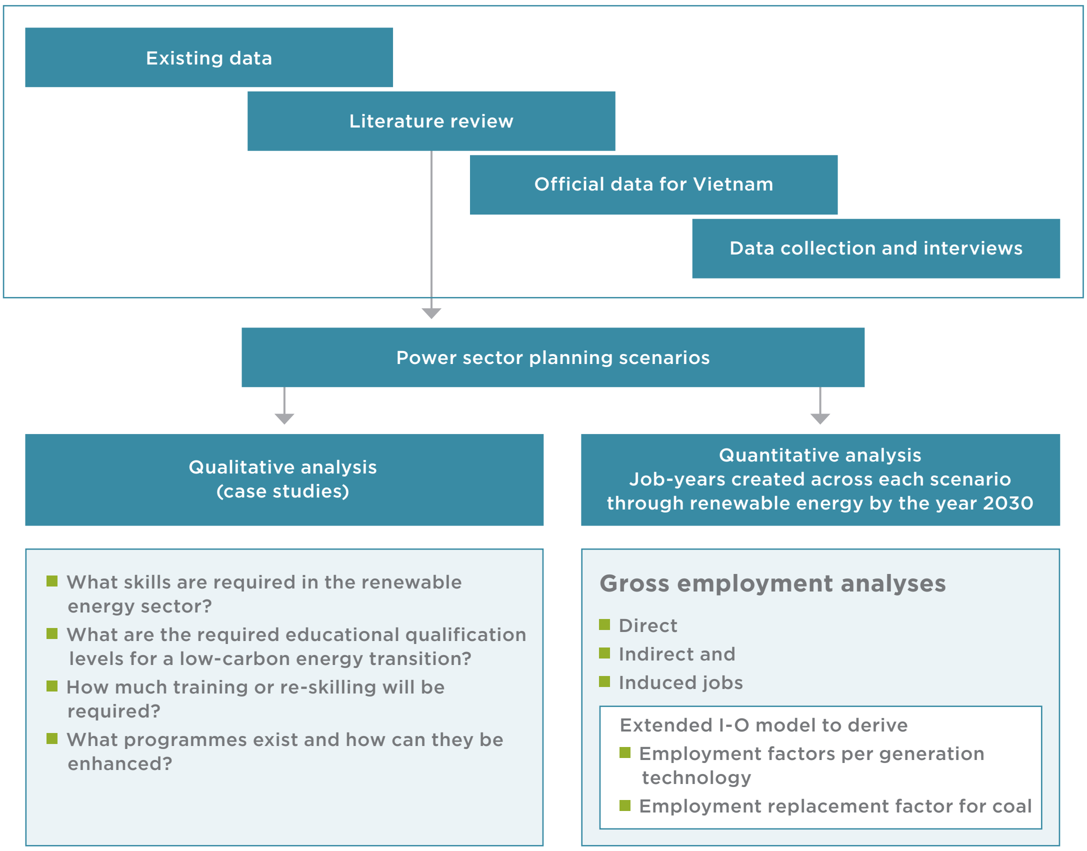

Figure 2: Schematic overview of the study methodology

Source: own

The qualitative approach uses data gathered from literature reviews and enterprise surveys conducted for the RE sector in order to understand the existing value chains for both the RE and conventional power sectors. By unpacking the information obtained, a better understanding of the skill requirements of each scenario is determined. Furthermore, by piecing together the future skills requirements, the study is able to determine the training requirements necessary to resolve a predicted labour shortfall over the assessment period. Furthermore, an in-depth case study analysis was conducted of the skills needed in the wind power and solar PV value chains. In order to report findings from the surveys and the skill attainment levels required across all power generation technologies, the study adopts the classification detailed in Table 1.

The quantitative assessment applies a Vietnam-adapted Input–Output (I–O) model to estimate the gross employment effects of different power sector pathways identified for the country (*cf. equations* 1–4). Vietnam-specific factors are used, such as equipment capital cost, wages and share of domestic production in the manufacturing value chain. For each technology, the I–O model estimates the economic impacts associated with the construction, and the operation and maintenance (O&M) phases of power generation plants, by characterising these phases in terms of changes in the country. The gross employment assessment considers only the positive direct, indirect and induced job-creation impacts in the value chain. The employment impacts of deploying differing capacities of renewable energy within each scenario are assessed for the period 2018 to 2030.

Skill level	Description based on education system
Highly skilled	Tertiary education
Skilled	Technical school training
Semi-skilled	Secondary (high school) education
Unskilled	Primary education or un-schooled

Table 1: Classification of skill attainment levels for Vietnam

Source: adopted for the study

Supporting equations:

$$X_j = (I - A)^{-1} F_j \quad (1)$$

$$e_j = w_j X_j$$

$$X_{indirect_j} = (1 - A)^{-1} g \quad (2)$$

$$e_{indirect_j} = w_j X_{indirect_j} \quad (3)$$

$$Induced\ employment\ per\ sector = w_j X_{induced,j} \quad (4)$$

Where:

$$X_j = gross\ output\ for\ sector_j$$

$$F = final\ demand\ from\ sector_j$$

$$A = I\text{–}O\ matrix\ for\ Vietnam$$

$$I = unit\ matrix$$

$$(I - A)^{-1} = Leontief\ inverse$$

$$w_j = employment\ coefficient\ for\ sector_j$$

$$This\ represents\ the\ unit\ change\ in\ employment\ in\ a\ sector\ as\ result\ of\ a\ change\ in\ the\ final\ demand\ in\ that\ sector?$$

$$e_j = direct\ workers\ in\ sector_j$$

$$e_{indirect_j} = indirect\ workers\ in\ sector_j$$

$$X_{j_{indirect}} = effective\ ouput\ from\ sector_j\ to\ satisfy\ sector_j\ indirect\ demand$$

