Implemented by

TỔNG CỤC GIÁO DỤC NGHỀ NGHIỆP
DIRECTORATE OF VOCATIONAL EDUCATION AND TRAINING

STAKEHOLDER MAPPING AND ASSESSMENT OF HUMAN RESOURCE DEVELOPMENT IN THE RENEWABLE ENERGY SECTOR

Hanoi, June 2023

IMPRINT

This publication is supported by the Vietnamese-German Programme “Reform of Techical and Vocational Education and Training in Viet Nam”. The Programme *is commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ) and implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in cooperation with the Vietnamese Directorate of Vocational Education and Training (DVET) under the Ministry of Labour – Invalids and Social Affairs (MoLISA). The programme aims to better align TVET to the changing world of work which will be increasingly digital and green.*

The Programme “Reform of TVET in Viet Nam”
2nd Floor, No. 1, 17 Alley, Ta Quang Buu Street, Hanoi, Viet Nam
T: +84 24 397 46 571
E: office.tvet@giz.de
W: www.tvet-vietnam.org/ www.giz.de

Author: Nguyen Huong Thao

Editors: Afsana Rezaie, Juergen Hartwig, Le Minh Thao, Nguyen Giao Hoa, Enzo Sociolla

Photo credits: Nguyen Ngoc Quang

As at: Hanoi, June 2023

STAKEHOLDER MAPPING AND ASSESSMENT OF HUMAN RESOURCE DEVELOPMENT IN THE RENEWABLE ENERGY SECTOR

Hanoi, June 2023

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ANNEXES

ABBREVIATIONS

COP26	2021 United Nations Climate Change Conference
DACUM	Develop a Curriculum
DVET	Directorate of Vocational Education and Training
EVN	Vietnam Electricity Group
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GWO	Global Wind Organization
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
JETP	Just Energy Transition Partnership
MoIT	Ministry of Industry and Trade
MoLISA	Ministry of Labour, Invalid, and Social Affairs
O&M	Operation and Maintenance
PDP	Power Development Plan
PPA	Power Purchase Agreement
PV	Photovoltaic
RE	Renewable Energy
SSC	Sector Skills Council
TVET	Technical and Vocational Education and Training
TVET Programme	Programme “Reform of Technical Vocational Education and Training in Viet Nam II”
VCCI	Vietnam Chamber of Commerce and Industry
VCEA	Vietnam Clean Energy Association
VEA	Vietnam Energy Association

EXECUTIVE SUMMARY

Viet Nam's energy sector has been rapidly growing over the years, and this trend is expected to continue until 2050. According to the International Energy Agency (IEA), Viet Nam's energy demand is projected to increase by an average of 4.6% per year from 2015 to 2030, and by 3.5% per year from 2030 to 2050.

Most of Viet Nam's energy consumption is currently met by fossil fuels, especially coal. However, the government is taking steps to diversify its energy mix by promoting renewable energy (RE) sources such as solar PV and wind power with the commitment to “net zero” by 2050. Regarding Power Development Plan 8 (2023), the country aims to reduce the share of coal-fired power plants to 20% by 2030 and 0% by 2050 and increase share of renewable energy. No more coal plants will be built after 2030.

Although wind and solar PV projects in Viet Nam have been developed at breakneck speed over the last 5 years, putting Viet Nam in the lead position in RE in Southeast Asia, recent difficulties in installation and commissioning due to Covid-19 and the adjustment in feed-in tariffs prices are causing project developers worrying about getting out of business. This causes uncertainties in the development of new and unfished projects and clearly affects the prospect of employment for wind and solar PV sectors.

For the long term, although Viet Nam has made significant strides in developing its renewable energy sector over the past decade, it still faces challenges and barriers to accelerate its growth and achieve clean energy targets. These include insufficient policy and regulatory framework, limited financing options, grid capacity constraints, land acquisition issues, and limited local supply chain.

Another challenge is human resources. Desk research and interviews with various stakeholders show that Viet Nam is ambitious to achieve the 2050 "net zero" commitment and even becomes a forerunner in RE in the ASEAN region, specifically in regard to wind power (off-shore and on-shore). However, the lack of skilled workers due to the existing gap between supply and demand in human resources can impede the realization of this ambition.

For human resource needs of RE sectors, this report started by shedding light into the global value chain of renewable energy and the turned the focus into the context of Viet Nam, highlighting the key stakeholders affecting the human resources in the wind and solar PV sectors. Surveys and interviews were conducted with stakeholders to explore their roles in human resources (HR) for RE sectors. The collected information was analysed and clearly shows that the rapid development of the RE sector has left education-related stakeholders lagging both in policy and in real practice. This causes the shortage of skilled workers in Viet Nam due to several factors, including the lack of specialized training programs, experienced professionals, readiness of education programs, and general soft skills. Below is the current status on the involvement of various stakeholders to develop the necessary human resources for the sector.

- Business and educational institutions have been on their own in addressing these gaps in human resources. From now to the foreseeable future, what business needs are mostly operation and maintenance (O&M) technicians specialized in RE. Although they can hire talents from other fields (electrical, mechatronics, construction) and provide speacialised training on RE or outsource their HR needs to third parties, business reported that future growth will rely on their own internal well-trained recruits. These recruits can come out fresh of educational institutions or get certified by private training providers. Private training providers in Viet Nam have been quite successful in serving a specific skill set needed for business and even provides training to foreigners.

- The government agency that directly oversees TVET in Viet Nam is DVET. Unfortunately, RE is a new sector and not on the list of key occupations of MoLISA. Therefore, DVET needs to focus its resources on foundation/basic skills and other programs in the list of key occupations, not specifically on RE. To receive more resources from the government, RE programs must be in the list of key occupations and the first step is standardisation of the training curriculum, which will help match the demand of business and the supply of TVET institutions.
- It is found that none of the vocation colleges under MoLISA has an official RE program. Only Mien Trung vocational college and Ho Chi Minh City Electric Power College under the Ministry of Industry and Trade (MoIT) offer official programs in RE at College level. However, their equipment and facilities for practical training are still not sufficient.
- For universities, only one offers an official RE program. Others intergrate some RE-related courses in different energy programs. The feedback from business is that university programs tend to focus on research and design, which is not necessary serving the needs of O&M technicians of business, currently.

For a long-term solution to the HR challenge to RE sectors in Viet Nam, all interviewed stakeholders from business, TVET institutions to government agencies share the same view that it is important to establish a close engagement mechanism among the industry, educational institutions, and government authorities.

In Viet Nam, this engagement mechanism has been piloted in recent times with some sectors, with different names and structures such as Sector Skills Council (SSC) for Agriculture which is supported by ILO (the council managed and operated by the skills department of the Directorate of Vocational Education - DVET); Industry Reference Council in logistics industry (initiated by Aus4skills in collaboration with Vietnam Chamber of Commerce and Industry Branch in Ho Chi Minh City – VCCI-HCM) or Quality Advisory Board in TVET in automotive engineering, aquaculture, textiles, hospitality - supported by the Norwegian Employers Federation (NHO) with management and operation by VCCI-HCM), etc. The SSC will help to bridge the gap between supply and demand in the labor market for each industry and ensure the national energy security in the case of the SSC in RE.

1 Introduction

1.1 Background information

Viet Nam is identified as one of the most vulnerable countries to be affected by climate change. This is due to its diverse geography, with an extensive coastline of 3,200 km, vast deltas and floodplains, location on the path of typhoons as well as large population living in marginalized areas. Thus, Viet Nam is commited to devloping resilient pathways and decarbonicing pathway to reduce the climate risks not only nationaly but also globally. With the right policies and strategies ensuring "just transition" to a low-carbon and green economy the country can advance in the socioeconomic development. Over the past years, Viet Nam has accelerated the implementation of national plans and strategies on green growth for the period of 2021-2030, with a vision to 2050[1]. For Viet Nam, the shift to a green economy and green growth is not only an inevitable choice but also an opportunity to become a pioneer in the region, catching up with the development trend of the world.

The Resolution of the 13th National Congress of the Party affirmed the policy "to continue to develop rapidly and sustainably the country, ensuring macroeconomic stability, strong reform of the growth model, improve productivity, quality, efficiency and competitiveness of the economy".

On 1st October 2021, the Decision No. 1658/QD-TTg approving "the National strategy on green growth for the period of 2021 – 2030, with a vision to 2050" was approved. The objective of the strategy is to reduce greenhouse gas (GHG) emissions per GDP. The overall objective of the strategy is green growth, contributing to promoting economic restructuring associated with growth model innovation, in order to achieve economic prosperity, environmental sustainability and social equity; towards a green, carbon-neutral economy and contribute to the goal of limiting global temperature rise.

In the frame of the net-zero commitment of the Prime Minister at the UN Climate Conference COP 26 in Glasgow in November 2021 to the target of reaching carbon neutrality by 2050, the climate response requires close cooperation between public and private stakeholders. On 15 December 2022, Viet Nam and the G7 countries agreed on a Just Energy Transition Partnership (JETP) which aims to support Viet Nam with technical and financial assistance amounting to $15.5bn to realize a more ambitious coal phase-out and related emission reductions towards the net zero target in 2050. It aims to gradually replace the share of coal in the energy mix by renewable energy (especially on-shore and off-shore wind energy and solar PV energy) and by natural gas. Actually, Viet Nam was planning for 36 percent of its energy generation to come from renewable source by 2030. The JETP, however, is targeting increasing that figure to 47 percent. According to Power Development Plan 8 (2023), the country aims to reduce the share of coal-fired power plants to 20% by 2030 and 0% by 2050 with no more coal plants will be built after 2030. The JETP political declaration among other things aims to "develop and implement educational, vocational training and re-skilling programmes to develop necessary skills and competencies and support job creation for labour in sectors and regions affected by the transition, as well as other forms of support to ensure better living conditions for workers after the transition".

The EVN report in 2021 states that Viet Nam has emerged as the energy transition front runner in South-East Asia with a share of approx. 25% renewable energy (RE) being installed over the last 4 years, especially solar PV and wind energy. That means that an already established RE market exists from which valuable practical experiences regarding employment and skills needs of market actors in wind and solar PV power can be drawn. However, Viet Nam still lacks trained experts in operation and maintenance (O&M), which may limit the country's ability to further develop and operate renewable energy projects.

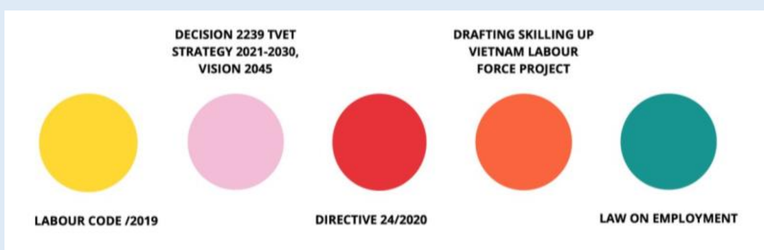
Based on the dynamic development of the RE sector over the past years, it is confirmed that Viet Nam needs to act on (high skilled) labour force development in a more holistic and long-term manner. An integrated strategy where human resource development is aligned with the needs of a just energy transition must be established. Accordingly, there is a need for evidence-based information on predicted employment effects - changes in labour and skill demand, respectively, in the RE sector.

To ensure that economic growth is sustainable and socially equitable and achieve competitiveness in the region and in international markets, Viet Nam needs to further modernise its economy and train urgently needed skilled workers and have a demand oriented TVET (Technical and Vocational Education and Training) system. There is a necessity for effective mechanisms to make informed decisions on policy level, which are based on skills forecast and employment trends by sector and occupational group. However, the cooperation mechanism among stakeholders, especially business sector engagement in TVET, is still limited. A multi-level approach of the establishment of Skills Council mechanism is crucial and one key solution to ensure coordination amongst all relevant stakeholders to respond to skills needs on national, regional, and sectoral level. It will act as a bridge between all stakeholders (relevant ministries, business sector, provincial administration, TVET institutes, workers unions etc.) and address skills gaps between demand and supply.

Box 1: Normative documents have been mentioned Skills Councils

Skills Councils have been mentioned in normative documents as following:

- The Labour Code 2019 – chapter 4 (Article 59, section 2) encourages employers to provide vocational training and develop occupational skills for their own employees and for society through “joining the sector skills council”.
- The Directive 24/2020/CT-TTg of the Prime Minister promotes Skilled workforce development to contribute to improve productivity and national competitiveness in the new situation. The directive also mandates MoLISA to pilot sector skills councils.
- Decision 2239 approving the national TVET strategy for the period 2021-2030 with a vision to 2045 also identifies the solution “Pilot setting up a number of sector skills councils for key industries for the period 2021-2025 and scale up to the period 2026-2030”.
- The draft version of the Skilling-up Vietnam Labour Force Project identifies the establishment of skills council as one important solution to improve business cooperation in TVET and contribute to the skilling up of the labour force.
- Law on Employment and Decree 31/2015 (Also Decree Amending and supplementing current Decree 31): Detail several articles regarding Assessment and Grant of NOSS certificate in which the role of business cooperation is highlighted. Here, the SSCs can play a key advisory role in the development and assessment of occupational skills.



