CASE for Southeast Asia

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

IKI INTERNATIONAL CLIMATE INITIATIVE

Co-benefits of energy transition in Viet Nam's industrial development

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The study was conducted within the framework of the CASE Project, which aims to support partner countries in Southeast Asia in transitioning to a future clean energy system that provides reliable and affordable energy to the people while advancing political ambitions to achieve the Paris Agreement. With a comprehensive approach involving public, private and research organisations, the CASE project seeks to contribute to the transformation of the energy sector in Thailand, Indonesia, the Philippines and Viet Nam towards an evidence-based energy transition.

Ha Noi, 2023

Summary

The study on "Co-benefits of energy transition in Viet Nam's industrial development" aims to provide an overview of the localisation of the industrial sector amid the energy transition. It examines various aspects, including policy framework, international experience, current status and the localisation potential of two key technologies: wind and solar power in the period 2025-2050. On the other hand, this study also serves as a foundation for GIZ to conduct more detailed and in-depth policy framework research for localisation in the next stages.

Research results show that in general, the total market potential of wind and solar power technologies across the three stages of project development, manufacturing, installation/construction in the period 2025-2050 is estimated at nearly USD 160 billion (at 2023 current prices), accounting for 1.02% of Viet Nam's Gross Domestic Product (GDP) of the entire period. This figure is roughly equal to the 2022 GDP contribution at current prices of the Industry and Construction sector, with a value of USD 155 billion. Of which, the market potential of offshore wind accounts for the largest proportion of 51.8% (USD 82.5 billion), followed by onshore wind (24.3%) and solar (24%).

The average local content for solar power is approximately 45% at present and is projected to increase to nearly 78% by 2050. For wind power, the localisation rate is 37% at the current time and is anticipated to reach 54% by 2050. During the entire 2025-2050 period, the localised value of wind and solar power technologies in the three aforementioned project stages is projected to reach nearly USD 80 billion, accounting for 50% of the total market potential for these two technologies. Although the current average local content of solar power is higher than that of wind power, the localisation of solar power mainly focuses on stages with low cost share in the investment unit cost, whereas the production stage for solar panel, which on average takes up a relatively high percentage of costs at about 55%, has a low local content level due to competition with imported products from China.

Promoting localisation will bring certain benefits, however, localisation policy also faces challenges such as (1) Clearly defining how much localisation is reasonable and designing a roadmap to achieve that goal, (2) Insufficient investment and low technological capability have become significant challenges for Vietnamese enterprises engaging in supporting industries, (3) The localisation targets has not been integrated into FDI attraction policies.

In addition, there are challenges in transitioning jobs from the current labour market to a high-skilled labour market, especially in the context where multinational corporations implement supply chain strategies that involve multiple support suppliers, as seen with companies like Samsung, Toyota, Intel, etc.

To maximise the benefits and minimise the challenges of localisation, a number of policy proposals should be considered:

- Integrating co-benefits of energy transition into legal system and policy impact assessment processes. Early co-benefit assessment should be conducted as soon as possible to provide inputs from the policy formulation stage to ensure comprehensiveness and optimal policy decisions.

- Determining the socio-economic development targets of the energy transition trend through local content targets: One of the potential benefits of local content requirements is the opportunities it provides for domestic enterprises to learn by doing and to promote innovation. Prioritising the localisation of the stages of project development, installation/ construction, and manufacturing of equipment that Viet Nam currently has strengths in, such as substations, cables, towers, mounting structures, etc. This is especially instrumental in the context of integrating international RE supply chains with high entry barriers. In this context, Viet Nam will need to thoroughly break down current market conditions and existing value chains in order to develop appropriate local content targets for different periods.