$$g = indirect\ impact\ vector\ for\ sector_j$$

2.1 Scenarios and assumptions

Four scenarios are analysed for the future development of the power sector in Vietnam. These are used to compare the impacts of various capacity additions for different power generation sources. From these four, one government-level scenario from the Vietnamese Ministry of Industry and Trade (MOIT) represents the planned official composition of Vietnam's energy mix over the short- and medium-term planning horizons, and forms the basis for assessing the employment impacts of deploying different generation sources in the country. The power supply mix and new capacity additions from the Power Development Plan VII (revised)[2] (PDP 7 (rev)) developed by MOIT are chosen as the baseline, representing the policy planning status-quo in the power sector. The remaining scenarios are independent planning scenarios from developmental agencies suggesting forward-looking power sector plans for Vietnam. The scenarios considered include the Danish Energy Agency Stated Policy scenario (DEA Stated Policies), Asian Development Bank "Pathways to low-carbon development for Vietnam" low-carbon scenario (ADB Low-Carbon) and the Base & Renewable Energy[3] scenario (Base & Renew En) developed by GreenID. Figure 3 gives a breakdown of the share of renewable energy sources (non-hydro) across all scenarios used in this assessment. It is noteworthy that the use of different underlying assumptions for each scenario means that they cannot be compared directly if modelled exactly. Thus, only the production shares and capacity additions of each technology in each scenario are considered as priorities in the I–O equilibrium analysis.

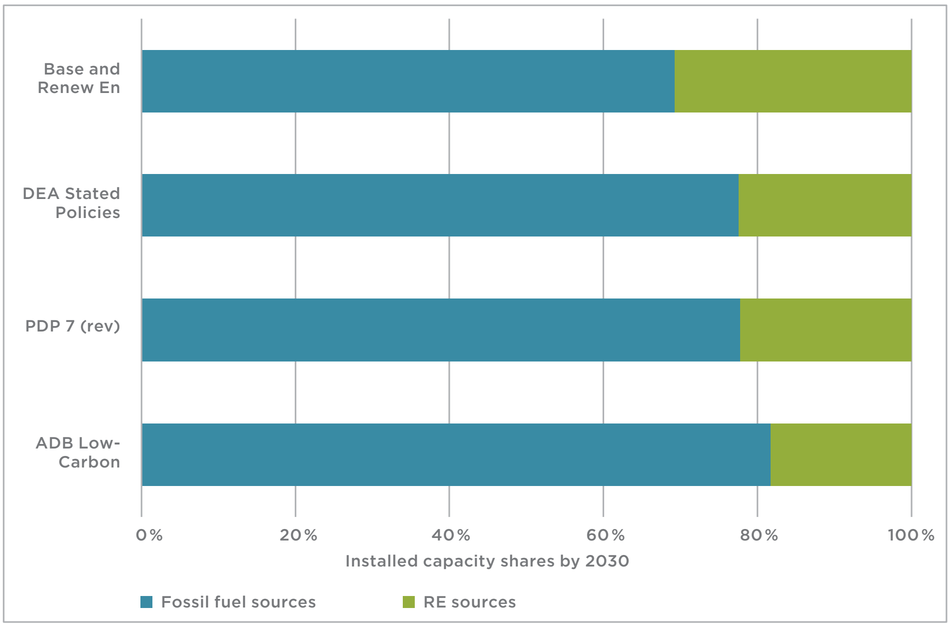

Figure 3: Installed capacity of renewable energy sources in comparison to fossil sources across assessed scenarios

Source: own

[2] The PDP 7 (rev) scenario developed by the Ministry of Industry and Trade Vietnam sets the planning basis for development of the electricity sector up to the year 2030.

[3] Analysis of future generation capacity scenarios for Vietnam, developed in collaboration with Vietnam Sustainable Energy Alliance: This scenario analyses the potential for meeting Vietnam's growing energy needs in a least-cost manner that also takes into account external costs and carbon emissions.

3. Renewable energy drives employment opportunities in Vietnam

KEY POINTS:

- Solar PV, with an employment factor[4] of 3.51 Jobs/$MW_{average}$, has the largest impact on gross employment in Vietnam's power sector over a 15-year timeframe. Wind, hydropower and biomass create 2.79, 2.67 and 2.22 Jobs/$MW_{average}$, respectively.
- When coal is replaced with renewable energy, the employment effects are more evident during the equipment manufacture, construction and installation phase (representing 62% of the replacement effects).
- Employment effects through the power sector depend substantially on the capacity increases – substantially higher capacity installations lead to larger employment effects (independent of power source). This needs to be taken into account when comparing scenarios/energy plans.

3.1 Employment effects of different power sector pathways

This section compares the absolute number of jobs created (gross employment) during the construction, installation and manufacturing (CIM) phase, as well the operation and maintenance (O&M) phase over a fifteen-year period (2015–2030) across the four scenarios assessed. This is based on changes in the generation capacities of the various technologies embedded in each scenario. The results are measured as full-time-equivalent employment for the duration of one year ("job-year"). This value indicates the full-time employment that can be created by the end of the year 2030. In principle, it should be considered that jobs during the O&M phase last for a longer time–the lifetime of a facility, which covers periods between 20 and 35 years depending on the technology deployed. These longer timeframes are not taken into account at this stage for comparability purposes, but are further considered in the calculation of Vietnam-specific employment factors (EF) for the different power generation technologies.