Source: *TVET Programme, GIZ Viet Nam*

Currently, the mechanism of Sector Skills Council has been mentioned in a number of legal documents. Information can be found in detail in Box. 1. So far, several international development partners have piloted skills council models in Vietnam. Sector Skills Council has been piloted in Vietnam since December 2017 in the Logistics sector with technical support from the Aus4Skills Program commissioned by the Australian Foreign Ministry in Viet Nam. The Logistics Industry Reference Council (LIRC) has been working as a mechanism to link enterprises, TVET and government agencies in developing training packages for different occupational profiles in the industry, forecasting skills that meet the rapid development needs of the industry. In 2019, with the support of the International Labor Organization (ILO), the Ministry of Labour, Invalids and Social Affairs (MOLISA) issued a decision to establish the Sector Skills Council in Agriculture.

Since 2013, energy has become one of the development cooperation priorities of the German Government in Viet Nam with the GIZ Energy Support Program. The program aims to contribute to Viet Nam's GHG emission reduction and green growth strategy by strengthening the regulatory framework for Renewable Energy and Energy Efficiency to promote private sector investment through enhancing professional and managerial capacities of stakeholders as well as promote technical cooperation.

The joint Vietnamese-German technical cooperation Programme “Reform of Technical Vocational Education and Training in Viet Nam II” (TVET Programme) is financed by the German Ministry of Economic Cooperation and Development (BMZ) with counterpart funds from the Vietnamese Government. The implementing agencies are GIZ and the Directorate of Vocational Education and Training (DVET) under the Ministry of Labour, Invalides and Social Affairs (MoLISA).

The TVET Programme aims at better aligning TVET in Viet Nam to the changing world of work. It consists of three outputs:

- Output 1: State actors, TVET staff, TVET institutes and the business sector are interconnected.
- Output 2: The regulatory framework of TVET is aligned to the requirements of the changing world of work.
- Output 3: The concept of High-Quality TVET institutes is successfully implemented in selected TVET institutes.

Understanding the Just Energy Transition context in Viet Nam along with GIZ´s long-term experience in the energy industry, especially renewable energy as well as vocational education in Viet Nam, the TVET Programme strongly advises the establishment of Sector Skills Council in renewable energy (with focus on wind and solar energy),

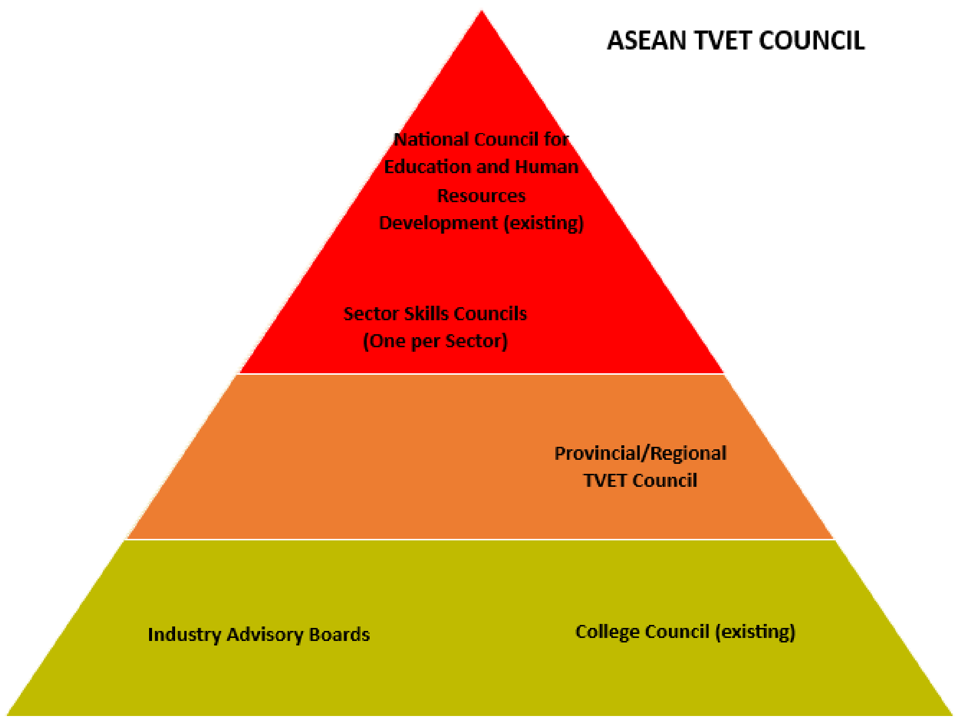
Based on the analysis of the international experience, as well as lessons learnt from different piloted council mechanisms in the context of Viet Nam, the TVET Programme highly advises on a harmonized approach to ensure the sustainable dissemination and institutionalisation of the Skills Council (SC) model in Viet Nam. Here, the memberships and functions of SCs should be considered within a holistic approach for demand driven TVET, especially in the linkage with stakeholder engagement mechanisms at the national, sectoral and institutional levels.

With the representatives of national, provincial, and local government/administrations, VCCI /professional and business associations, enterprises, trade unions and TVET institutes, the SSC will function as an advisory body to:

- Consult on TVET strategies and policies, skills development;
- Support labour market intelligence - skills forecasting;
- Support and consult on the development of occupational standards/learning outcomes;
- Promote the participation of employers;
- Consult on training and skills development for workers at enterprises;

- Harmonize National Qualifications Framework with international qualifications frameworks (AQRF, EQF etc.);
- Provide in-company training /apprenticeships;
- Advice on qualifications and curricula;
- Jointly implement training programmes and participate in assessment and certification of students;
- …..

Figure 1: Holistic approach on stakeholder engagement in TVET



Source: *TVET Programme (2023)*

Currently, at sectoral level, the TVET Programme will support the establishment of a sectoral skills council in renewable energy, in which solar PV power and wind power are the focus. At provincial/regional level, the TVET Programme provides technical support in the establishment of a TVET Council in the province of Ninh Thuan to improve the linkage between labour market and TVET as well as contribute to the development of high qualified human resource for the province. In January 2023, the Ninh Thuan Provincial People Committee approved the decision to establish the Provincial TVET Council. Ninh Thuan has made leaps and bounds to become Viet Nam's leading locality in renewable energy development, such as wind power and solar PV power, as the coastal province is blessed with abundant sunshine and wind. The Trung Nam Group based in Ninh Thuan, contributes 1.63GW of electricity to the country's electricity supply as October 2021.[1] Working to establish itself as National RE Center and the foundation of the TVET Council, with the task force on RE, Ninh Thuan will be well prepared to be linked with the SSC in RE sector.

[1] Trung Nam Group (June 2023). Available at https://www.trungnamgroup.com.vn/en-US/business-activity/energy

1.2 Introduction to the study

Objective of the study

In support of the establishment of the Sector Skills Council (SSC) for the renewable energy sector, a study on stakeholder mapping and assessment on the priorities and demand of the socio-economic development with focus on but not limited to the skills/human resource demand of the renewable energy industry was commissioned. The study aims to identify key partners and required capabilities for the assessment of human resource development with particular focus on the linkage between the industry and TVET system, in the mentioned sectors. The focus of the study is to analyse and synthetise all findings through a consultative process and develop a stakeholder mapping and analysis report, which will serve as an information source for the establishment of the SSC in RE at sectoral level. The mapping and outreach to stakeholders includes all social partners as well as all ministries relevant to the RE sector.

Methodology

To fulfil the objective, a mixed methodology was adopted. The following data collection methods were used:

- Desk review of secondary data
- Qualitatively complemented by semi-structured and in-depth interviews as well as focus group discussions with the key stakeholders including representatives from government agencies, businesses, TVET Institutes, etc. The qualitative component complements further knowledge and information collected from the desk review. Different semi-structured questionnaires were developed and detailed questionnaires are listed in Annex 1-5.

The assessment will rely on the qualitative approach by conducting the desk review of the existing documents and key informant interviews (KIIs) or focus group discussions (FGDs) with the stakeholders from solar PV and wind power.

The list of documents to be reviewed include but are not limited to:

- The current policies relating to renewable energy.
- Relevant studies of the renewable energy stakeholder mapping
- The socio-economic reports of Vietnam
- Relevant documents on the TVET education system in Vietnam

At the national level, KIIS were conducted with:

- Ministry of Labour, Invalid, and Social Affairs (MoLISA) - General Directorate of Vocational Training (DVET), which plays the main functions of state management of vocational education and training public services.
- EVN, the largest power company in Vietnam, which manages the operation of the national power system. The interview is subject to be confirmed by the corporation.
- Power Market Development Research and Training Center, Ministry of Industry and Trade (MoIT)

At the provincial level, the KIIS were conducted with related stakeholders in Ninh Thuan, the leading locality in renewable energy development.

- The Provincial People’s Committees,

- Ninh Thuan Department of Industry and Trade,
- Ninh Thuan Department of Labour - Invalid - and Social Affairs,
- Ninh Thuan vocational college
- Leading RE companies

To gain insight from the employers on the prospect of the labour demand in the renewable energy industry, as well as the expected standards of the industry workforce, the interviews were conducted with different leading companies (both SMEs and big corporations), TVET institutes, universities, wind associations. The list of KIIs is detailed in Annex 6-7.

Structure of the report

The report is structured into eight chapters. The first chapter introduces the study while the second chapter provides a broad overview of the Renewable Energy Sector in Viet Nam. Chapter three focuses on the value chains of wind and solar PV power globally. The discussion on HR needs for these global value chains, gaps, and approaches to address the gaps are being discussed in chapter 4. In chapter 5 the focus is on Viet Nam, mapping the relevant stakeholders to Viet Nam's value chains with the focus on human resource needs for the wind and solar PV sectors. Following this, the challenges faced by Viet Nam's wind and solar PV sectors and detailed discussions on HR, based on our survey and interview with different stakeholders, are analysed in chapter 6. In chapter 7 the necessity of an engagement mechanism to address problems is discussed. The recommendation and conclusion can be found in chapter 8.

2 Overview of the Renewable Energy Sector in Vietnam

2.1 Expected Growth in Electricity Demand

Viet Nam is an emerging economy with a population of almost one hundred million inhabitants. Its annual GDP growth has ranged from 7-8% in the last decade. This growing trend is expected to remain until 2030, resulting in a high demand for electricity. The country's electricity demand has increased at an average of 10 percent per year over the past five years. To keep up with the demand, the country will need a significant amount of new capacity, requiring $150 billion in capital investments for generation and grid upgrades, according to EVN's estimates.[2]

In 2015, the Government of Viet Nam introduced the first national development strategy for renewable energy, aiming for renewables to account for around 32% of total primary supply and electricity generation by 2030. In 2020, The National Power Development Plan VIII (PDP VIII) and the National Energy Master Plan for the Period 2021–2030, Vision 2050, have been drafted at the same time. Following the plans, in the next 10 to 25 years, the government aims to increase new and renewable energy up to 30% of the total primary supply.

[2] McKinsey (2019), Vietnam's renewable energy future. Available at https://www.mckinsey.com/capabilities/sustainability/our-insights/sustainability-blog/vietnams-renewable-energy-future

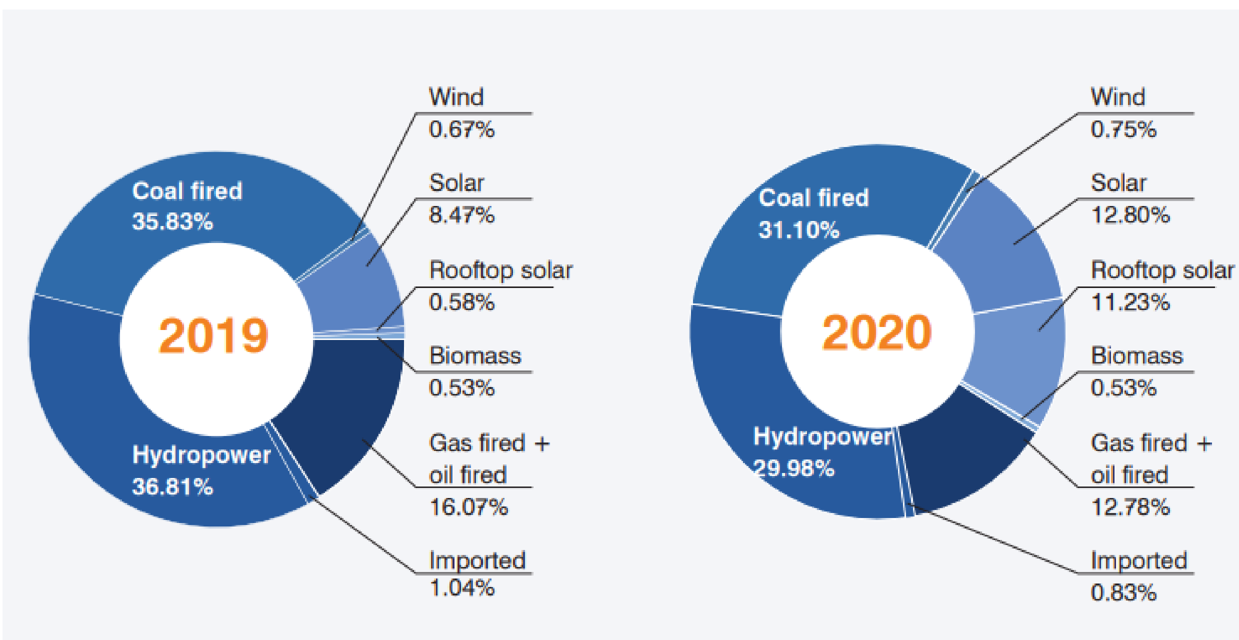
Figure 2: The installed capacity by fuel types in Viet Nam[3]