- Increasing local value through human resource development: Viet Nam has established effective "demand pull" policies, including FIT, rooftop solar power development supporting policies, etc. However, the "supply push" measures have not yet been implemented strategically due to the conditions available at the time. Viet Nam's value creation can be promoted by combining product R&D with human resource training and development of domestic service providers. This will also help reduce the dependence on foreign experts. Furthermore, Viet Nam can provide skilled engineers to other countries in the region.

Limitations of the study: Due to time and resource constraints, the study has certain limitations. For example, the quantity and volume of survey samples are still modest, at the same time, the project development, equipment manufacturing, and construction stages in the value chain have not yet been dissected at deeper levels. Further in-depth research on the localisation of the wind and solar power industry in the next period is required to inform a policy framework and detailed roadmap that will maximise the benefits and mitigate the risks of localisation, and carefully consider these limitations when applying the results to the real contexts.

Disclaimer

While to the maximum extent possible the authors have attempted to provide up-to-date and reliable information provided in this report, the authors cannot be held legally responsible for its absolute accuracy. The information presented was provided at the time of research and may change over time.


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Content


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LIST OF ACRONYMS

No.	Acronyms	Full form
1	BAU	Business as usual
2	CASE	Clean, Affordable and Secure Energy for Southeast Asia
3	CCUS	Carbon capture, use and storage
4	CEM	Clean Energy Ministerial
5	EVN	Viet Nam Electricity
6	FDI	Foreign Direct Investment
7	FIT	Feed-in-Tariff
8	GDP	Gross domestic product
9	GIZ	German Agency for International Cooperation
10	GHG	Greenhouse gas
11	IE	Institute of Energy
12	IEA	International Energy Agency
13	IPCC	Intergovernmental Panel on Climate Change
14	IPG	International Partners Group
15	IRENA	International Renewable Energy Agency
16	JETP	Just Energy Transition Partnership
17	JSC.	Joint Stock Company
18	Ltd.	Limited

19	MOIT	Ministry of Industry and Trade
20	OECD	Organisation for Economic Cooperation and Development
21	PDP 8	National Power Development Plan VIII
22	PECC	Power Engineering Consulting JSC
23	PECC1	Power Engineering Consulting JSC 1
24	PECC2	Power Engineering Consulting JSC 2
25	Portcoast	Portcoast Consultant Corporation
26	PTSC	PetroVietnam Technical Services Corporation
27	PTSC	PetroVietnam Technical Services Corporation
28	PVN	PetroVietnam
29	PV	Photovoltaic
30	R&D	Research and development
31	RE	Renewable energy
32	Standard PPA	Standard Power Purchase Agreement
33	VATEC	VATEC Energy Engineering Consulting Company
34	Vinacomin	Viet Nam National Coal - Mineral Industries Holding Corporation Limited
35	VPI	Viet Nam Petroleum Institute

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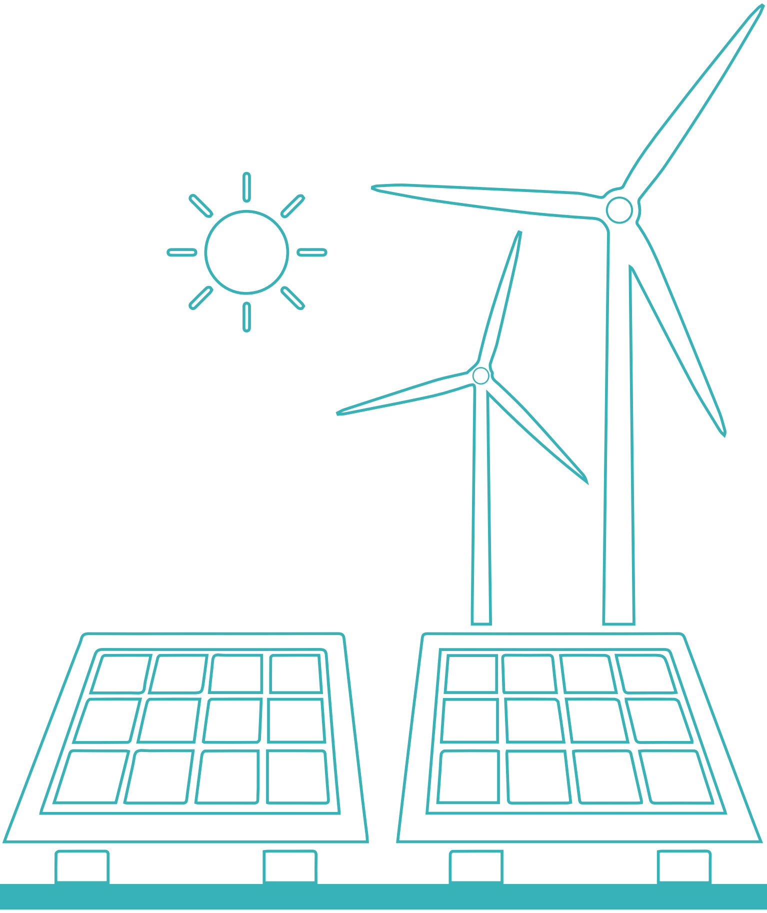