In absolute numbers from the I–O analysis, the PDP 7 (rev) scenario creates the highest number of jobs (1.93 million job-years), followed by the DEA Stated Policies (1.86 million job-years), Base & Renew En (1.70 million job-years) and ADB Low-Carbon (1.61 million job-years) scenarios (cf. Figure 4). This employment effect trend depends, to a certain extent, on the generation capacity added by each scenario. Consequently, this explains why the PDP 7 (rev) scenario had the highest positive job creation effect over 15-year assessment period: namely that the PDP 7 (rev) scenario had the highest installed power generation capacity of the four scenarios and vice versa for the ADB Low-Carbon scenario. A value chain breakdown of the gross employment effect suggests that approximately 80% of jobs created in the power sector by the year 2030 are in the construction and installation phase (see Figure 5).

[4] The employment factor calculated in this study takes into account the capacity factors of all technologies.

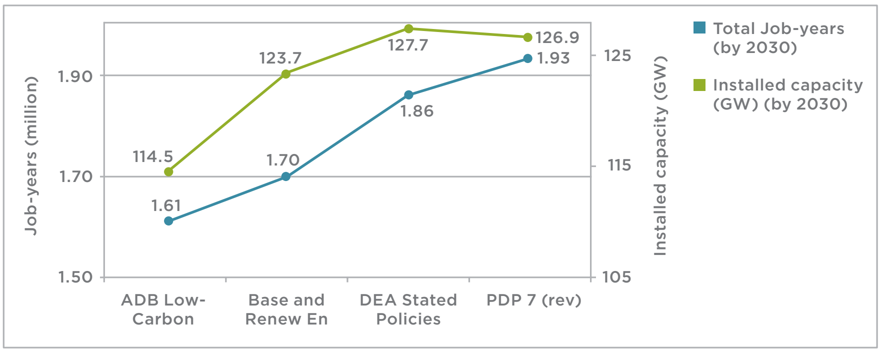

Figure 4: Employment effects between the years 2015 and 2030, partially dependent on the generation capacity addition

Source: own, I-O analysis

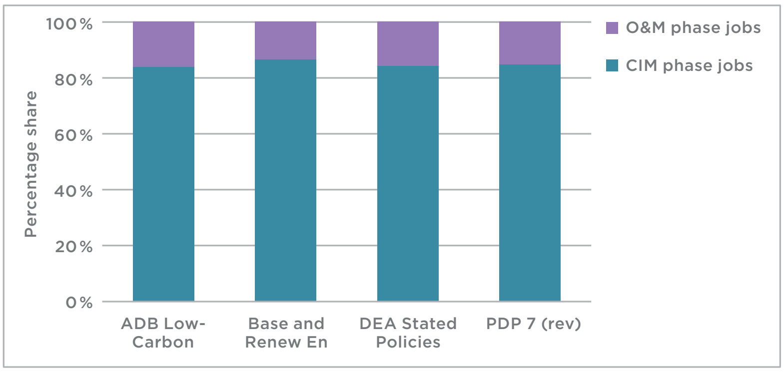

Figure 5: Percentage CIM and O&M value chain contribution to gross employment between the years 2015 and 2030

Source: own, I-O analysis

By following the PDP 7 (rev) scenario until the year 2030, the renewable energy sector, comprising solar PV, wind and biomass technologies, can create approximately 315,000 job-years (cf. Figure 6). A shift to GreenID's Base & Renew En scenario will increase gross employment in the RE sector to approximately 434,000 job-years, a 38% increase compared with PDP 7 (rev) (cf. Figure 6).

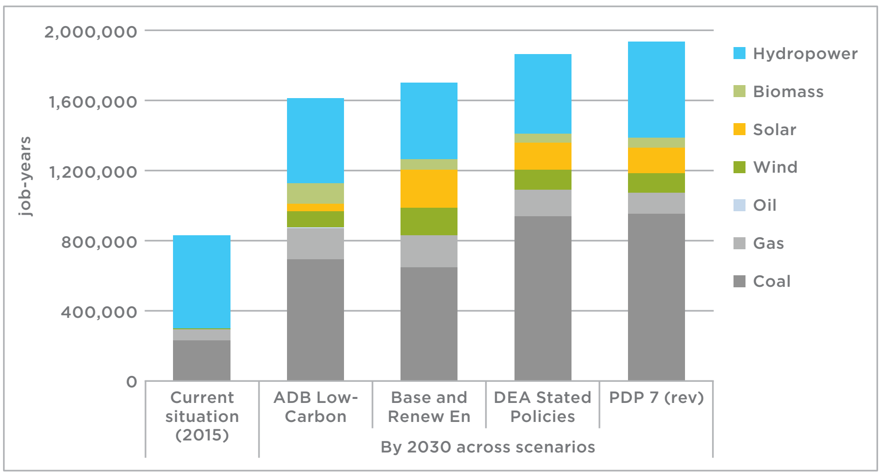

Figure 6: Employment effect by the different technologies across scenarios by the year 2030

Source: own, I-O analysis

Coal and hydropower are established technologies in Vietnam and are expected to constitute approximately 60% of gross employment in the power sector across all scenarios by 2030, notwithstanding the noteworthy contributions of solar and wind (more than 20%) in GreenID's Base and Renew En scenario (cf. Figure 7).