Installed capacity by fuel types

Power source	2019		2020	
	(MW)	(%)	(MW)	(%)
Hydropower	20,283	36.81%	20,774	29.98%
Coal fired	19,744	35.83%	21,554	31.10%
Gas fired + oil fired	8,857	16.07%	8,858	12.78%
Wind	369	0.67%	518	0.75%
Solar	4,669	8.47%	8,871	12.80%
Rooftop solar	320	0.58%	7,785	11.23%
Biomass	293	0.53%	365	0.53%
Imported	572	1.04%	572	0.83%
Total	**55,107**	**100%**	**69,297**	**100%**

Source: *International Trade Administration (2022)*

Figure 3: Percentage of power generation sources in Viet Nam[3]



Source: *International Trade Administration (2022)*

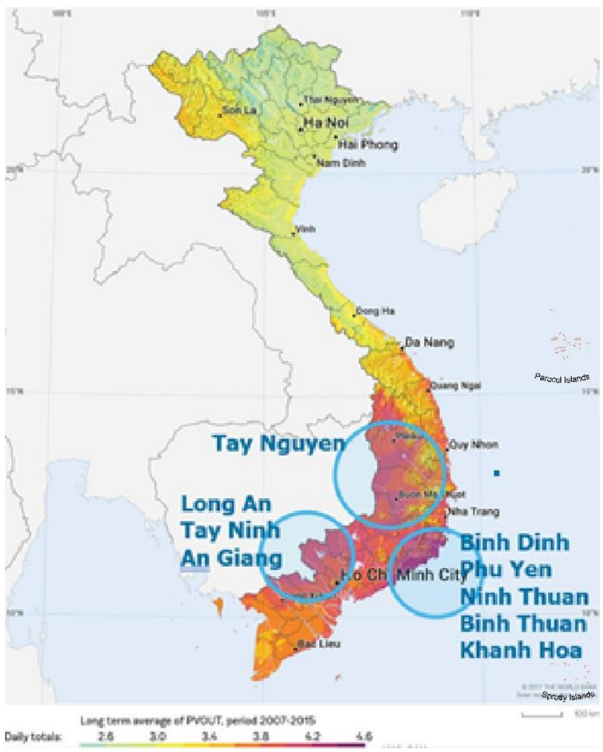
According to the report of the Institute of Energy of Viet Nam (IEV) from March 2021, the installed power-generation capacity in Viet Nam is approximately 56,000 MW (56 GW). The Vietnamese electricity system has a total installed power source capacity of about 69 GW (when adding hydroelectric power imported from Laos and rooftop solar PV power).

[3] International Trade Administration (2022), Vietnam's Power Generation, Transmission and Distribution. Available at https://www.trade.gov/country-commercial-guides/vietnam-power-generation-transmission-and-distribution

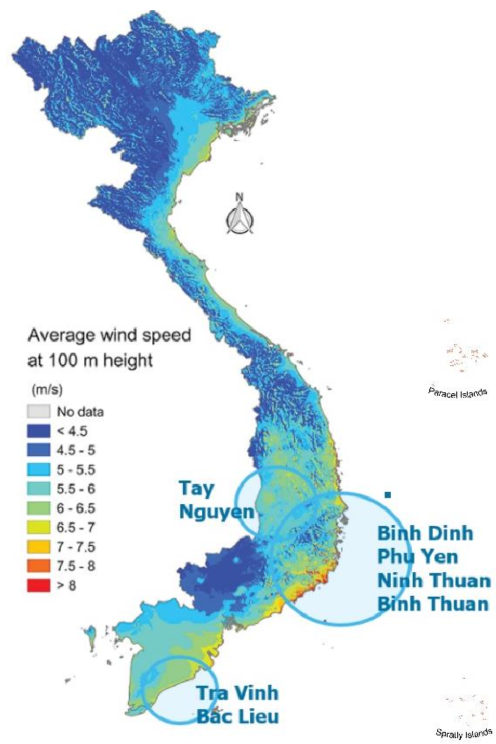
In March 2020, Viet Nam's Politburo (the highest body of the Communist Party of Viet Nam) issued Resolution No. 55 on Strategic Energy Orientation until 2030 with vision to 2045. Which underlines that installed capacity by 2030 is expected to be 125-130GW, meaning to double its capacity in 10 years.

2.2 Potential of Renewable Energy in Viet Nam

Figure 4: Potential areas for wind and solar PV power in Viet Nam[4]



Province with Solar PV Potential in Viet Nam



Province with Solar PV Potential in Viet Nam

***Source**: National Load Dispatch Center – EVN (March 2023)*

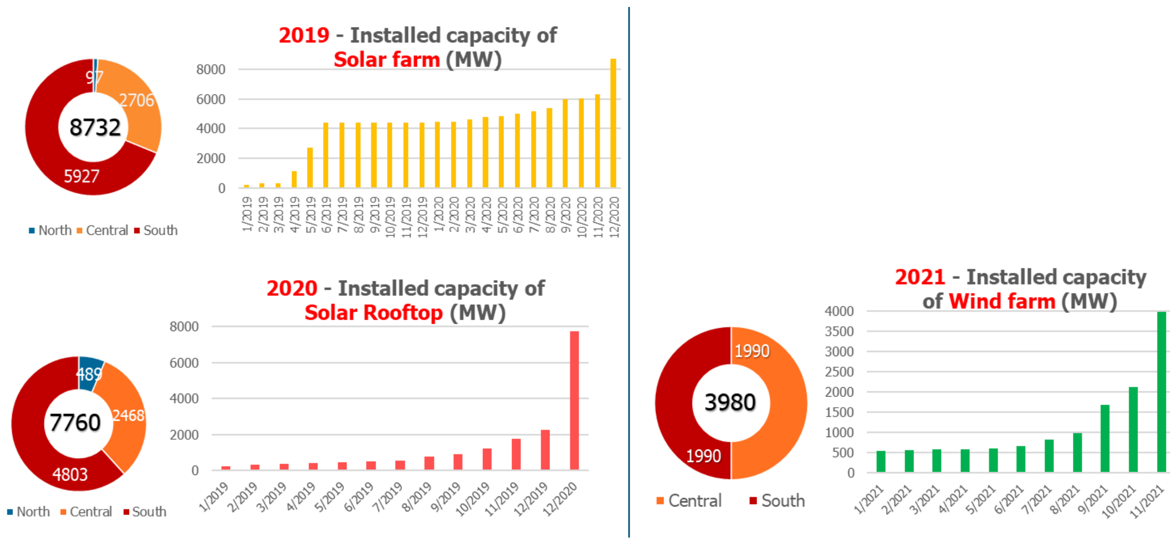
Viet Nam has considerable potential for harnessing its wind resources due to the long 3,000km coastline and being in the tropical wet climate and trade-wind littoral climate. The provinces with the most promising wind potential include Binh Thuan, Ninh Thuan, Vung Tau, Ben Tre, Soc Trang, Bac Lieu and the Central Highlands. Viet Nam is also considered as a nation with high solar PV potential, especially in the central and southern parts of the country such as the areas of Long An, Tay Ninh, An Giang, Tay Nguyen, Binh Dinh, Phu Yen, Ninh Thuan, Binh Thuan, Khanh Hoa. Solar PV energy intensity on average is 5 kWh/m^2. The intensity is lower in the North at about 4kWh/m^2 due to the annual winter-spring cloudy and drizzling sky.

[4] National Load Dispatch Center – EVN (March 2023), Report at "Shifting energy towards net zero emissions - Opportunities and challenges" Conference at VCCI, HCMC.

One prominent province with immense potential for both solar PV and wind energy is Ninh Thuan, located in the south-central coastal region of Viet Nam. Ninh Thuan has an average solar PV radiation of about 5.5kWh/m2/ay, the average number of sunshine hours is about 2,600-2,800 hours per year (equivalent to 200 sunny days/year), and a total solar PV power installation scale of about 1,500MW. The province has the largest number of solar PV power projects in Viet Nam.

Ninh Thuan also has the largest wind power potential in the country, with an annual average wind speed of about 7m/s at a height above 65m. The whole province has 14 potential wind regions with about 8,000 ha, concentrated mainly in the three districts of Ninh Phuoc, Thuan Nam, and Thuan Bac. Storms in Ninh Thuan are not serious, especially with the wind blowing steadily for 10 months at a speed of 6.4-9.6m/s, ensuring stability for wind power development. The technical wind power potential and the highly feasible area of Ninh Thuan are 1.442MW with 21,642 ha[5].

Figure 5: Development of solar PV and wind power in Viet Nam[4]



***Source**: National Load Dispatch Center – EVN (March 2023)*

Renewable Energy Growth in Vietnam's Power Development Plan

In the Power Development Plan (PDP) VIII, a comprehensive roadmap for the development of the country's energy power sector until 2030, with a vision to 2045, has been mapped out. The plan aims to balance the country's energy mix, ensure energy security, and promote sustainable development.[6]

With the Feed-in tariff price introduced by the government, renewable energy plants grew extremely fast, making the country one of the major RE installers. Viet Nam's installed wind power capacity grew to 787 MW during 2021, up from 637 MW a year earlier. Wind and solar power are

[5] Vu Minh Phap et al. (2020), Analysis of Economic and Technical Potential of Renewable Power Sources for Establishment of Renewable Energy Center in Ninh Thuan Province, Vietnam. E3S Web Conference 209, 06022.
[6] The Government (2023), Power Development Plan VIII. Available at https://xaydungchinhsach.chinhphu.vn/toan-van-quy-hoach-phat-trien-dien-luc-quoc-gia-11923051616315244.htm

set to cover 27% of the energy mix by 2030, according to the newly approved Power Development Plan (PDP VIII).

Viet Nam's installed solar PV capacity has doubled in recent years, rising to an estimated 17,600 MW in 2021, owing mainly to a massive build of more than 11,000 MW in 2020. Given the swift growth of the sector, the target for solar PV power could reach up to 22,000 MW by 2030 as proposed in the draft PDP VIII, until then issues over connecting the new solar PV capacity to the grid needs to be resolved.

One of the key objectives of the draft PDP VIII is to increase the share of renewable energy sources in the country's power generation mix. Viet Nam plans to increase the share of renewable energy sources to 21% by 2030. The plan also aims to reduce the share of coal-fired power plants to 43% by 2030. Coal power sources gradually switch to biomass or ammonia by gradually increasing the proportion from 20% after 20 years of operation of the sources. Then a switch to 100% biomass/ammonia burning after 30 years or by 2050 is foreseen. Liquefied Natural Gas (LNG) power gradually switches to hydrogen (10%, 100% hydrogen after 10, 20 years). There will be no more coal plants after 2030 and no more LNG plants after 2035.

The draft PDP VIII also focuses on enhancing the efficiency of the power sector. The plan aims to reduce the transmission and distribution losses to below 8% by 2030. It also aims to promote energy conservation and efficiency measures. After the COP26 Climate Change Summit, the draft PDP VIII was adjusted which showed an increase in renewable sources to reflect the commitment to "net zero" by the Vietnamese government:

Table 1: Updated share of renewable energy in Viet Nam after COP26[4]

Wattage of each renewable sources in MW	2030			2045		
	Before COP 26	4/2022	% increase/ decrease	Before COP 26	4/2022	% increase/ decrease
Hydro power	25,498	28,946	14%	30,077	35,139	17%
Onshore, nearshore wind power	12,470	16,121	29%	32,720	55,950	71%
Offshore wind power	2,000	7,000	250%	36,000	64,500	79%
Large-scale solar PV power	13,635	8,736	-36%	63,640	75,987	19%
Biomass and other renewable sources	1,170	1,230	5%	5,250	5,210	-1%
Pumped-storage hydroelectricity and storrage battery	2,400	2,450	2%	11,400	28,950	154%

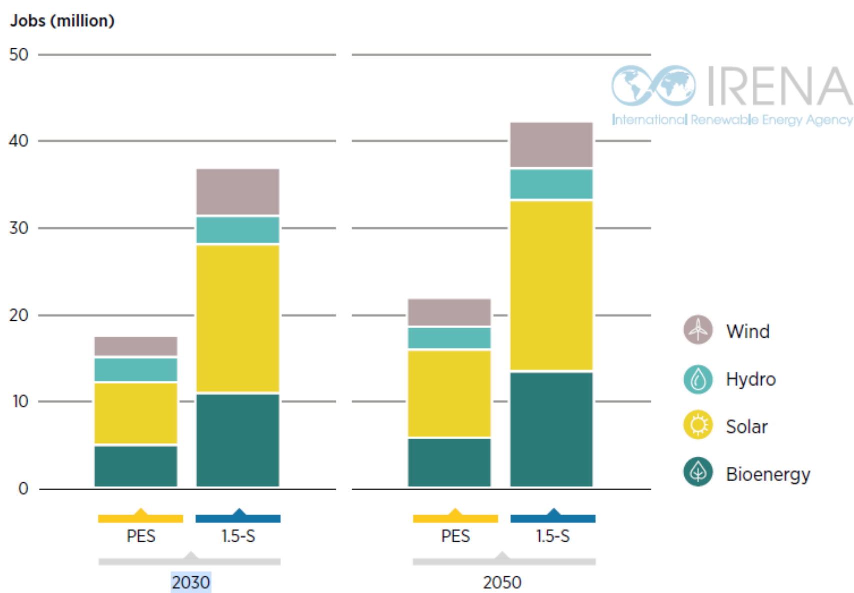
***Source**: National Load Dispatch Center – EVN (March 2023)*

On the 15 May 2023, Prime Minister with Decision 500/QD-TTg approved PDP VIII which shows more commitment to reduce the coal power capacity to 0 by 2050 and replaced by generation of renewable energy.