Overview

Since the 1990s, the term "co-benefits" has been widely used in both academia and official policy documents. This term has become popular in recent years and 'co-benefit' has become an important concept in policy development, implying the interconnection of energy security, environmental and sustainable socio-economic development goals. Major reports of the Intergovernmental Panel on Climate Change (IPCC) now feature "co-benefits" as a central concept. Here, the concept "co-benefits" refers to "positive impacts that a policy or measure can have on other objectives alongside its main objective".

However, the interpretation of "co-benefits" varies significantly in research as well as policy documents, depending on specific purposes and the context used to analyse impacts and plan relevant policies. For example, the document *Mobilizing the co-benefits of climate change mitigation*[1] presents specific experiences in assessing the co-benefits of low-carbon policies across cities, land use and energy sectors. In addition, other approaches and methods are being developed to carry out co-benefit assessments in climate and energy policies. As demonstrated in the *Global Energy Assessment (GEA) 2012*, the co-benefit approach in the energy sector revealed many important economic and social co-benefits in the transition to sustainable energy. Based on this approach to climate change mitigation and RE promotion, co-benefit assessment is considered a strategic shift in impact assessment towards policy-oriented directions[2]. Furthermore, the document *Green Shift to Sustainability: Co-benefits and Impacts of Energy Transformation*[3] also suggests conducting a comprehensive assessment of all benefits during the policy impact assessment. Accordingly, the energy transition is building an energy economy that serves the needs of the population much better than the old energy system. However, some of the benefits are not reflected in traditional economic indicators and statistics and therefore give false signals to policy makers.

1 Mobilizing the co-benefits of climate change mitigation, Institute for Advanced Sustainability Studies
2 Sebastian Helgenberger and Martin Janicke, Mobilizing the Co-Benefits of climate change mitigation through capacity building among public policy institutions, International Climate Initiative, 2017
3 R. Andreas Kraemer, Green Shift to Sustainability: Co-benefits and Impacts of Energy Transformation, 2017.

In many studies, authors have used the term "co-benefits" to refer to a wide range of climate-related, economic, environmental, social and political goals.[4] Currently, as the transition from fossil fuels to new energy sources and RE is taking place robustly on a global scale towards the main goal of addressing serious climate change issues, the concept of co-benefits has attracted considerable attention. Besides the main goal of mitigating climate change, the rapid development of new energy sources and RE has brought a series of additional social and economic benefits. The example in the figure below presents a summary of the main co-benefits of the energy transition process, including many beneficial environmental, climate-related, economic, social and political & institutional impacts.