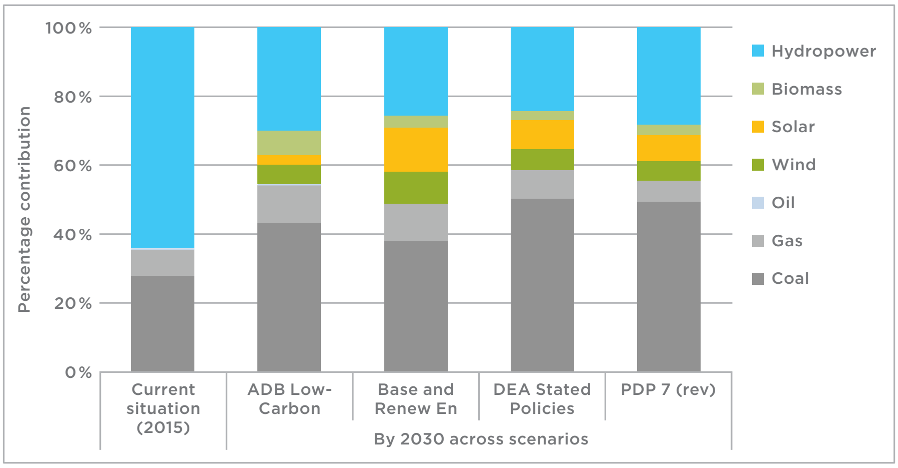

Figure 7: Contribution to gross employment by different technologies year 2015 and 2030

Source: own, I-O analysis

Furthermore, for each job created directly from the power sector in Vietnam, two additional jobs (indirect & induced) are created (cf. figure 8). Irrespective of the scenario assessed, the direct, indirect and induced employment impacts contribute approximately equal proportions (33% each) to the gross employment effect from the power sector in the country.

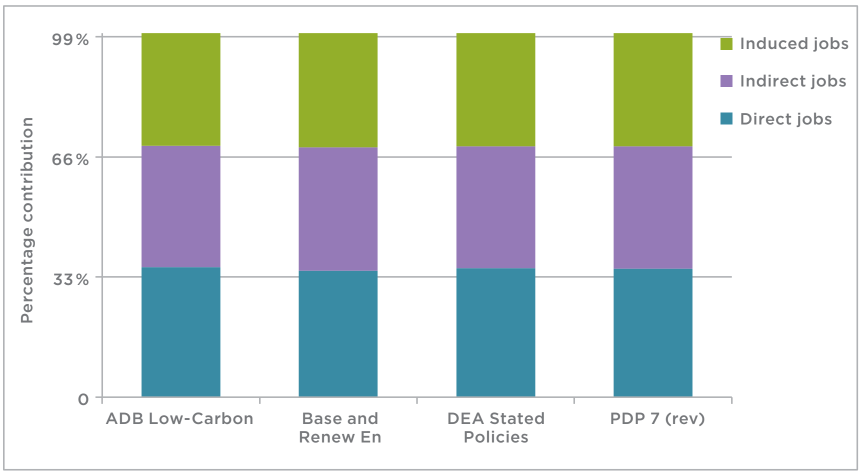

Figure 8: Direct, indirect and induced employment effects during the CIM and O&M phases, year 2015 and 2030

Source: own, I-O analysis

3.2 Employment effects of different power generation technologies

As each scenario consists of a mix of different power generation technologies, a comparison of individual employment effects does not reveal the employment factor (EF) or employment coefficients of the different power generation technologies independently. Hence, it is essential to compare the gross employment effects of each generation technology against each other in order to determine the job creation impact of each technology in the power sector. Equation 5 shows the baseline approach used to calculate the employment factors $\frac{Jobs}{MW_{average}}$ for individual technologies along the value chain. This EF unit takes into consideration the capacity factor of the generation technology and the jobs created per MW, obtained from the I–O analysis.

Using the $\frac{Jobs}{MW_{average}}$ factor ensures that each of the generation technologies is comparable by means of the individual capacity factor.[6]

$$\frac{Jobs}{MW_{average}} = \frac{\frac{Jobs}{MW_{peak}}}{Capacity\ factor} \qquad (5)$$

Figure 9 shows that over the lifetime of a power generation facility, renewable energy technologies have better employment effects in the power sector in Vietnam. Solar PV, with an EF of 3.54 $Jobs/MW_{average}$ has the highest job creation effect, followed by wind (2.79 $Jobs/MW_{average}$) and hydropower (2.66 $Jobs/MW_{average}$). The EF, without taking into account the technology's capacity factor(ie. $\frac{Jobs}{MW_{peak}}$) is shown in Figure 10.

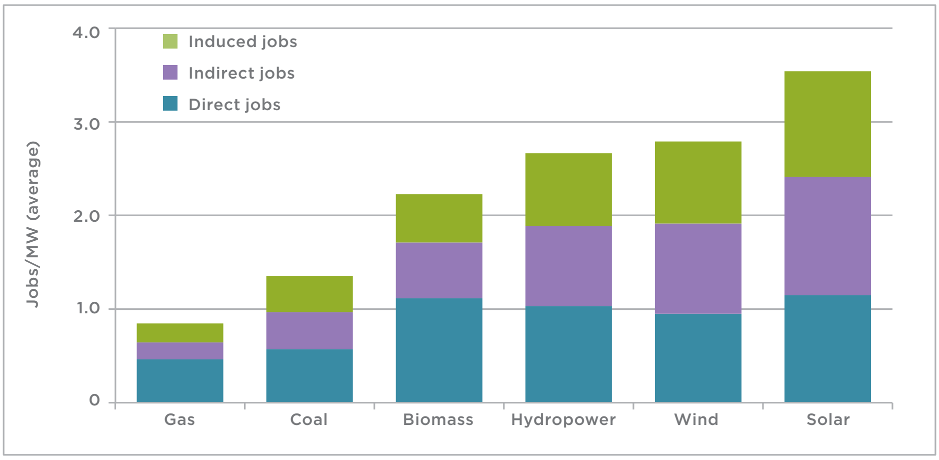

Figure 9: Comparable gross employment factor of each generation technology by individual capacity factor