2.3 Employment in the Renewable Energy Sectors – Globally and in Viet Nam

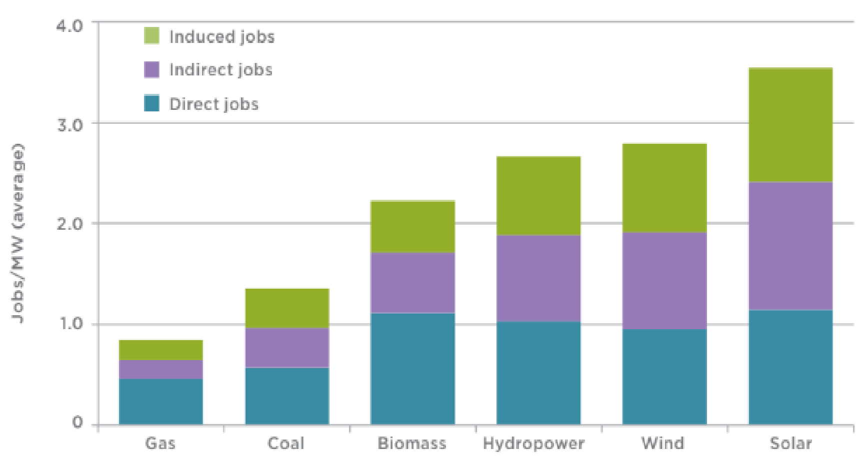
Looking at the big picture globally, under IRENA's 1.5°C compatible global pathway[7], the renewable energy sector could account for 38 million jobs by 2030 and 43 million by 2050, double the number under current policies and pledges. Worldwide, jobs in the whole energy sector will grow to 122 million in 2050 under the 1.5°C pathway, compared with 114 million under current policies and pledges. As is the case today, solar PV will make up the largest share of jobs in renewable energy in 2050, with 19.9 million jobs, followed by bioenergy (13.7 million), wind (5.5 million) and hydropower (3.7 million).

Figure 6: Estimated jobs in renewable energy by difference sectors globally, in 1.5-S scenario and planned energy scenario, 2030 and 2050[7]



***Source**: IRENA (2021)*

Figure 7: Comparable gross employment factor of each generation technology[8]



***Source**: IRENA (2014)*

[7] IRENA (2021), Renewable energy and jobs – Annual review.

IRENA's definitions of direct, indirect, and induced employment effects are used when reporting gross employment impacts:[8]

- 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.

A study on future skills and job creation through renewable energy in Viet Nam conducted by the Cobenefits in 2019, showed that over the lifetime of a power generation facility, renewable energy technologies had better employment effects in the power sector.[9] Solar PV, with an employment effect of 3.51 Jobs/MW average had the highest job creation effect, followed by wind (2.79 Jobs/MW average) and hydropower (2.66 Jobs/MW average).

Nevertheless, there is no official forecasting on HR for renewable energies in Viet Nam. Most of the experts who were interviewed agreed on large demand in the future, based on their own experience and observation of the power industry. A few businesses are pessimistic due to the overall difficulties of the industry (section 6). While data of employment effects by the energy transition remains limited in Viet Nam, this study suggests a deep dive to further study the human resource needs to address the demand of skilled workers, particularly graduates from TVET sector, and the linkage with stakeholder engagement mechanisms at national, sectoral, local and institutional level.

The rapid growth of the renewable energy in Viet Nam industry as elaborated in chapter 2.3 leads to the assumption that the government needs to prepare for the high demand of qualified labour supply to respond to the new requirement of the industry. Understanding the employment impacts of a sustainable transition to renewable energy generation is important for the government to mobilise sufficient efforts to address the knowledge and skill gaps of the labour force.

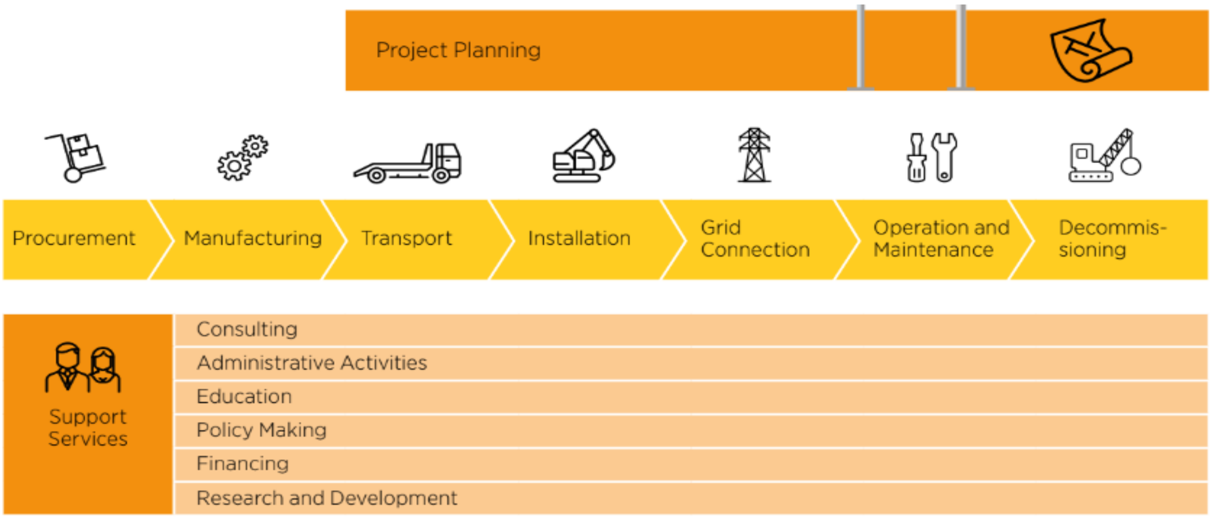
3 The Value Chain for the Wind and Solar PV Sectors, Globally and in Viet Nam

The first step of the research is a survey of relevant stakeholders, which will help the research team to clarify potential skill gaps between the needs of the industry and the products of Vietnamese vocational education system for renewable energy industry. To systematically identify relevant actors, it is necessary to establish the RE value chains, in which these actors have an overall impact and then, in particular, in the area of human resources. This section is devoted to creating such value chains. The desk research initially analysed on the global basic value chains, then narrowed it down to specify the situation of value chains in Vietnam. The basic structure of the value chain for both wind and solar PV power industries can be drawn as in Figure 8. The next two sections will dive deep into each value chain.

[8] IRENA (2014), REmap 2030: A Renewable Energy Roadmap.

[9] Cobenefits (2019), Future skills and job creation through renewable energy in Viet Nam.

Figure 8: Global basic structure of wind and solar PV power value chain[10]



***Source**: IRENA (2017)*

3.1 Value Chain - Wind Power Industry

The wind power industry value chain includes various stages of the production process, from raw materials to the end-user. Here are the main stages in the value chain of the wind power industry:

Table 2: Wind power value chain

Manufacturing of wind turbine components	**Phase 1**	**Raw Material Extraction**	The first stage involves the extraction of raw materials needed to manufacture wind turbines. The most important raw materials are steel, aluminum, and copper.
	Phase 2	**Component Manufacturing**	Once the raw materials are extracted, they are transported to factories to be transformed into components for wind turbines. These components include blades, hub, nacelle, tower, gearboxes, generators, and control systems.
Site preparation and transportation	**Phase 3**	**Site Preparation**	Site selection and feasibility analysis > Obtain necessary permits and approvals > Site assessment > Design and engineering > Equipment procurement > Key materials are steel, concrete.
	Phase 4	**Construction, Logistics, and Transportation**	Construction involves building access roads, installing foundations for the turbines, and installing transmission lines and other infrastructure.

[10] IRENA (2017), Renewable energy and jobs – Annual review.

			Heavy and large components of wind turbines are transported to wind farms by specialized trucks, trains, and ships.
Installation, sale, and distribution	**Phase 5** 	**Installation, Testing and Commissioning**	After being transported to the site, wind turbines are installed using heavy cranes, then tested and commissioned. This includes the installation of the blades, gearbox, generator, and control system onto the tower as well as the connection to the power grid. Once the wind turbines are operational, they generate electricity by converting the kinetic energy of wind into electrical energy.
	Phase 6 	**Sales, marketing, and customer service**	This involves the marketing and sale of wind power to utilities and other customers, including negotiating power purchase agreements and managing customer relationships.
	Phase 7 	**Operation, Transmission, Distribution and Maintenance**	The generated electricity is transmitted through high-voltage power lines and distributed to local grids to power homes, businesses, and other applications. Wind farms need regular inspections, repairs, and component replacements to ensure the turbines continue to operate efficiently and safely.
End of life	**Phase 8** 	**Decommission**	Several steps are required: Obtain necessary permit -> Dismantle turbines and infrastructure > Recovery (metals) > Waste disposal > Restore site > Further decommissioned site monitoring for any potential environmental impact issue.

***Source**: Authors' own compilation*

Overall, the wind power industry value chain is complex and involves many different stages, from raw material extraction to ongoing maintenance and finally to decommission. Each stage is essential to the production and operation of wind turbines, which generate clean, renewable energy. [11]

3.2 Value Chain – Solar PV Power Industry

The solar PV power industry value chain is an interconnected system that involves multiple players at various stages. Effective coordination and collaboration among these players are essential to achieve cost-effective, dependable, and sustainable solar PV power solutions.[12] The solar PV power industry value chain is often viewed in 4 segments: Upstream, midstream, downstream, and supporting services.

[11] Gloria Ayee et al., (2008), "Wind Power: Generating Electricity and Employment", Chapter 11 of Manufacturing Climate Solutions – Carbon-Reducing Technologies and U.S report.

[12] IEA (2022), Special Report on Solar PV Global Supply Chains.

Table 3: Solar PV power value chain

Upstream	**Phase 1**	**Raw Material Extraction**	The raw material for most solar PV cells is silicon, which is mined from quartz and then purified to produce silicon ingots.
	Phase 2	**Component Manufacturing**	The silicon ingots are sliced into thin wafers. The wafers are coated with chemicals to create a p-n junction to make solar PV cells that can convert sunlight into electricity. Solar PV cells are then assembled into modules or panels.
Midstream	**Phase 3**	**Site Preparation**	Availability of solar PV radiation > Site assessment (rooftops, ground mounts, or other structures) large enough to accommodate panels, inverters, others equipment > Environmental condition assessment > Grid connection assessment > Obtain necessary permits and approvals.
	Phase 4	**Installation and commissioning**	The panels are combined with other components, such as inverters, batteries, and monitoring systems, to create a complete solar PV system. The system is tested and verified for functioning correctly and producing the expected output. Safety certification is required.
Downstream	**Phase 5**	**Sales, marketing, and customer service**	This phase involves the distribution, marketing, and sales of solar PV power systems to end-users, such as residential, commercial, and utility-scale customers.
	Phase 6	**Operation, and Maintenance**	The solar PV system will require ongoing monitoring and maintenance to ensure that it continues to operate at maximum efficiency. This may include regular cleaning of the panels, monitoring the system's performance, and replacing any faulty or damaged components.
End of life	**Phase 7**	**Decommission**	At the end of their useful life, solar PV panels can be recycled or disposed of in an environmentally responsible manner.

***Source**: Authors' own compilation*

3.3 Stakeholders in Wind and Solar PV Value Chain in Viet Nam

Based on the research and interviews with stakeholders, for Viet Nam, most of the manufacturing of essential components happens abroad. They include solar PV panels, turbine (blade, rotor, gear box, generator, etc.), inverters. There have been considerable shipments of PV modules manufactured in Viet Nam to other markets but those are products of Chinese-invested manufacturers with the focus to exporting to the US market. Vietnamese manufacturer can provide wind tower, basic packaging of equipment with imported components provided by contractors like ABV, Siemens GE. Vietnamese businesses mostly focus on project development – financing, logistic, construction (for solar PV farms, and both in-shore and off-shore wind farms) to operations & maintenance (O&M) which is phase 4-7/8 for both solar PV and wind sectors. For sales, marketing, and services, since business can only sell to EVN, the activities and HR needs are simple compared to other phases.

4 Review of the Skill Needs for Wind and Solar PV Energy Sectors

4.1 Global Skill Needs for Wind and Solar PV Sectors

Overall, the global wind and solar PV energy workforce requires a diverse set of skills, including technical, operational, business, and managerial competencies, as well as effective communication, collaboration, problem-solving, innovation and creativity skills. Workers in general also need to be adaptable, fluent in digital tools and possess strong gender awareness. Table 4 below lists the surveyed skills needed for wind and solar PV sectors.[13,14]

Table 4: Global skills needs for wind and solar PV industries.

SKILLS	DESCRIPTION
Technical Skills	
Electrical Systems	Knowledge of electrical systems and components used in wind and solar PV energy systems
Mechanical Systems	Understanding of mechanical systems and components in wind and solar PV energy systems
Troubleshooting Skills (Ability to identify and solve problems in equipment and systems	
Repair	Knowledge of repair techniques for equipment and systems
Maintenance	Understanding of maintenance requirements for equipment and systems
Safety and Compliance Skills	
Health and Safety Regulations	Knowledge of health and safety regulations related to installation, operation, and maintenance of wind and solar PV energy systems
Environmental Regulations	Understanding of environmental regulations related to wind and solar PV energy systems
Industry Standards	Knowledge of industry standards related to wind and solar PV energy systems
Project Management Skills	
Project Planning	Ability to plan and organize wind and solar PV energy projects
Budgeting	Understanding of budgeting and financial management for wind and solar PV energy projects
Risk Management	Ability to identify and mitigate risks associated with wind and solar PV energy projects

[13] IRENA (2022), Renewable energy and jobs – Annual review.