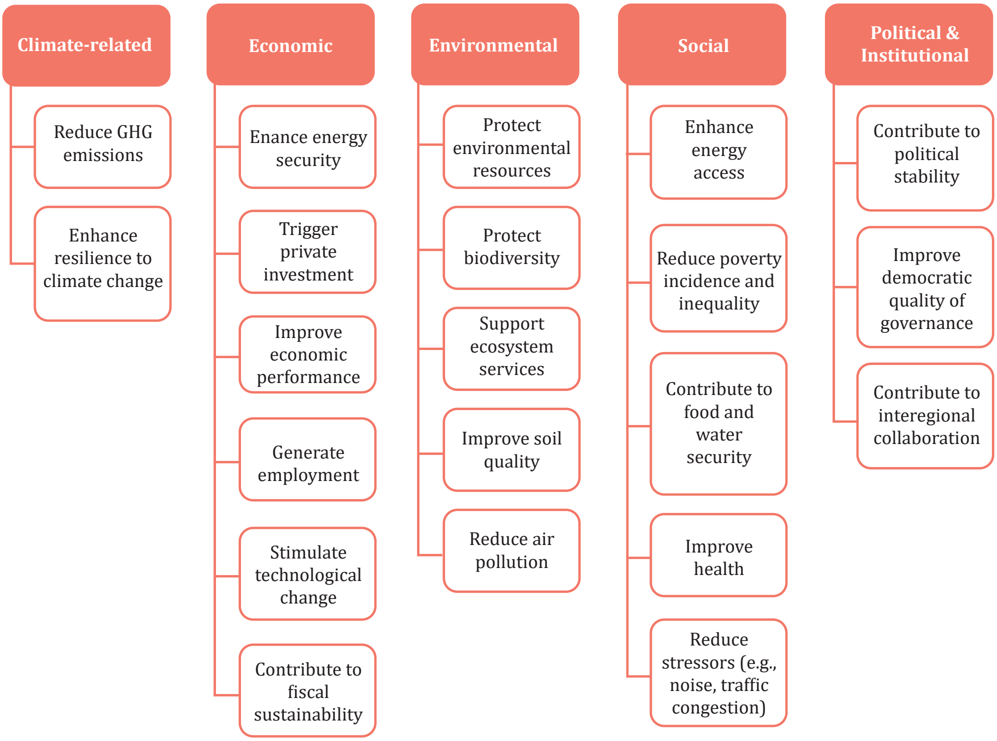

Figure 1. Key co-benefits of the energy transition

Sources: Jan P. Mayrhofer 2016

4 Jan P. Mayrhofer *, Joyeeta Gupta, The science and politics of co-benefits in climate policy, The science and politics of co-benefits in climate policy mayrhofer_2016.pdf (colorado.edu)

These co-benefits include various aspects directly related to sustainable socio-economic development such as:

Enhancing energy security: Diversifying energy sources and promoting the use of wind and solar energy will help countries improve their national energy security by reducing dependence on the fluctuations of the global fossil fuel market and risks related to geopolitical conflicts around the world.

Encouraging domestic investment: Countries can take advantage of the energy transition to promote domestic investment and industrial development. For example, by implementing support policies, they can promote the development of domestic enterprises that provide RE equipment such as insulation foam, solar panels, or services such as installation of solar power systems at various sizes. Investments in RE projects not only support sustainable development but also create profitable investment opportunities and attract capital flows into green initiatives. With a wide range of scales from multi-billion dollar to several kWp rooftop installations, renewable energy projects offer good opportunities for domestic small and medium-sized enterprises (SMEs) to invest in manufacturing equipment as well as providing services from design, installation to operation, maintenance and decommissioning.

Promoting export opportunities: Countries can capitalise on the energy transition trend to develop RE products and technologies. The development of the domestic energy equipment manufacturing industry brings about the potential to export to international markets. This not only creates new sources of income for the economy but also strengthens the country's position in the technology and energy transition sectors.