Source: own, country-specific I–O analysis

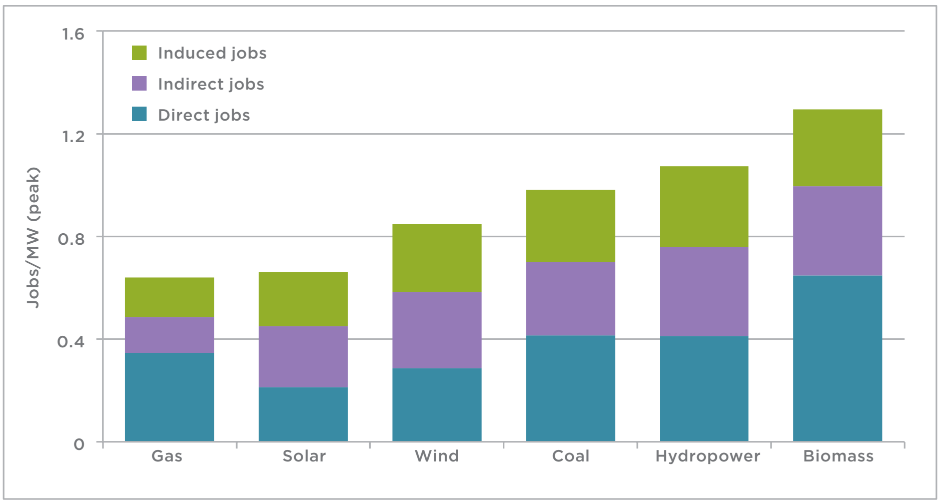

Figure 10: Gross employment factor of each generation technology. This does not consider the capacity factors of individual technologies

Source: own, country-specific I–O analysis

[5] The number of jobs/GWh might have been a more appropriate employment coefficient, but Vietnam has no robust, publicly available data on the production shares of its installed wind and solar PV facilities.

[6] The capacity factor is the average power generated, divided by the rated peak power of a power generation technology.

3.3 Boosting job creation by replacing coal

This sub-section explains which energy source provides the best replacement for coal power generation in terms of potential job creation.

Replacing coal with either solar PV or wind in Vietnam creates at least two more jobs per average installed MW (cf. Figure 11). Solar PV creates about four jobs, while wind power creates about three jobs on average. On the other hand, replacing coal solely with gas will lead to a decline (job losses) of about 0.5 jobs per average MW of installed capacity.

Furthermore, when coal is replaced with renewable energies, the employment effects are more evident during the CIM phase (during which 62% of the replacement effects occur). Additionally, the analysis shows that the gross employment replacement effect of biomass technology is highest during the O&M phase, which is due to this technology's close linkage to the agricultural and extractive sectors in Vietnam.

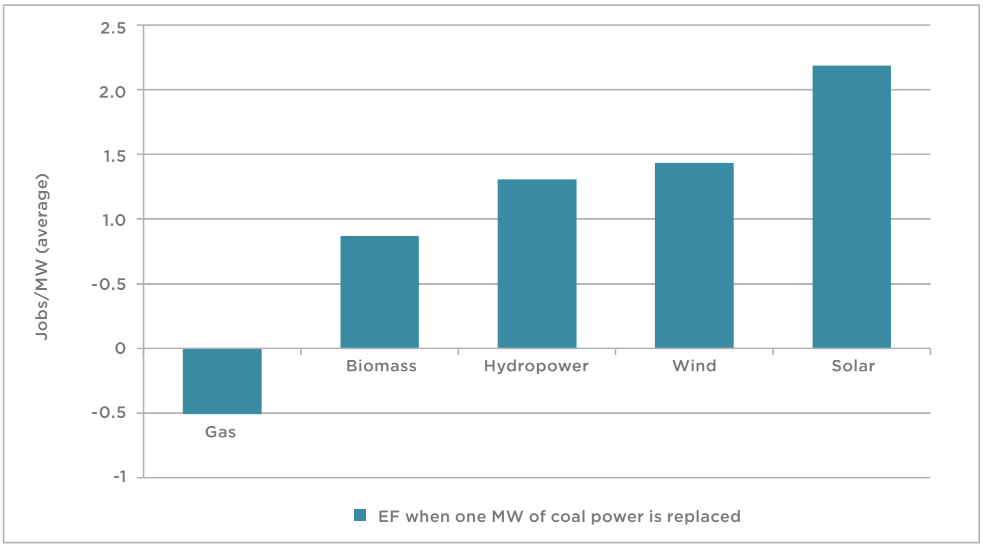

Figure 11: Jobs created when one MW of coal power is replaced by other power generation technologies

Source: own, country-specific I–O analysis

3.4 Skill requirements in an evolving Vietnamese power sector

Using PDP 7 (rev) as a baseline scenario, the bulk of employment through the power sector during the CIM phase is observed in the skilled labour group, especially in the semi-skilled sub-group (cf. Figure 12); the skill classification approach adopted here is shown in Table 2 on page 18. Across all energy generation sources, around 25% of employment requires skilled and highly-skilled labour in Vietnam. This, in turn, highlights the need to provide targeted technical training for the evolving skill requirements in the country's power sector.

However, the skill attainment requirements during the O&M phase are much more diverse than those observed during CIM. Compared with other energy technologies, biomass showed a need for more of the unskilled labour group (cf. Figure 13). This can be attributed to the strong backward-linkage of biomass fuel feedstocks (needed during the operation of the plant) to the agricultural and forestry sectors, unlike other technologies. Wind and solar technologies showed equal need for the semi-skilled labour group (similar to that of coal), while gas would require a greater proportion of highly skilled labour groups. With these anticipated changes in employment requirements within the power sector, there should be a decline in the demand for unskilled labour by the year 2020, during the CIM phase (under the PDP 7 (rev) scenario). This trend is also observed during the O&M phase over the scenario horizon. By the year 2030, the demand for higher-skilled labour groups is expected to grow by 31% for CIM jobs and 25% for O&M jobs. This change (as seen in Figure 14) can be partially attributed to the increased demand for RE sources, especially solar and wind, which have a lower demand for unskilled or low-skilled labour during the CIM phase.