[14] ILO (2020), Skills for a Greener Future: A Global View.

SKILLS	DESCRIPTION
Stakeholder Engagement	Knowledge of methods for engaging stakeholders in wind and solar PV energy projects
Business Skills (Companies need workers with business skills to understand the economic and financial aspects of wind and solar PV energy projects. This includes skills in financial management, marketing, and business development.)	
Communication and Collaboration Skills	Effective communication and collaboration to work effectively with colleagues, stakeholders, and customers. Workers need to have good people skills, be able to work collaboratively in teams, and be able to communicate technical information to non-technical stakeholders.
Analytical and Problem-Solving Skills	Analyze data, identify problems, and develop solutions. This includes skills in data analysis, modelling, and simulation.
Innovation and Creativity	As the wind and solar PV energy sectors continue to evolve, workers need to be able to think creatively and develop innovative solutions to challenges.
Adaptability and flexibility	The wind and solar PV energy sectors are rapidly evolving, and workers need to be able to adapt to modern technologies, work practices, and regulations. This requires a willingness to learn and a flexible approach to work
Digital skills	With the increasing use of digital technologies in the wind and solar PV energy sectors, workers need to have digital literacy skills (software usage and tools for data collection, monitoring, and analysis).
Gender-sensitive skills	To ensure that women are included and empowered in the wind and solar PV energy sectors

***Source**: Authors' own compilation*

4.2 Global Challenges on Developing Adequate Human Resources for Wind and Solar PV Industries – Approaches to address these Challenges.

Developing human resources in the field of wind and solar PV energy is a complex challenge faced by many countries. One major obstacle is the mismatch between education system offer and industry demand. Many countries do not have adequate educational institutions or training programs that focus on renewable energy technologies.

Another challenge is the shortage of experts in the field. The renewable energy industry is an emerging sector, and there is a limited pool of experienced professionals. This scarcity makes it difficult for countries to find the necessary human resources to lead their renewable energy projects. Additionally, the high demand for these professionals often results in increased competition to attract talents, making it difficult for some countries to attract and retain skilled workers. Those problems are acute especially in developing countries.

Final challenge is the cost of implementing renewable energy technologies can be prohibitive. Many developing countries face financial constraints and may not have the necessary resources to invest in renewable energy infrastructure or human resources development.[15], [16]

We look briefly to India which is close to Viet Nam both geographically and economically. India had problems in skills gaps for wind and solar PV industry that can serve as indicators of what Viet Nam is facing. India set an ambitious target of achieving 175 GW of renewable energy by 2022. However, the country faces a severe shortage of skilled human resources, particularly in the solar PV and wind energy sectors. The lack of qualified professionals in the sector has led to a significant gap between demand and supply in HR, hindering India's progress in RE development.[17] Since 2010, India has been trying to address this skill gap by several approaches including creating the national skill development program.[18] If the problem of skill gap is solved effectively, employment prospects in India's RE sectors are bright. According to the 2019 study by Cobenefits, India's total employment in RE will be 3.2 million people.[19]

Brief desk research shows that to overcome the challenges in HR for RE sectors, solutions such as investing in educational institutions, training programs, and apprenticeships to develop a skilled workforce have been identified and implemented. Government can also provide incentives for businesses to invest in renewable energy technologies, which can lead to job creation and human resources development. Furthermore, collaboration and knowledge-sharing among countries can help to accelerate the growth of the renewable energy industry and ensure that human resources development is a global priority. Employers must work closely with educational institutions to develop standardized training programs and offer incentives to attract and retain skilled professionals. Governments and industry bodies can also play a role in supporting the development of renewable energy human resources through funding and policy initiatives.

[15] IRENA (2019), Renewable energy and jobs – Annual review.
[16] Hugo Lucas et al. Solar PV Energy, Volume 173, October 2018, Pages 449-455, Education and training gaps in the renewable energy sector.
[17] The Economics Times (2023), India misses RE capacity target due to low solar rooftop, wind energy project installations: Parliamentary panel. Available at: https://economictimes.indiatimes.com/industry/renewables/india-misses-re-capacity-target-due-to-low-solar-rooftop-wind-energy-project-installations-parliamentary-panel/articleshow/98870462.cms

[18] Suramiya Skill Devlopment Program. Available at https://suryamitra.nise.res.in/
[19] Cobenefit (2019), Future skills and job creation with renewable energy in India.

5 Relevant Stakeholders in Wind and Solar PV Power Energy in Viet Nam

5.1 Global Stakeholders in the Wind and Solar PV Power Value Chain

The wind power value chain involves various stakeholders who play a crucial role in the production and distribution of wind energy. This report identifies these below stakeholders with different involvement to the phases in the value chains:

Table 5: Stakeholders in wind power value chain

No.	Stakeholders	Description
1	Wind Turbine Manufacturers	These are companies that design, manufacture, and supply wind turbines for power generation.
2	Component Suppliers	These are companies that supply components required for manufacturing wind turbines. These components include blades, towers, gearboxes, generators, and control systems.
3	Wind Farm Developers	Identify and secure suitable locations for wind farms, conduct feasibility studies, obtain necessary permits, secure financing the project, and construct the wind farm. They work with buyers for safe and effective connection to the grid. Operate and own the wind farms, ensuring they are running efficiently and safely. Responsible for maintenance, repair, and upgrading of the wind turbines.
4	Construction, Transportation and Environmental Companies	These are companies that construct wind farms and install wind turbines. They are responsible for the civil works, electrical works, and commissioning of the turbines.
5	Operators and Maintenance Companies	These are companies that operate and maintain wind farms to ensure optimal performance and uptime. They conduct regular maintenance, repairs, and troubleshooting to minimize downtime and maximize energy production.
6	Power Purchase Agreement (PPA) Buyers	Utility companies, government entities, or corporations that purchase the electricity generated by the wind farm and distribute it to end-users. They play a crucial role in integrating wind energy into the grid and ensuring a stable and reliable supply of electricity.
7	Regulators and Governments	Government agencies and regulators that set policies, regulations, and incentives to encourage the development and adoption of wind power. They set standards for safety, quality, and environmental impact, and provide incentives and subsidies to encourage investment in wind power.
8	Local Communities	Provide input, support, or opposition to the construction of wind farms. Can also benefit from the economic opportunities associated with wind power development.
9	HR Development	These companies/institutions provide skilled labor to various stakeholders in the wind power value chain. They are responsible for sourcing, recruiting, and training personnel for wind farm development, construction, operation, and maintenance.
10	Investors	Provide financial services for wind power projects, including loans, equity investments, and project financing. Examples include banks, private equity firms, and development finance institutions.
11	Donors	Provide funding for research and development for wind power projects, often in developing countries. Examples include governments, and multilateral development organisations.

***Source**: Authors' own compilation*

The value chain of solar PV industry is a bit different from wind industry on two important aspects: (i) setting up and further O&M work in solar PV projects are simpler than in wind projects and (ii) solar PV panel can be sold directly to consumers for private usage without the need to sell electricity to a distributor.

Table 6: Stakeholders in solar PV power value chain

No.	Stakeholder	Description
1	Raw Material Suppliers	Companies extract and supply the raw materials needed to produce solar PV panels, such as silicon, aluminum, and copper.
2	Solar PV Panel and Component Manufacturers	Companies that produce solar PV panels using the raw materials supplied by the raw material suppliers. They assemble cells, frames, and other components to make solar PV panels. Companies that provide other important components such as solar PV inverters, storage inverters, and storage batteries.
3	Distributors	Companies that buy solar PV panels from the manufacturers and distribute them to various end-users, such as households, businesses, and government agencies.
4	Installers	Companies that install solar PV panels on rooftops, grounds, or other locations. They normally also provide maintenance and repair services. There is also 3rd party O&M provider.
5	Power Purchase Agreement (PPA) Buyers	Companies that buy solar PV energy from individuals or businesses that generate excess energy from their solar PV panels and distribute it to other customers on the grid.
6	Government, Regulatory Agencies	Entities that create policies, regulations, and incentives that encourage the adoption of solar PV energy. They also set standards for the quality and safety of solar PV panels.
7	Investors	Individuals or institutions that provide financial support to solar PV companies or projects. They may invest in manufacturing, distribution, installation, or financing of solar PV energy projects.
8	Donors	Provide funding for research and development for solar PV power projects, often in developing countries. Examples include governments, and multilateral development organisations.
9	Consumers	Individuals or businesses that use solar PV energy for their own purposes, such as powering their homes or offices. They may also sell excess energy back to the grid.

***Source**: Authors' own compilation*

5.2 Stakeholders related to HR and awareness for renewable energy development.

In both wind and solar PV power industries, as the industry expands, it is crucial to develop the necessary human resources to support it. This requires the involvement of various stakeholders, including government agencies, industry associations, educational institutions, companies, foreign agencies, and communities. We continue to breakdown the stakeholders involving in the value chains in previous section that are relevant to Viet Nam's conditions.

Table 7: Mapping roles of stakeholders in the value chain of wind power industry

		Wind Turbine Manufacturers	Component Manufacturers	Wind Farm Developers	Construction, Transportation and Environmental Companies	Operators and Maintenance Companies	Power Purchase Agreement (PPA) Buyers	Regulators and Governments	Local Communities	HR Development	Investors	Donors
Stakeholders present in Vietnam				Most companies in Vietnam			EVN	Government, MoIT, MoLISA	Local people, government	School, MoIT, MoLISA	Bank, Fund	NGO, agencies
Phase 1	Raw Material Extraction	x	x					x	x	x		
Phase 2	Component Manufacturing	x	x					x	x	x		
Phase 3	Site Preparation			x				x	x	x	x	
Phase 4	Construction, Logistics, and Transportation			x	x			x	x	x		x
Phase 5	Installation, Testing and Commissioning			x	x			x	x	x		x
Phase 6	Sales, marketing, and customer service			x				x	x	x		x
Phase 7	Operation, Transmission, Distribution and Maintenance			x		x	x	x	x	x		x
Phase 8	Decommission			x	x	x		x	x	x		X

***Source**: Authors' own compilation*

Viet Nam's wind power value chain involves multiple stakeholders who work together to generate, distribute, and utilise wind energy. Each stakeholder plays a crucial role in ensuring the success of the industry and the transition to a more sustainable energy future. As of now, Vietnam has not yet developed a significant wind turbine manufacturing industry. So relevant stakeholders in Viet Nam are mostly positioned from Phase 3 to Phase 8.

Table 8: Mapping roles of stakeholders in the value chain of solar PV power industry

		Solar PV cells Manufacturers	Component Manufacturer s	Solar PV Farm Developers	Construction, Transportation and Environmental Companies	Operators and Maintenance Companies	Power Purchase Agreement (PPA) Buyers	Regulators and Governments	Local Communities	HR Development	Investors	Donors
Stakeholders present in Vietnam		Mostly for export		Most companies in Vietnam			EVN	Government, MoIT, MoLISA	Local people, government	Schools, MoIT, MoLISA	Bank, Fund	NGO, agencies
Phase 1	Raw Material Extraction	x	x					x	x	x		
Phase 2	Component Manufacturing	x	x					x	x	x		
Phase 3	Site Preparation			x				x	x	x	x	
Phase 4	Installation, testing, and commissioning			x	x			x	x	x		x
Phase 5	Sales, marketing, and customer service			x				x	x	x		x
Phase 6	Operation and Maintenance			x		x	x	x	x	x		x
Phase 7	Decommission			x	x	x		x	x	x		X

***Source**: Authors' own compilation*

Viet Nam’s solar PV power value chain involves multiple stakeholders who work together to generate, distribute, and utilise solar PV energy. Each stakeholder plays a crucial role in ensuring the success of the industry and the transition to a more sustainable energy future. As of now, Viet Nam has companies to produce solar PV panels and some key components but mainly for export purpose. So relevant stakeholders in Vietnam are mostly positioned from Phase 3 to Phase 7.

In later sections, we present and analyse surveys and interviews to these stakeholders to explore and analyse their impact to the human resource factor in Viet Nam’s both value chains.

Companies

Through analysing the value chain and conducting interviews with stakeholders, at this stage of the development of Viet Nam’s renewable sectors, it can be concluded that the job opportunities will mostly be on operation and maintenance (O&M). Businesses need many technicians working at wind farms while demand for solar PV sector is low. Although technical foundation requirements for wind and solar PV are the same, the wind sector requires more specific training and knowledge because machines and components in the wind industry are more advanced and complicated. Further, workers are required to have better physical health conditions for working at height, offshore and under high-risk conditions. The feedback from companies shows that they can hire technical talents from other fields (electrical, mechatronics, construction) and provide further specialised training on renewable energies to satisfy human resources needs.

Interested people can also register for different training courses such as on safety and technical skills at the Global Wind Organization (GWO) to strengthen their skills.

Some companies also rely on O&M teams provided by suppliers since it is challenging for them to recruit and manage people, but they all expect to build internal teams in the future. The situation also gives rise to potential O&M service providers participating in the labour market.