Promoting employment diversification: The transition to RE increases employment opportunities and creates new jobs in many fields related to clean energy technology, project implementation and O&M. For example, the construction and operation of wind power plants provides jobs for workers in construction, maintenance and system management. At the same time, R&D and RE equipment manufacturing activities provide career opportunities for technical experts and scientists. Career opportunities for those with high professional qualifications as well as unskilled labour are expanded during the energy transition process.

Improving air quality and advancing public health:

The obvious result of the transition to RE is the reduction of harmful emissions, leading to improved air quality and thus a healthier living environment. This leads to improved public health, reduced cases of respiratory diseases and related health problems, contributing to reducing medical and health care costs for the community.

Encouraging innovation

Developing RE technologies will promote research, development and innovation, providing new solutions and advancing scientific progress. For example, new technology companies can develop and deploy smart solutions to forecast, optimise the management of RE power plants and utilise the weather-dependent, variable energy sources such as wind and solar power.

Just electricity access that leaves no one behind

The development of RE sources expands the ability to supply electricity to remote areas where access to the national grid's is limited by geographical factors, contributing to a more just energy supply possibly due to the scalability flexibility of RE sources, especially mini hydropower and solar power. New power sources must ensure affordable energy costs for everyone.

Creating added economic value for affected communities and areas

The adoption of RE encourages economic development in localities, especially in areas with high potential, creating opportunities for communities to exploit and utilise their local RE resources.

In short, the synthesis of positive impacts of the energy transition is often referred to as "co-benefits", including the positive effects that result from the implementation of climate change policies. In other words, the co-benefits model emphasises the potential synergy between environmental sustainability and socio-economic progress.

As part of the COBENEFITS[5] project funded by the German Government, a similar approach has been taken to identify the potential economic and social co-benefits of RE and develop policy solutions to create an enabling environment to maximise these opportunities for the people, communities and domestic enterprises.

5 The "Mobilising the Co-Benefits of climate change mitigation through capacity building among public policy institutions" (COBENEFITS) project is part of the International Climate Initiative (IKI). The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supports this initiative on the basis of a decision adopted by the German Bundestag. The COBENEFITS project is coordinated by the Institute for Advanced Sustainability Studies (IASS lead).