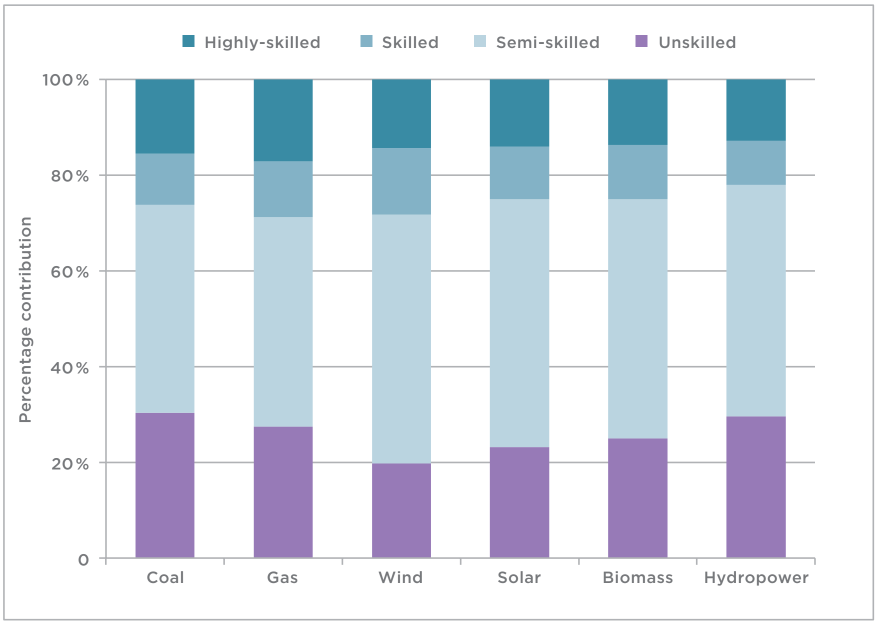

Figure 12: Expected skill attainment levels for each power generation source during the CIM phase in Vietnam

Source: own

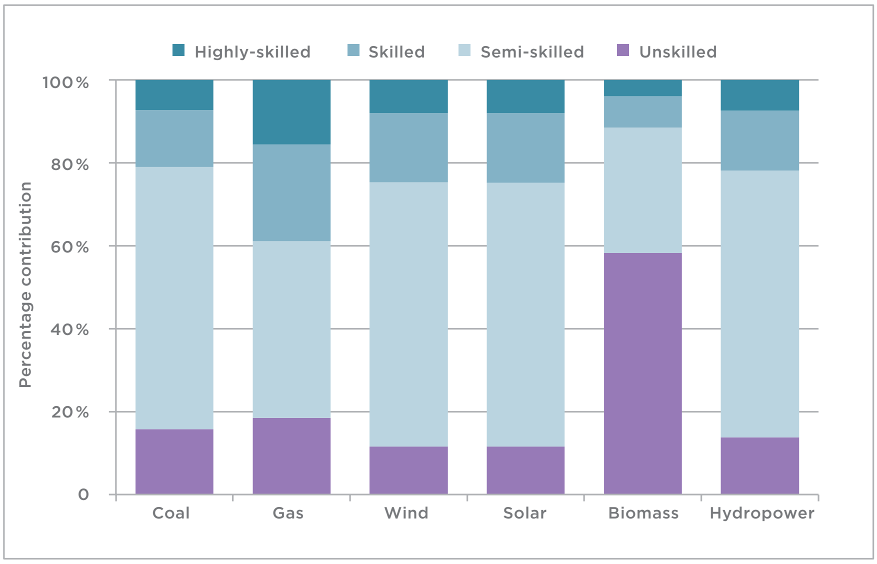

Figure 13: Expected skill attainment levels for each power generation source during the O&M phase in Vietnam

Source: own

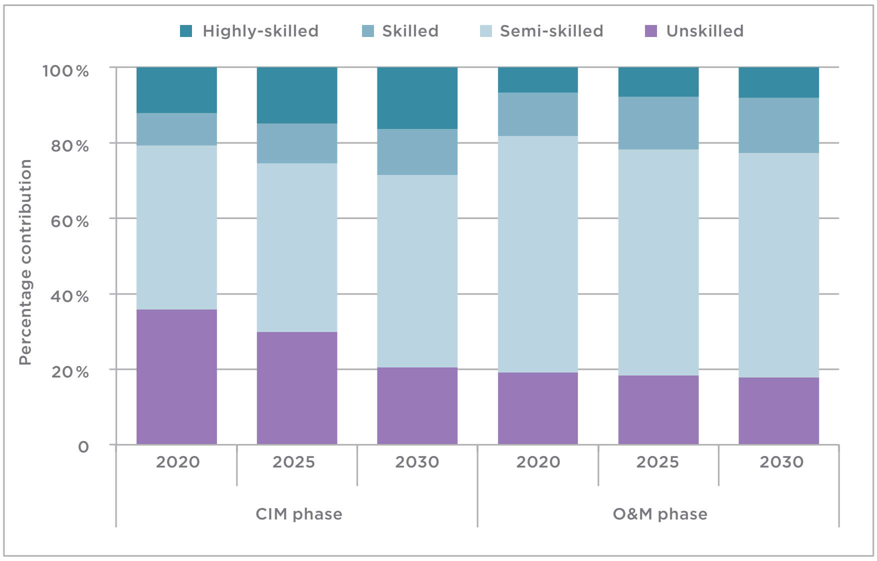

Figure 14: Expected evolution of skill attainment levels in the CIM and O&M phases based on gross employment impacts in the power sector using PDP 7 (rev), 2020–2030

Source: own

4. Status of skilled labour availability in the solar and wind value chains in Vietnam

Analyses conducted in India and South Africa suggest that the lack of a skilled local labour force in the RE value chain may serve as a bottleneck, both to growth in the sector and also its ability to drive socio-economic value creation in the local economy (Ghosh et al., 2016; IASS/CSIR, 2019). Therefore, this section reports the findings from the case-study survey conducted with stakeholders, concerning the specific technical or non-technical skill requirements in the wind and solar power construction, installation, operation and maintenance value chains in Vietnam. Key stakeholders engaged include local private-sector project developers, Vietnamese research institutions, colleges of technical and vocational training, as well international developmental partners advising on renewable energy projects.