It is found that the difference between students from universities and from vocational colleges is not significant. In general, companies need graduates with high O&M skills sets. Graduates from high-ranking universities tend to focus more on the design and research aspects and less on the real world. Companies are satisfied with recruits coming even from low-ranking universities and vocational colleges as long as the graduates have good technical and O&M skills. Experts from the education sectors shared that some vocational colleges with better equipments and better internship programs can perform even better in preparing their graduates.

A more detailed survey of companies shows that technicians for O&M positions can be categorized into 5 levels i.e. (i) elementary level doing manual work (60-70%), (ii) intermediate level for more technical tasks including troubleshooting (20-30%) and (iii) engineer level for troubleshooting, improving efficiency (5-10%). Higher than these levels are (iv) experts that cover commissioning and (v) managers.

Companies can provide training programs and job/internship opportunities for individuals interested in pursuing a career in the sector. They collaborate with educational institutions to develop training programs that meet the needs of the industry. A case study of this collaboration is the support of CEO of Song Hung Thuan – a developer and O&M business for University of Technical Education HCMC for their renewable energy bachelor program.

Government agencies

The Vietnamese government plays a crucial role in promoting the development of renewable energy and ensuring that the necessary policies and regulations are in place to support it. They can also provide funding for training programs and research initiatives. Additionally, government agencies can collaborate with educational institutions and energy companies to establish a framework that supports the development of the renewable energy sector.

There are several government agencies responsible for Technical and Vocational Education and Training (TVET) in Viet Nam which might be oversee vocational renewable human resource development. These agencies include:

1. Ministry of Labour, Invalids and Social Affairs (MoLISA)
2. Directorate of Vocational Education and Training (DVET), including its departments, e.g. Formal Training Department, Continuing Training Department, Skills Training Department, and Vietnam Vocational Education and Training Accreditation Agency (VETA).
3. Ministry of Industrial and Trade (MoIT)

MoLISA is the primary government agency responsible for labour and social affairs, which includes the development and implementation of TVET policies and regulations. Under MoLISA, DVET is a subordinate agency of MOLISA, undertakes functions of providing consultancy, assistance for MoLISA in state management and organizing implementation of law on VET (excludes pedagogy) across the country; managing, implementing public services concerned with TVET under its authority as regulated by the law. DVET is responsible for the development of policies, strategies, projects, plans on VET, national technical standard, professional economic – technical norms in the field of vocational education; national occupational skills standards, etc. and assist the MoLISA to direct, provide guideline and organize the implementation of these policies, strategies, projects, plans, etc. The State management function in TVET includes:

- Formal training in TVET.
- Continuing training.
- TVET teachers and management staff.
- Student affairs in TVET.
- Physical Assets & Training Equipment in TVET
- Accreditation of TVET quality.
- Assessment and grant of national occupational skills certificates.

DVET is also responsible for the management of VET levels in Viet Nam Qualification Framework. There are different department under DVET i.e. Formal Training Department, Continuing Training Department, Skills Training Department, and Vietnam Vocational Education and Training Accreditation Agency (VETA), etc.

DVET is proposing to synchronously develop the vocational skill ecosystem including 5 basic pillars: standardization of vocational skill of workers; assessment and issuance of national vocational skill certificates; education and training and vocational training; recruiting and employing workers with vocational skill and technical and financial resources (Skills Training Department 2023).

Unfortunately, renewable energy is a new sector and is not in the list of key occupations of MoLISA. And as they must focus resources on foundation skills and other programs in key occupation list, further effort to address skills gap in renewable energy must be spent by all stakeholders.[20] Especially at the standardisation phase so that RE trade can be considered as a key vocation.

Under MoLISA, there are 1040 vocational colleges[21], and none has an official RE program. Our interview with one of those schools, Ninh Thuan Vocational College, and with HCM University of Education and Technology (key provider of vocational teachers) shows that it is needed to further establish learning outcomes for RE programs. This task can be done best with support from business.

Under MoIT, there was effort to target the RE needs through official programs in 2 colleges: Ho Chi Minh City Electric Power College and Mientrung Industry and Trade College. However, they only have solar PV energy facilities. There are no facilities for teaching skills related to wind power yet. Recruitments started in 2011 with vocational intermediate level (1.5 years) and vocational college level (2.5 years). Some students graduated and have found jobs. Representative from MoIT expresses the need for some mechanism to get support to the school from business.

Renewable Energy Industry Associations

Table 9: Renewable Energy Industry Associations

1	Viet Nam Clean Energy Association (VCEA)	VCEA is a non-profit organization that focuses on promoting and developing clean energy, encouraging the use of renewable energy sources, such as solar PV, wind, hydro, and biomass in Viet Nam. Their activities include advocacy and policy development, capacity building, providing training and education programs to promote the adoption of clean energy technologies and practices, research and development activities to identify and promote innovative clean energy solutions and networking and partnerships, brings together clean energy industry professionals, investors, and policymakers to share knowledge, build relationships, and collaborate on sustainable energy projects.
2	Viet Nam Energy Association (VEA)	VEA has been working closely with the government to develop policies and regulations that support the growth of renewable energy. It has been advocating for the implementation of incentives, such as tax breaks and feed-in tariffs, for businesses and investors who invest in renewable energy projects. VEA has also been working closely with the government to ensure a more transparent and streamlined licensing process for renewable energy projects.
3	The Vietnam Chamber of Commerce and Industry (VCCI)	VCCI is a key player in promoting the growth and development of renewable energy in Vietnam. Through its advocacy, policy support, technical assistance, and partnership building initiatives, the organization is contributing to the country's efforts to transition to a more sustainable, low-carbon future.
4	Binh Thuan Wind and Solar PV Energy Association	This is Industry forum of one of the strongest provinces in renewable energy. The association receives participation of business and local governments and has long time conducting activities to promote the use of renewable energies, conferences to target difficulties and training, RE potential surveying program in the province.

***Source**: Authors' own compilation*

[20] MoLISA (2019), Decision 1769/QD-LDTBXH on approval of key industries and occupations..

[21] National Institute for Vocational Education and Training of DVET (2019), Report on Vocational Education and Training of Viet Nam.

Educational Institutions:

Universities and vocational schools can provide the necessary education and training for individuals interested in pursuing a career in renewable energy. They can also conduct research to advance in the industry and develop modern technologies. Officially, graduates at university level will not be available in 1-2 years. One of the findings is that not many institutions offer programs or courses on renewable energy. Universities mostly offer extra courses integrating to other electrical and power programs. Only one university offers a dedicated program on renewable energy. Only 2 vocational colleges under MoIT offer O&M program for solar PV energy. General observation shows that universities are more on theoretical and design while vocational colleges are more on practical with previous support from other organizations to have better training facilities and equipment. Vocational colleges also have better links to renewable energy companies to help train their students.

Some TVET Institutes have institutionalized collaboration with key businesses as part of Industrial Advisory Boards (IAB) at college level such as IAB for Energy and Building Technology at VCMI or IAB for Industrial Electric-Electronics at NTVC. Even with Ninh Thuan Vocational College shows an active role in Provincial TVET Council especially Renewable energy taskforce and engage a lot of leading businesses in the province in the taskforce to provide sufficient advice for TVET system and the development of skilled labour force in the province.

Table 10: Institutions with renewable energy programme

University programme		
1	Hanoi University of Science and Technology (HUST)	The School of Electrical Engineering offers an international accredited bachelor's program in Electrical Engineering with a specialization in Power System and Renewable Energy (EE-E18x). 50 students enroll for this programme each year. The training provides students with the knowledge and skills needed to design, install, and maintain renewable energy systems. It covers topics such as solar PV energy, wind energy, hydro energy, and bioenergy.
2	Vietnam National University, Ho Chi Minh City (VNUHCM)	The University offers a bachelor's programme in Energy Engineering, which covers the fundamentals of energy engineering and introduces students to various renewable energy sources.
3	University of Technology and Education at HCMC	The University offers the RE bachelor programme (7510208D) is a comprehensive and focused program with participation of industry for teaching and internship phase. The latest cohort is in third year.
4	Vietnam France University - USTH	The University offers a bachelor programme on electrical engineering and Renewable Energy which provides technical knowledge of production, transmission, distribution, and use of electricity. Students will be equipped with knowledge of smart grid, renewable energy technologies such as photovoltaic systems, wind power, hydropower, biofuels, fuel cells, energy efficiency, and management.
5	University of Engineering and Technology, National University at Hanoi	The University offers the Bachelor programme in Energy Engineering with theoretical courses on renewable and sustainable energy.
6	Danang university of Technology	The University offers the Bachelor programme in energy and environmental engineering with courses renewable energy.

Vocational programme		
1	Ninh Thuan Vocational College	NTVC offers a training programme for teachers. Modules on solar and wind energy were developed and integrated into the general electrical-electronics and mechatronic programmes, with support from GIZ. A 3-months short course offered to students and technicians on rooftop solar. Trainees have opportunities to learn how to install, operate and maintain rooftop solar power systems as well as general knowledge of commercial marketing, and customer consulting services. NTVC aims to create itself as a Center of Excellence (CoE) for research, development, and skills training for RE with support from other stakeholders, developing their own certificate program or importing foreign program. Instructors are also providing services for wind farm in Dak Lak. As Ninh Thuan is the most prominent province for renewable energy, they think it is easy to recruit students. They also receive requests for program transfer from other provinces such as Tra Vinh, Soc Trang, Khanh Hoa, Da Nang.
2	Mientrung Industry and Trade College	The college offers a training programme on the Installation and Maintenance of Renewable Energy System at college level (6520270). This school has a workshop for solar PV energy practice.[22]
3	Ho Chi Minh City Electric Power College	The college offers a training programme on the Installation and Maintenance of Renewable Energy System (6520270). This school has a workshop for solar PV energy practice.
4	Hue Industrial College	Two modules called renewable energy and solar PV rooftop integrated in electrical, heat and refrigeration Engineering program. The school is considering pursuing an official training program in RE or short-time certificate. Under the electrical-electronics department, there are 3 main subject groups i.e. Industrial electricity, Electronics Automation and Electrical System and Renewable Energy.
5	The Vocational College of Machinery and Irrigation	VCMI to build the College into a high quality Green TVET center in Vietnam; contribute to providing a qualified labor force to meet the needs of developing a “Green” and sustainable economy in the process of industrialization, modernization and international integration of Vietnam. With the help of the German GIZ, in recent years, the College has worked with international experts to organize many advanced courses for managers, employees; supplementing modern training equipment to serve the needs of training in the field of Electrical – Electronics and Mechanical Engineering. Currently, the College is being supported by top technical experts of GIZ to develop intermediate, college level output standards for new occupations 1) Electronic for Energy Efficiency and Building Technology and 2) Mechanics for Sanitary, Heating and Climate Technology which related to solar energy.

***Source**: Authors’ own compilation*

[22] MoLISA (2020), Circular 26-202 on List of training programs IV for intermediate and college levels.

Non-governmental organizations (NGOs) and non-profit social enterprises

NGOs can play a role in promoting the development of renewable energy and advocating for policies that support it. They can also provide training and education initiatives for communities and individuals interested in learning more about renewable energy.

In Viet Nam, Viet Nam Sustainable Energy Alliance (VSEA) is a network of NGOs working to promote sustainable energy development. They work to increase public awareness, advocate for renewable energy policies, and support the development of renewable energy projects.

Development agencies

Technical and Vocational Education and Training (TVET) is an essential aspect of Viet Nam's education system. To support the development of TVET in Vietnam, several development agencies have been supporting the country's efforts:

- **The Deutsche Gesellschaft fuer Internationale Zusammenarbeit und Entwicklung (GIZ)** is one such agency that has been supporting TVET in Viet Nam. GIZ has been working with the Vietnamese government to improve the quality of vocational training by providing technical assistance, curriculum development, and teacher training.
- **The Australian government** has also been supporting TVET in Viet Nam through the Australian Department of Foreign Affairs and Trade (DFAT). DFAT has been working with the Vietnamese government to develop and implement vocational education and training programs that meet the needs of the country's workforce.
- **The United States Agency for International Development (USAID)** is another agency that has been supporting TVET in Vietnam. USAID has been working with the Vietnamese government to improve TVET policies and practices, as well as supporting the development of vocational education and training programs.
- **European countries** provided support such as the Danish-Vietnamese Technical and Vocational Education and Training (TVET), and the EU VET Toolbox grant to support Vietnam to benchmark VET provision against UK quality standard frameworks.
- Other agencies supporting TVET in Viet Nam include the Japan International Cooperation Agency (JICA), the United Nations Development Programme (UNDP), ADB, and the World Bank.

Communities

Local communities can play a role in supporting the development of renewable energy by advocating for policies that promote it and participating in training and education initiatives. They can also provide feedback to stakeholders on the needs of the community and potential job opportunities.

In central Viet Nam, the community of Phong Dien has been using solar PV power to light up their streets. The local government installed solar PV panels on streetlights to save electricity costs and reduce carbon emissions. The residents also installed solar PV panels on their rooftops to power their homes and businesses.

This is just an example of how local communities in Viet Nam are taking the initiative to promote renewable energy. By utilizing natural resources such as water, sunlight, and wind, these communities are not only reducing their carbon footprint but also becoming more self-sufficient in terms of energy production.

Training service provider

Global Wind Organization (GWO) has authorized several training centers in Viet Nam such as Vivablast to provide standardized training for wind technicians. These centers offer courses in Basic Safety Training, which covers topics such as first aid, safety, working at heights, turbine, blade inspection and service, basic technical skills (hydraulics, mechanical, electrical). These training certifications open opportunities for both business and technicians to work both in Viet Nam and abroad as we will elaborate further below in 6.4.