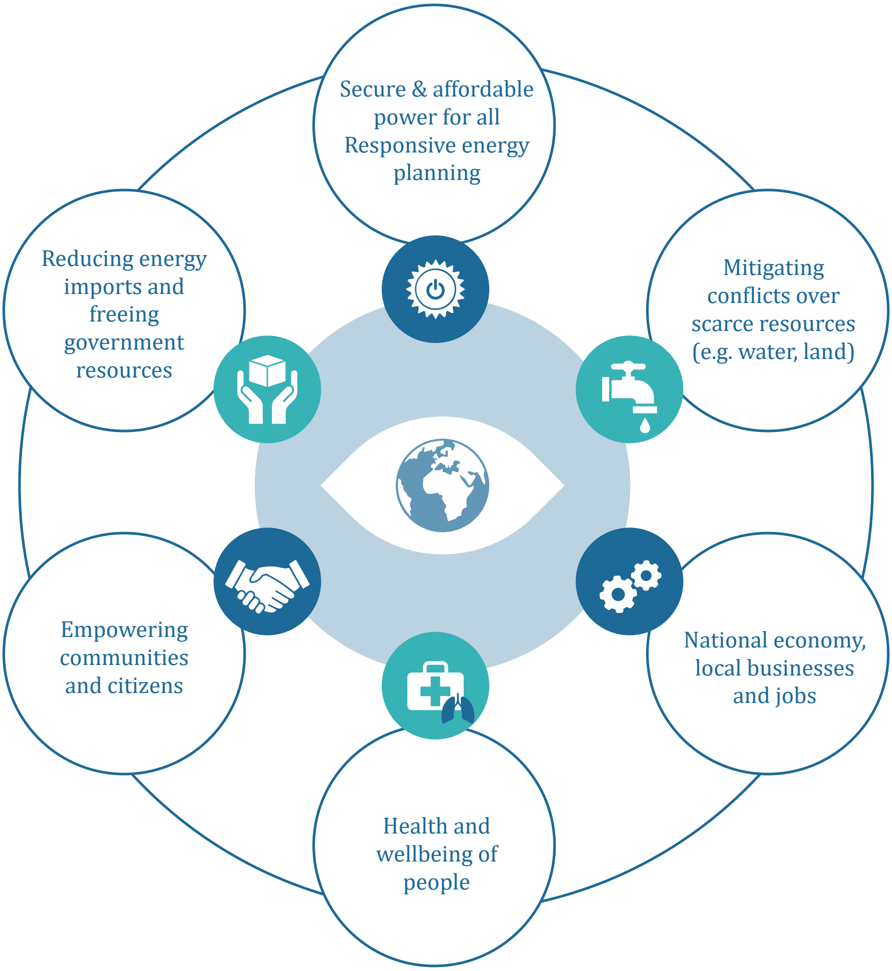

Figure 2. Example of the co-benefit approach in energy transition in Viet Nam

Sources: COBENEFITS Policy Report Viet Nam, IASS 2017b

Considering the various co-benefits of climate policies during the policy development process helps develop optimal climate change and environmental policies[6]. Accordingly, prioritising issues of public concern will maximise the chance of gaining public support, but sufficient consideration and evaluation based on potential impacts and the benefits of other important issues are also necessary. Regarding climate change and environmental policies, if the Government overlooks the benefits that such policies can bring to other prioritised issues, it may lead to a situation where policy decisions are not optimal. On the other hand, in cases where a policy affects many governmental departments, examining the co-benefits factors of that policy with multiple relevant agencies also brings stronger effects than considering the benefits for an individual agency. In fact, a policy can simultaneously impact various departments, providing combined benefits that would add value and help justify the development of such a policy. Within the policy-making community, comprehensive consideration of the co-benefits of potential policies is also one of the principles to ensure that policies are optimally implemented. However, differences in expertise and areas of focus between governmental departments may create some barriers to formulating policies that benefit various departments simultaneously[7].

Implications of energy transition's co-benefits for industrial development[8]

Because energy is an integral part of all economic sectors and many sectors are involved in the energy sector's value chains (e.g., forestry, agriculture, mining, metals, electronics, ICT), the energy transition will have universal impacts[9]. In addition, due to the characteristics of new RE technologies, the trends in technology development and digitalisation will accelerate the growth of related industries. This is a crucial foundation for undertaking the 4.0 industrial revolution.

The energy transition has the potential to benefit the economy and society in ways that are less quantifiable and are not often reflected in economic figures, despite the fact that its impacts on cost reduction, trade, economic activities and taxes can be measured and forecast. However, the potential socio-economic impacts of the energy transition can only be fully recognised if the decarbonisation process of the power sector goes hand in hand with policies that create an enabling environment to seize co-benefits (also called enabling policies).

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6 Neil Jennings , Mapping the co-benefits of climate change action to issues of public concern in the UK: a narrative review. Sources: Mapping the co-benefits of climate change action to issues of public concern in the UK: a narrative review - PubMed (nih.gov)
7 Neil Jennings, Daniela Fecht, Sara De Matteis, Mapping the co-benefits of climate change action to issues of public concern in the UK: a narrative review, Discussion Section
8 UfU/IASS (2022): Maximising co-benefits of the energy transition: Enabling policies in countries worldwide. COBENEFITS Impulse. Potsdam, September 2022.
9 Tuukka Mäkitie, The energy sector: an industrial perspective on energy transitions, Handbook of Industrial Development (pp.287-301), Chapter: 17 (PDF) The energy sector: an industrial perspective on energy transitions (researchgate.net)

A high share of RE increases investment capital flows, narrows the technology gap and promotes innovation in the country. Thus, countries can benefit from improving their local value chains with the participation of domestic small and medium-sized manufacturing enterprises, thereby increasing the competitiveness of industries. Another important aspect of the energy transition is the creation of employment opportunities and investment attraction power for local industries. Strengthening local value chains and encouraging the use of domestic products and services can create a business environment that promotes sustainable development and provides the foundation for a more time- and cost-efficient energy transition.