The case study is designed to identify the most important jobs and skills for the various project lifecycle stages in the wind power and solar PV sectors, and presents a situational analysis of present development in the sector. To provide clarity and consistent information for survey participants, skills were predefined based on the International Labour Organization's green jobs description (cf. Table 2). These refer to jobs that help reduce negative environmental impacts, ultimately leading to environmentally, economically and socially sustainable enterprises and economies (Strietska-Ilina et al., 2011)

Skill level	Typical training requirement	Examples
None	No technical training required	Bus drivers
Low	Short training courses or on-the-job learning	Welders
Medium	Short course or extended continuous training	Energy efficiency building consultants, mechanics, plumbers, solar system installers
High	University degree or extended technical school	Engineers and system designers, wind turbine installers, system operators

Table 2: Classification of green jobs in the solar & wind value chains

Source: Strietska-Ilina et al., 2011

The qualitative findings show that, due to the present low installed capacity of solar PV and wind turbines in Vietnam's power sector, there is still limited demand for and availability of local technical expertise in the sub-sector. To meet the present demand, project developers currently recruit engineers who are not directly/specially trained for the renewable energy sector. Thus, those employed lack both the knowledge and skills necessary for power plant construction, grid connection, remote system monitoring and operations, etc., and are retrained on-the-job with the support of foreign experts. Conversely, in the wind power sector, it is standard practice for the turbine manufacturer to provide the skilled personnel responsible for the system's construction, installation and maintenance.

The current trend of depending on highly skilled foreign labour for the solar PV and wind power value chains is expected to change if the growth of the sector suffices according to the planned PDP 7 (rev) scenario or other, more ambitious, RE scenarios. Companies interviewed during the survey expressed their willingness to recruit skilled local workers if the training provided by universities and technical schools is aligned with the technical skills demanded by the RE sector, as shown in Table 3 .

Table 3: Key technical skills requirements in Vietnam's solar PV and wind power sectors

Source: own survey results

Value chain	Relevant jobs and occupations	Technical skill requirements
Planning and projection/ development	■ Project planners ■ Project managers ■ Electrical engineers ■ Industrial engineers ■ Lawyers ■ Meteorologists (wind and solar assessment) ■ Geologists	■ Plant design, engineering and architecture ■ Project management ■ Bid drafting and pricing; site selection and leasing ■ Financial modelling ■ Contract design and negotiation
Construction and installation	■ Electrical engineers ■ Electronic technicians ■ Mechatronic technicians ■ Civil engineers ■ Structural engineers ■ Logistics managers ■ Installers and crane managers	■ Site engineering (civil, electrical and mechanical) ■ Plant design and architecture ■ Structure erection (wind towers) ■ Power plant construction ■ Grid work (integration and connection) ■ Land surveying ■ Project management ■ Logistics management
Operation and maintenance	■ Service technicians specialised in RE sectors ■ Mechatronic technicians ■ Data analysts	■ Fault management ■ System monitoring and control ■ Performance data analysis and management ■ Mechanical repairs and equipment management

The data obtained from the survey and stakeholder engagement process suggest that there is insufficient formal training in universities, colleges and technical schools to meet the technical skill requirements of the RE sector. Although a large number of electrical engineers have graduated and are being educated in Vietnamese institutions, specific knowledge on renewable energy systems is invariably still lacking. Vocational training schools are not yet equipped to provide the specialised training, knowledge and skills involved in the operation, maintenance and repair of specialist wind and solar PV equipment. Nevertheless, through diverse skill-transfer protocols between the Vietnamese Government, the private sector and foreign organisations, pilot training activities are evolving in order to close the local skill gap in the RE sector. Multiple such events are still required across Vietnam to retrain workers and improve the technical skills of the present workforce.

5. Creating an enabling environment to boost employment in renewables within the power sector and the wider economy

Impulses for furthering the debate

This COBENEFITS study shows that Vietnam can significantly boost gross employment by increasing the share of renewables. Replacing coal-fired power plants with solar PV and wind turbines creates approximately 2 more jobs per average MW installed in the power sector by 2030. Up to 3.5 jobs per average installed MW can be created (gross) by 2030 through solar and wind power if the country achieves an effective transformation of the power sector.

What can government agencies and political decision makers do to create a suitable enabling environment to maximise employment benefits in Vietnam's power sector, both in terms of job creation within the renewable energy sector, and alleviating any negative externalities or job losses in the country resulting from shifts away from coal?

How can other stakeholders harness the social and economic co-benefits of building a low-carbon, renewable energy system while facilitating a just energy transition in the country?

Building on the study results and the surrounding discussions with political and knowledge partners, we propose to direct the debate in three areas where policy and regulations could be put in place or enforced in order to benefit from the potential employment opportunities:

Government ministries need to develop a joint strategy for vocational training and university programmes for the renewable energy sector

In Vietnam, several pioneering universities and colleges offer university or vocational training programmes on the application of renewable energy technologies. However, graduates from both universities and vocational training programmes do not always meet the highly specific needs of the renewable energy sector, while the existing pool of experts and skilled workers with the capabilities to carry out the practical work of construction, operation and maintenance of RE technologies still need to be retrained.