Research institutions

Viet Nam's basic research in solar PV energy has focused on developing more efficient solar PV cells and improving the storage of solar PV energy. Viet Nam's research institutions have been working on developing new materials for solar PV cells, such as perovskite, which seems to be very promising. They have also been improving the storage of solar PV energy in batteries, which is crucial for ensuring a constant supply of energy. The research work has been conducted at research institutions such as Vietnam Institute of Physics, Vietnam Institute of Energy, Laboratory of Nanotechnology in HCMC and in prominent universities such as Hanoi University of Science and Technology and HCMC University of Technology.

Basic research in wind technology is not prominent for Viet Nam. Their work is mostly on application and HR training. These institutions can serve as knowledge hubs when Viet Nam moves up in the value chain in both the solar PV and wind industry.

Representatives of the Institute of Technical Education, HCM University of Technology and Education were interviewed in the frame of this study. The mentioned organization oversees designing new training programs using the DACUM method. It was found from our interview that there is a lack of overall strategy to address the training gap at vocational schools. A collaboration between the schools, businesses and the government are much needed to standardise learning outcomes, bring support and further investment into the schools.

6 General challenges for Renewable Energy Sectors in Viet Nam

6.1 Covid-19

The Covid-19 pandemic has had a significant impact on many industries worldwide, and the RE energy sector in Viet Nam has not been immune to this disruption. Both wind and solar PV projects were affected by lesser demand of electricity during Covid-19.

One of the most significant effects of the pandemic on wind farms in Viet Nam has been the disruption of supply chains. Many of the components needed to build and maintain wind turbines are imported from other countries. The delay affected the completion of on-going projects and prevented them of getting the favorable FIT price which expired on 31/10/2021.[23]

Another significant impact of Covid-19 on wind farms in Viet Nam has been the disruptions to workforce availability. Furthermore, the pandemic has caused a decline in electricity demand in Viet Nam, leading to a decrease in electricity prices. This has made it difficult for wind farms to compete with other energy sources, and some wind farms have had to reduce their output or shut down temporarily.

6.2 Long term concern

Viet Nam has made significant strides in developing its renewable energy sector over the past decade, but there are still several challenges and barriers that must be addressed to accelerate its growth and achieve its clean energy targets. Here are some of the main challenges and barriers for renewable energy sector in Viet Nam:

1. Insufficient policy and regulatory framework: While Viet Nam has implemented policies and regulations to promote renewable energy, there is still a lack of comprehensive and consistent framework that could incentivise and support private sector investments in the sector.
2. Limited financing options: Renewable energy projects often require large capital investments, but the financing options available to project developers in Vietnam are limited, particularly for smaller-scale projects. The high upfront costs and long payback periods also make it challenging to secure funding from commercial banks.
3. Grid capacity constraints: The existing electricity grid infrastructure in Vietnam was not designed to accommodate large-scale renewable energy projects. This means that there are limitations on the amount of renewable energy that can be integrated into the grid without causing instability and reliability issues.[4]
4. Land acquisition issues: Land acquisition for renewable energy projects can be challenging, particularly in densely populated areas where land is scarce and competition for use is high. This can lead to delays and increased costs for project developers.
5. Limited local supply chain: There is a lack of local supply chain for renewable energy equipment, which makes it more expensive and difficult to import necessary components and can also lead to quality concerns and delays in project development.

[23] GWEC (2021), USD 6.7 billion in wind power investment in Vietnam at risk without COVID-19 relief. Available at https://gwec.net/gwec-usd-6-7-billion-in-wind-power-investment-in-vietnam-at-risk-without-covid-19-relief/

6.3 Urgent Concern of the Industry - Feed-in Tariffs Price

On 7 January 2023, the MoIT announced that the ceiling price will be VND 1,184.90/kWh for ground mounted solar PV projects, VND 1,508.27/kWh for floating solar PV projects, VND 1,587.12/kWh for onshore wind projects and VND 1,815.95/kWh for offshore wind projects. These prices are 20-30% lower than previous tariffs. There are 84 renewable energy projects (34 completed) across the country (total capacity of 4,676 megawatts) to fall under the new tariffs.[24]

Wind and solar PV energy developers are concerned they may go bankrupt as the government's new feed-in tariffs are too low for them to make profits. The low tariffs might make it impossible for developers to pay back the loans and they must lower the project's internal rate of return. In the view of the developers, there is an apparent risk of never opening projects for business.

Previously, the Vietnamese government has called for reducing 'high price' renewable energy. Wind energy in Viet Nam is more expensive than globally and power from other sources, while technology has progressed very rapidly, and production costs have fallen greatly. Renewable energy businesses do not have to invest in the transmission network, which has been done at huge cost by the government.[25] So, in the government's view, it is necessary to review electricity prices and renegotiate wind power deals to find suitable solutions that harmonise the benefits of investors, the government and consumers.

In conclusion, while the wind power and solar PV power industries in Viet Nam have great potential for growth and development, there are still some challenges that need to be addressed. The government's support and incentives have attracted significant investment in the sector, but more efforts are needed to overcome the difficulties in obtaining permits, grid connection and setting a reasonable buying price to fully realize the potential of the renewable energy sector in the country.

6.4 Difficulties in Developing Adequate Human Resources for Wind and Solar PV industries

Our extensive survey and interview of companies in the renewable energy business in Vietnam has revealed several challenges in recruiting suitable human resource.

Lack of specialized training programme

The first is the lack of specialized training programs for renewable energy. Most universities and vocational schools in Viet Nam do not offer programs that focus specifically on renewable energy. For universities, separate courses and modules on the topic is integrated into the curriculum but the added knowledge is mostly theoretical and do not bring enough practical exposure to the students. For vocational colleges, only 2 colleges officially offer programs in RE as shown in Table 10.

To mitigate this issue, Vietnamese businesses are choosing either (i) to outsource O&M work to equipment suppliers or (ii) recruiting candidates with background on electrical system and mechatronics and spending time and resources on training these new hires, which can be costly

[24] Vnexpress (2023), Clean energy firms fear bankruptcy amid low prices. Available at https://e.vnexpress.net/news/economy/clean-energy-firms-fear-bankruptcy-amid-low-prices-4581681.html

[25] Vnexpress (2022), PM calls for reducing 'high' renewable energy prices. Available at https://e.vnexpress.net/news/industries/pm-calls-for-reducing-high-renewable-energy-prices-4544334.html

and time-consuming. Some have relied on private training service provider to get qualified workers with a certificate on safety, health, rescue and others basic but standardised technical skill to work on wind farm.

Currently some service providers in Viet Nam have filled the missing role of formal institutions and even provide training for foreigners from Japan, Korea, Indonesia. They even helped sendind technicians to work abroad. This turns out to be a good opportunity for HR in Vietnam since both training centers and vocational colleges confirm the opportunity of exporting technicians to foreign countries which cannot fill up openings for blue-collar work in their countries. Our interviews show that West European and Asian countries like India, Taiwan need such workers.

Lack of experienced professionals

Second issue is the lack of experienced professionals in the field. The head of a large consultancy firm in Viet Nam working on wind industry has revealed that he lost many qualified staff. Many businesses must compete for a small pool of experienced candidates, which drives up the cost of hiring and can lead to a shortage of qualified staff. Many key positions must be filled with foreigners from G7 countries which will drive the cost higher for investors.

In addition, no human resource or skills forecast for renewable energy have been conducted in Viet Nam. The only projection was conducted by IRENA back in 2019[15], which has been outdated with the recent commitment of Viet Nam to the net zero future and recent turmoil in the industry deal to Covid 19 and to the so hot development of the sectors in the last 5 years.

Education programs are not ready

Additionally, although having a rapid growth, the renewable energy industry is still relatively new in Viet Nam, and there is a shortage of regulatory frameworks and standards. Like it is mentioned above, renewable energy is not in the list of key occupations of MoLISA, so although some stakeholders anticipate rapid scale up on Vietnam's human resource, government agencies and educational institutions still cannot make the needed preparation quickly enough. This can make it difficult for businesses to know what qualifications and certifications are required for different roles to recruit accordingly and offer satisfying remuneration. On the side of institutions, both, universities and vocational colleges have difficulties to properly prepare curriculum and invest in training equipment to meet future demand.

Fresh Graduates Lack of Soft Skills

Finally, soft skills of Vietnamese students – how to behave in an industrial working workplace, how to work in team and collaborate with others, language skills – are all concerns for business. This issue was mentioned in all our interviews, although the business sector is generally satisfied with graduates' foundational and technical skills. They all found that effective employees will need to receive on-job training to have more exposure to real workplace, learn more on new technologies and machineries and acquire more soft skills. Having these skills improved before students leaving schools are preferable to business. This soft skill deficiency has been reported and addressed for long by multiple initiatives and institutions and companies can learn from those case studies to best calibrate their actions.

In conclusion, the renewable energy industry in Viet Nam is facing significant challenges when it comes to hiring qualified human resources. Businesses will need to work closely with universities and technical institutions to develop specialized training programs, as well as invest in the development of their existing staff to meet the demands of this growing industry.

Addressing these challenges and barriers will require a coordinated effort from policymakers, project developers, investors, and other stakeholders. The government could develop and implement more comprehensive and consistent policy and regulatory frameworks, increase financing options, upgrade the grid infrastructure, streamline land acquisition procedures, develop a local supply chain, and invest in training programs to develop a skilled workforce. Within the scope of this study, we will propose a mechanism for addressing these challenges.

7 The necessity of forming an engagement mechanism among stakeholders for renewable energy industry in Viet Nam

Through analysing the current situation and potential development trends of the renewable energy industry in Viet Nam, it can be said that Viet Nam has a lot of potential to become a powerhouse in wind and solar PV energy. At the same time, based on the current capacity in training skilled workers for the renewable energy industry, it is still sketchy, poor and unsystematic. Programs at the university level focus on general theoretical training on renewable energy while in the vocational education sector there are very few vocational education institutions, both public and private, that have vocational skills training program for the workforce serving the renewable energy industry. Since then, there is a very urgent requirement for Viet Nam to prepare a skilled workforce for the development strategy and trends of the industry, turning potential into advantages and driving force for the transformation to clean energy production, associated with SDG sustainable development goals and Vietnam's net zero commitments at COP26, and at the same time proactively ensure national energy security.

To fulfil the above requirement, in the context of labor market fluctuations, the demand for skills for workers is increasing and new skills are constantly changing. Experience in setting up the human resource development strategies, especially in new industries in Viet Nam such as the renewable energy industry, shows the need to build a close engagement mechanism between the industry/ enterprises and training service providers (schools, training institutions, training centers) and government authorities, policy makers and human resource development for the industry.

Through a engagement mechanism, the requirements and forecasts of knowledge and skills for each job position will be continuously updated and discussed by enterprises with government authorities on vocational education at all levels in order to promptly develop policies on macro level, including the issuance of relevant training codes, development of relevant learning outcomes, and training support a suitable teaching staff, and at the same time guide schools and training institutions to develop training programs that properly meet the trends and development needs of the industry.

This mechanism also creates conditions for schools and businesses to interact more frequently, promoting businesses' participation in vocational education in a more substantive, comprehensive, and effective way. Especially for new occupations, professional requirements and standards including requirements for knowledge, skills and attitudes are standardised according to international standards. Establishing an engagement mechanism between the labor market and vocational education system also play a key role in sharing knowledge and saving resources between Viet Nam and other countries in the world. Thereby, it will help the trained workforce in Viet Nam approach quickly to the international standards, be ready to participate in job positions that require skills according to the professional standards required by the industry.

In Viet Nam, this engagement mechanism has been piloted in recent times in a number of industries, with different names and structures such as Sector Skills Council for agriculture sector supported by ILO, managed and operated by the skills department of the Directorate of Vocational Education - DVET); Industry Reference Council (in logistics industry, initiated by Aus4skills in collaboration with Vietnam Chamber of Commerce and Industry Branch in Ho Chi Minh City – VCCIHCM) or Quality Advisory Board in TVET (in automotive engineering, aquaculture, textiles, hospitality - supported by the Norwegian Employers Federation (NHO) with management and operation by VCCIHCM). Although the name is different, the overall goal of this mechanism is to help the supply and demand parties in the labor market together with the relevant government authorities interact and cooperate closely with each other.

In the frame of this study in-depth interviews were conducted with stakeholders including state management agencies in vocational education (DVET and Departments of Labour, Invalids and Social Affairs in the provinces); training institutions, businesses, and business associations in the renewable energy industry. All the interviewees said that the formation of this cohesive mechanism is necessary and showed interest and support for the operation of this mechanism, is established. These can be considered as initial favorable conditions for the formation of a Skills Council for the renewable energy industry in Viet Nam.

8 Conclusion and recommendations

This study has done wide research on value chain mapping to have more understanding of the skill gap in Viet Nam's RE. Multiple stakeholders from business, institutions, government agencies have been consulted. One major finding is that Viet Nam has the potential to follow the 2050 "net zero" commitment and even to become a forerunner in wind and solar PV energy in the ASEAN region but lacks skilled workers.

Due to the rapid development of RE sectors, stakeholders in the education sector are lacking behind, and more work needs to be done. Vietnam's HR deficiency is due to (i) lack of specialized training programs, (ii) lack of experienced professionals, (iii) lack of readiness of education programs and (iv) lack of general soft skills.