Local enterprises, especially those that deploy RE for self-consumption, can also benefit from using renewable electricity, as the electricity prices are more stable and cheaper (in some countries and in the long term), and reducing their dependence on fossil energy markets where prices fluctuate widely and tend to increase over time. The increasing development of RE technologies such as solar power and wind power, along with the growing electric vehicle uptake in specific markets, have resulted in significant reductions in the cost of production for solar and wind power over the past two decades. These sources can now compete with traditional energy sources in some regions worldwide. According to the report "Renewable power generation cost in 2022", published in 2023 by IRENA:

- For onshore wind: The LCOE (Levelised Cost of Electricity, global weighted average and project level) of onshore wind decreased by 69% between 2010 and 2022, from USD 0.107 to USD 0.033 USD/kWh. Consequently, onshore wind now increasingly competes with utility-scale solar power without financial support, and even with mature RE sources such as bioenergy and hydropower.

- Offshore wind: Between 2010 and 2022, LCOE of offshore wind decreased by 59%, from USD 0.197/kWh to USD 0.081/kWh. From its peak in 2007, LCOE of offshore wind had fallen 65% by 2011.

- Solar PV: Between 2010 and 2022, LCOE of utility-scale solar PV projects decreased by 89%, from USD 0.445/kWh to USD 0.049/kWh.

The co-benefits of decarbonising the power sector in industrial development are evident in many countries when coupled with a well-designed strategy that requires an incremental local content to support local industries in the RE sector and other related industries. Countries often make efforts to remove barriers and promote the development of the domestic RE manufacturing industry by improving manufacturing capacity, promoting the demand-side RE market and identifying segments suitable for domestic enterprises to increase the local value.

As co-benefits for industries are closely linked to socio-economic benefits for the economy, countries often start by increasing the local content of labour-intensive stages (such as transport, construction, installation, and maintenance) to create medium- and high-skilled job markets and attract investment in local industries. Therefore, many mechanisms, either incentive or mandatory, have been designed to require a minimum local content level when developing RE projects. Local content requirements often specify that projects must use domestically manufactured products and services, either as a mandatory requirement or a score weighting criterion for localisation rate in bidding procedures or private procurement contracts.

The energy transition process affects many different industries, from the supply of inputs (such as raw materials, equipment and services related to energy technologies) to outputs (such as manufacturing and energy use). Simultaneously, as the value chains of new technology industries (wind power, solar power, etc.) expand, the value chains of old technologies may face decline and disappear in the future. Therefore, **co-benefits in the industrial sector needs to be considered in both aspects: the benefits for new technology areas and the negative impacts on old technology areas** (e.g. in fossil fuel production). A just and equitable energy transition is the decisive factor for the sustainability of co-benefits in the industrial sector. Consequently, it will create a legal framework and appropriate support for affected parties in the transition process.

In short, the energy transition brings significant and positive co-benefits to the development of both the industry and the economy and society in countries. The ability to generate these positive impacts relies on the incorporation of a comprehensive strategy to promote the growth of the RE sector and related industries.

Countries worldwide are increasingly aware of the profound importance of co-benefits in industrial development during the development and implementation of energy transition policies. Optimising the co-benefits in the industrial sector is becoming a decisive factor in ensuring the success and sustainability of energy transition policies. Countries need to carefully consider and ensure that their decisions and measures not only bring environmental benefits but also create value for their industrial sector and domestic economy.