Hence, a joint strategy to reshape voca-tional training curricula and university programmes, with a focus on renewable energy technologies, needs to be developed by various government ministries, such those responsible for Industry and Trade (MOIT), Labour, Invalids and Social Affairs (MOLISA), Education and Training (MOET), and Science and Technology (MOST), to address current and potential skill gaps in the power sector. Working partnerships should be explored with local and international organisations as a means of developing "Train the Trainer" equipping-courses for ministerial staff. These should examine how educational and training opportunities can be aligned with the skills needed in the power sector, as informed by global expertise in low-carbon technology trends.

Additionally, the Vietnamese Government can actively manage a just transition to low-carbon energy sources by redeveloping vocational training curricula and university programmes towards the new energy world of renewables while supporting affected workers and communities domiciled in the coal-power-generating regions of the country, such as the Mekong Delta.

Strengthen education and training for the renewable energy sector

The curricula of courses that prepare students for work in the RE sector must be based on up-to-date information on the latest technological developments. This is only possible if curricula maintain a certain flexibility regarding their contents. Universities and vocational training institutions need to be in permanent exchange with representatives of the renewable energy industry, to constantly adapt their curricula to the latest developments in technology and on the job market. The successful development of skills needed in the renewable energy sector can be achieved by extending educational programmes to include mandatory professional internships and traineeships in cooperation with the private sector.

Furthermore, the private sector can be involved in developing standards to ensure that graduates are effectively prepared for the skill demands of companies operating in the RE sector. This can be achieved through developing feedback systems, whereby companies and universities engage in co-creation processes to determine whether graduates possess the skill-sets required in the job market. Furthermore, in order to ensure that less-educated people and residents of relatively remote areas also benefit from RE projects in their regions, companies should offer retraining (e.g., for local mechanics and workers) and additional vocational training programmes directly in the communities where renewable energy projects are located.

Broaden the visibility of job opportunities in the renewable energy sector

Although the COBENEFITS study showed the RE sector's potentials as a job generator, young people in Vietnam often tend to choose education and skilling courses that target jobs in more 'established' sectors. Information on job profiles and employment options in the RE sector are often difficult to access. The development of a job orientation strategy for the RE sector is key to communicating the multiple employment opportunities available in the sector. This orientation or information-sharing strategy should be developed in cooperation with educators at high school, vocactional training and university levels, in partnership the private sector. Conversely, more locally available vocational training opportunities onsite, where RE projects are developed, would also help to improve the visibility and public awareness of the sector.

A regularly updated, joint platform that bundles information from companies and external organisations – concerning job profiles, plus related educational and skill requirements, job-orientation programmes, as well as open internship and job opportunities – can be explored as a first step towards ensuring a functional, multi-directional system for sharing information.

Support the domestic manufacture of renewable energy equipment

As a rapidly developing market, the renewable energy sector offers new possibilities to develop future technologies and innovations that are 'made in Vietnam'. The domestic design and manufacture of renewable electricity generation equipment offers multiple benefits to Vietnam's industrial sector; however, realising these opportunities demands a tailored strategy for manufacturing RE equipment, developed by MOIT with technical support from MOST and the Ministry of Agriculture. To ensure its implementation, this policy should ideally be integrated into the policies and regulations directed to implement MOIT's *Industry Development Strategy of Vietnam to 2025, Vision to 2035*.[7] Research on current market conditions and comparative advances of Vietnam's RE manufacturing industry is a first yet crucial step to ensure tailored support. For the solar manufacturing industry, such research can be conducted within the Rooftop *Solar PV Promotion Program under MOIT*.[8] With a government-led initiative to expand and institutionalise support for local companies providing technological support and equipment manufacturing to the domestic RE sector, MOIT and MOST can contribute effectively to fostering the competitiveness of the RE manufacturing industry in Vietnam.

[7] http://asemconnectvietnam.gov.vn/default.aspx?ZID1=14&ID1=2&ID8=27556

[8] http://vepg.vn/wp-content/uploads/2019/07/2023_QD_BCT_Rooftop_Solar_EN.pdf

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List of abbreviations

ADB Low-Carbon	Asian Development Bank "Pathways to low-carbon development for Vietnam" low-carbon scenario
Base & Renew En	Green Innovation and Development Centre (GreenID) Base and Renewable Energy scenario
BAU	Business-As-Usual
CIM	Construction, installation and manufacturing
DEA Stated Policies	Danish Energy Agency Stated Policy
EF	Employment factors
GHG	Greenhouse gas
I-O	Input-Output (model)
MOET	Ministry for Education and Training Vietnam
MOIT	Ministry of Industry and Trade Vietnam
MOLISA	Ministry for Labour, Invalids and Social Affairs Vietnam
MOST	Ministry for Science and Technology Vietnam
NDC	Nationally Determined Contributions
O&M	Operation and maintenance
PDP 7 (rev)	MOIT Revised Seventh Power Development Pla
SDG	Sustainable Development Goals
VGGS	Vietnamese Green Growth Strategy

COBENEFITS
Connecting the social and economic opportunities of renewable energies to climate change mitigation strategies

COBENEFITS cooperates with national authorities and knowledge partners in countries across the globe such as Germany, India, South Africa, Vietnam, and Turkey to help them mobilise the co-benefits of early climate action in their countries. The project supports efforts to develop enhanced NDCs with the ambition to deliver on the Paris Agreement and the 2030 Agenda on Sustainable Development (SDGs). COBENEFITS facilitates international mutual learning and capacity building among policymakers, knowledge partners, and multipliers through a range of connected measures: country-specific co-benefits assessments, online and face-to-face trainings, and policy dialogue sessions on enabling political environments and overcoming barriers to seize the co-benefits.

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