To address this, there is the need to build a close engagement mechanism between the industry, training providers, and government authorities to update and discuss knowledge and skill requirements for each job position. A pilot of this engagement mechanism has shown favorable conditions for the formation of a Skills Council for the renewable energy industry in Viet Nam. This will help bridge the gap between supply and demand in the labor market for each industry and ensure national energy security.

References

Cobenefit (2019), Future skills and job creation with renewable energy in India.

Cobenefits (2019), Future skills and job creation through renewable energy in Viet Nam.

Gloria Ayee et al. (2008), "Wind Power: Generating Electricity and Employment", Chapter 11 of Manufacturing Climate Solutions – Carbon-Reducing Technologies and U.S report.

GWEC (2021), USD 6.7 billion in wind power investment in Vietnam at risk without COVID-19 relief. Available at https://gwec.net/gwec-usd-6-7-billion-in-wind-power-investment-in-vietnam-at-risk-without-covid-19-relief/

Hugo Lucas et al. Solar PV Energy, Volume 173, October 2018, Pages 449-455, Education and training gaps in the renewable energy sector.

International Trade Administration (2022), Vietnam's Power Generation, Transmission and Distribution. Available at https://www.trade.gov/country-commercial-guides/vietnam-power-generation-transmission-and-distribution

IEA (2022), Special Report on Solar PV Global Supply Chains.

IRENA (2014), REmap 2030: A Renewable Energy Roadmap.

IRENA (2017), Renewable energy and jobs – Annual review.

IRENA (2019), Renewable energy and jobs – Annual review.

IRENA (2022), Renewable energy and jobs – Annual review.

IRENA (2021), Renewable energy and jobs – Annual review.

ILO (2020), Skills for a Greener Future: A Global View.

McKinsey (2019), Vietnam's renewable energy future. Available at https://www.mckinsey.com/capabilities/sustainability/our-insights/sustainability-blog/vietnams-renewable-energy-future

MoLISA (2019), Decision 1769/QD-LDTBXH on approval of key industries and occupations.

MoLISA (2020), Circular 26-202 on List of training programs IV for intermediate and college levels.

National Institute for Vocational Education and Training of DVET (2019), Report on Vocational Education and Training of Viet Nam.

National Load Dispatch Center – EVN (March 2023), Report at "Shifting energy towards net zero emissions - Opportunities and challenges" Conference at VCCI, HCMC.

Suramiya Skill Devlopment Program. Available at https://suryamitra.nise.res.in/

The Economics Times (2023), India misses RE capacity target due to low solar rooftop, wind energy project installations: Parliamentary panel. Available at: https://economictimes.indiatimes.com/industry/renewables/india-misses-re-capacity-target-due-to-low-solar-rooftop-wind-energy-project-installations-parliamentary-panel/articleshow/98870462.cms

The Government (2023), Power Development Plan VIII. Available at https://xaydungchinhsach.chinhphu.vn/toan-van-quy-hoach-phat-trien-dien-luc-quoc-gia-119230516163152444.htm

Trung Nam Group (June 2023). Available at https://www.trungnamgroup.com.vn/en-US/business-activity/energy

Vnexpress (2022), PM calls for reducing 'high' renewable energy prices. Available at https://e.vnexpress.net/news/industries/pm-calls-for-reducing-high-renewable-energy-prices-4544334.html

Vnexpress (2023), Clean energy firms fear bankruptcy amid low prices. Available at https://e.vnexpress.net/news/economy/clean-energy-firms-fear-bankruptcy-amid-low-prices-4581681.html

Vu Minh Phap et al. (2020), Analysis of Economic and Technical Potential of Renewable Power Sources for Establishment of Renewable Energy Center in Ninh Thuan Province, Vietnam. E3S Web Conference 209, 06022.

Annex 1: *Suggested Questions for An In-Depth Interview with a Renewable Energy Technical Consultant*

The interview will begin with a brief introduction to the research as well as the objectives of the interview.

- Could you please brief us on the employment situation and characteristics of Vietnamese youth, economic transformation trends (digital transformation, automation, energy transition, etc.) and labour mobility? Is there a mismatch between supply and demand for the skills and experience required? How do you assess the impact of the energy transition on the workforce and job demand?
- Are there any skills forecasts at the national or sectoral level related to RE so far in Viet Nam?
- Does your organization support capacity building for schools (both University and TVET Institutes) to develop any new training programs related to energy transition or renewable energy (program code, training program code)?
- Has your organization developed or provided any programs to prepare teachers of training institutions (teachers, trainers, in-company trainers) to meet the upcoming needs related to the new renewable energy sector?
- So far, has your organization cooperated with relevant ministries and relevant domestic and international partners, the business sector, and educational institutions to develop programs suitable for the renewable energy sector?
- A Skills Council model for RE sector will help linking government agencies - training institutions – business sector. It will act as the bridge between demand and supply, advise on policy formulation to strengthen stakeholders' capacity, contribute to Skilled labour force, support labor Market Intelligence including skills forecasting, provide training and skills solutions, support development of qualifications and programme that meet the need of employers, etc. What do you think about such kind of mechanism and who need to be involved in the mechanism?
- Please share your thoughts on plans to support the development of high-quality human resources for the energy transition.

Annex 2: *Suggested Questions for An In-Depth Interview with Representatives of a Vocational Education Research Center*

The interview will begin with a short introduction to the research as well as the objectives of the interview.

- Could you please brief us on the energy context in Viet Nam, especially energy transition?
- Could you please brief us on the employment situation and characteristics of Vietnamese youth, economic transformation trends (digital transformation, automation, energy transition, etc.) and labour mobility? Is there a mismatch between supply and demand for the skills and experience required? How do you assess the impact of the energy transition on the workforce and job demand?
- Are there any any skills forecasts at the national or sectoral level related to RE so far in Viet Nam?
- Does your center have any collaboration programme with or support capacity building for schools (both university and TVET institutes) to develop any new training programs related to energy transition or renewable energy (program code, training program code)?
- Has the center developed or provided any programs to prepare teachers of training institutions (teachers, trainers, in-compant trainers) to meet the upcoming needs related to the new renewable energy sector?
- So far, has the institute cooperated with relevant ministries and relevant domestic and international partners, the business sector, and educational institutions to develop programs suitable for the renewable energy sector?
- A Skills Council model for RE sector will help linking government agencies - training institutions – business sector. It will act as the bridge between demand and supply, advise on policy formulation to strengthen stakeholders' capacity, contribute to Skilled labour force, support labor Market Intelligence including skills forecasting, provide training and skills solutions, support development of qualifications and programme that meet the need of employers, etc. What do you think about such kind of mechanism and who need to be involved in the mechanism?
- Please share your thoughts on plans to support the development of high-quality human resources for the energy transition.

Annex 3*: Suggested Questions for An In-Depth Interview with Business Representative*

Learn About Business: A Brief Introduction to Business? (Find out first, only ask directly when needed and add confirmation)

Establishment, structure, ownership, conditions, size, etc.

Business activities related to wind and solar PV power.

- Involving two industries
- How many MW of rooftop solar PV power system has produced over the past year?
- How many MW of energy did the solar PV farm system produce over the past three years?
- How many MW energy blocks did the wind energy system produce over the past three years?
- How many MW energy do you expect the rooftop solar PV system to produce over the next three years?
- How many MW energy do you expect the solar PV farm system to produce over the next three years?
- How many MW energy do you expect the Wind Energy System to produce over the next three years?
- What areas are businesses investing in? What are the main activities of the business?
- How many locations does your business have in Vietnam that operate in the wind/solar PV power sector?
- Could you please briefly share about the opportunities and challenges businesses face related to wind and solar PV power?
- What are the medium- and long-term challenges that businesses perceive?

Learn More About Human Resource Development (Questions sent separately, ask more direct inquiries if necessary)

- Total number of employees if shareable
- The ratio of technical employees/employees doing other jobs (administrative, financial, sales ...).
- Please outline the difficulties in recruiting suitable personnel for technical positions, if any.
- What is the level of education for the current technical personnel in the company? Mark (x) the relevant items.

High school and below	
Post-secondary	
Beginner level	
Intermediate level	
Associate degree	
Bachelor's degree	
Postgraduate Certificate	

- For new technical positions, are there any of the following skill sets or credential requirements? What is important for each skill set?

		Necessary	Favorite	Not necessary or preferred	Irrelevant
1	Previous work experience in related fields such as mechanical engineering and electrical installations				
2	Previous work experience in the wind/ solar PV power industry				
3	Training on wind / solar PV power (courses, seminars, forums...)				
4	Professional certification in the profession				
5	Wind/Solar PV Specific Professional Certification				
6	Associate degree in engineering				
7	Associate degree in wind/solar PV power				

- For each occupation, what training courses have been implemented for workers to maintain and improve their professional qualifications for the company work? What is your strategy to retain and upskill employees? What qualifications are required in your organization?
- Is there a mismatch/gap between the skills and experience your business needs and the skills and experience of newly hired workers?
- If YES, from your point of view, what is the root cause of this problem?
- What skills are required that are lacking in your business?
- Please evaluate the quality of new employees when entering the enterprise, especially those who have just started work from vocational schools, universities, or other higher education institution?
- What do you think about the quality of new employees graduating from vocational college or university? What is your assessment of vocational training qualifications in the vocational education market? Which activities are good, what ones are missing? What are the points to consider when starting to develop deeper training programs?
- How does your business find/recruit qualified talent or employees?
- Does your business have cooperative activities with government agencies, non-governmental organizations, vocational training schools, universities to support the training of young workforce, (e.g., internships, in-house training, etc.)? If so, please share about this cooperation, and how do you assess its effectiveness and impact?
- Do you know of any other stakeholders that have had a positive impact on the development of technical human resources for the company?

Annex 4: *Suggested Questions for An In-Depth Interview with TVET Institutions Representative*

The interview starts with the short introduction on the study and objective of the interview.

1. Learning about TVET School:
   - Establishment
   - Occupations/training offered by the school so far.
   - Number of students
2. Learning about the training programmes linked to RE:
   - Does the school have training programmes on sustainable energy/renewable energy? If YES, since when has this training programme(s) been introduced? Why did your school develop these programme(s)?
   - How does your school assess these sustainable energy/RE training programs regarding helping students develop the knowledge and skills required by employment now and in the future?
   - What are challenges and difficulties of your school in enrollment and training the students in RE?
   - How would your school assess the linkage between school and industry to develop a highly skilled labour force for the labor market?
   - If your school identifies any gaps in the industrial linkage, how do you improve the training programme and help students acquire the skills needed to transition to professional working environments?
   - Does DVET have any new programme supporting RE training and does school have opportunity to access the benefit of those programme?
   - From your point of view, any skill forecast, or labour market information has been done? If YES, please kindly share more detail?

Annex 5: *Suggested Questions for An In-Depth Interview with Related Government Agencies*

The interview will begin with a brief introduction to the research as well as the objectives of the interview.

- Could you please brief us on the energy context in Viet Nam, especially energy transition?
- Could you please brief us on the employment situation and characteristics of Vietnamese youth, economic transformation trends (digital transformation, automation, energy transition, etc.) and labour mobility? Is there a mismatch between supply and demand for the skills and experience required? How do you assess the impact of the energy transition on the workforce and job demand?
- Are there any skills forecasts at the national or sectoral level related to RE so far in Viet Nam?
- Does your organization support capacity building for schools to develop any new training programs related to energy transition or renewable energy (program code, training program code)?
- Has your organization developed or provided any programs to prepare teachers of training institutions (teachers, trainers, in-company trainer) to meet the upcoming needs related to the new renewable energy sector?
- So far, has your organization cooperated with relevant ministries and relevant domestic and international partners, the business sector, and educational institutions to develop programs suitable for the renewable energy sector?
- A Skills Council model for RE sector will help linking government agencies - training institutions – business sector. It will act as the bridge between demand and supply, advise on policy formulation to strengthen stakeholders' capacity, contribute to Skilled labour force, support labor Market Intelligence including skills forecasting, provide training and skills solutions, support development of qualifications and programme that meet the need of employers, etc. What do you think about such kind of mechanism and who need to be involved in the mechanism?
- Please share your thoughts on plans to support the development of high-quality human resources for the energy transition.

***Annex 6**: List of companies interviewed for this report.*

	Name	Details
1	Thuan Binh Wind Power JSC	Windfarm developers
2	Thuan Hai Renewable Energy Power	Consultancy, O&M
3	Song Hung Thuan Company	Consultancy, O&M
4	Trung Nam group	Wind and solar PV farm developer
5	Gia Lai Electricity Company	Wind and solar PV farm developer, O&M
6	Tidisun	Solar PV panel trading, O&M
7	BIM group	Wind and solar PV farm developer
8	Cleantech	Solar PV rooftop developer, O&M
9	Vivablast Vietnam Co.Ltd	Servicing, training, O&M
10	Dam Nai Renewable Energy Project	Wind energy project

***Annex 7**: List of other stakeholders interviewed for this report.*

	Name	Details
1	Directorate of Vocational and Training (DVET)	Department of Vocational Skills, and Department of Vocational Training.
2	Ministry of Industry and Trade (MoIT)	Power Market Development Research and Training Center
3	Power Engineering Consulting Joint Stock Company (EVN-PECC3)	Expertise on renewable energy consulting, development
4	Ninh Thuan Vocational College	Vocational college under MOLISA
5	Ninh Thuan Province	Leadership of the province
6	Hue Industrial College	Vocational college under MOIT
7	Physics Institute	Expertise on renewable energy since ‘90
8	Institute of technical education - HCM University of Education and Technology	Expertise on curriculum development