The impact of the energy transition on the economy and society through the local values of the industrial sector and market promotion will be addressed in the report. More specifically, the study will focus on analysing and assessing co-benefits in terms of creating local values to promote sustainable socio-economic development.

1 Viet Nam's policy framework on the co-benefits of energy transition

The review results of the consulting team show that although the term "co-benefits" has been recognised in a number of document[10] , the current Vietnam's legal system does not yet have a specific definition for the concept of "co-benefits of energy transition". However, the legal regulations related to the development of renewable energy (RE) or energy transition (ET) in Viet Nam tend to acknowledge certain specific benefits of energy transition, such as environmental protection, ensuring national security, improving the efficiency of resources utilisation, developing a green economy, and transitioning towards sustainable actions. Nevertheless, the contents regarding the co-benefits of energy transition are primarily mentioned in a general manner in some macro-level strategies or programmes, or in the general policy regulations of the State, such as sustainable economic development, environmental protection, and social welfare. Particularly, some co-benefits of energy transition, such as job creation or community health improvement, have not been specifically quantified in the current legal framework. These issues can lead to limitations in the awareness of governmental bodies, organisations, and individuals regarding the co-benefits of energy transition and the diversity of co-benefits that can be achieved through energy transition.

In this section, the consulting team reviews policies from the highest level which provide directions, visions and strategies to policies for implementing and applying these strategies.

Viet Nam's Party and Government policies on energy transition have focused on promoting sustainable development through improving energy efficiency, minimising environmental pollution, and ensuring social welfare. This reflects the nation's sharpness to creating a balance between economic development and environmental protection, thereby ensuring a sustainable prosperity for both the present and future generations.

The Communist Party of Viet Nam has been promoting sustainable development and considering environmental protection in the country's economic development process. This is demonstrated through the issuance of three important Resolutions: Resolution 24/2013 on environmental protection, Resolution 23/2018 on industrial development and Resolution 55/2020 on energy development.

Resolution 24-NQ/TW in 2013 on proactive response to climate change, strengthening resource management and environmental protection, which was inherited and developed from Resolution 41/2004, laid the foundation for environmental management and protection.

10 For example, Decision 1055/QD-TTg in 2020 concerning the National Climate Change Adaptation Plan for the period 2021-2030, with a vision to 2050, and Decision 882/QD-TTg in 2022 approving the National Action Plan for Green Growth for the period 2021-2030

This was not only an independent goal but also an essential part of sustainable socio-economic development. This resolution promoted the development and implementation of environmental protection policies and measures, from waste management to air and water quality monitoring, which has reinforced the importance of preserving natural resources and maintaining environmental balance in Viet Nam's economic development process.

Resolution 23-NQ/TW in 2018 on the orientation for developing a national industry policy until 2030, with a vision towards 2045, aimed to develop a modern and sustainable industry, creating favourable conditions for economic restructuring which includes putting the primary focus on development of information technology and electronics industries; developing processing and manufacturing industries as the core sectors, advancing smart manufacturing as a breakthrough strategy, and emphasising the development of green industries. By 2030, priority will be given to the development of certain industries, including the clean energy industry, RE, and smart energy. This development goal aims not only to enhance the economic competitiveness but also to create employment opportunities and improve the quality of life for the people.

Resolution 55-NQ/TW in 2020 of the Politburo regarding the direction of Viet Nam's National Energy Development Strategy until 2030, with a vision to 2045, was issued in the context of a strong energy transition. This resolution has adopted and encompassed various important aspects related to co-benefits in energy transition, such as prioritising rapid and sustainable energy development, taking a proactive approach with one step ahead, and linked with environmental conservation, ensuring national defence and security, and progressing and ensuring equitable society. Many important policy directions have been outlined, such as focusing on providing stable, high-quality energy sources at reasonable prices for rapid and sustainable socio-economic development; efficiently exploiting and utilising domestic energy resources in conjunction with rational energy imports and exports; proactively manufacturing certain key equipment within the energy sectors; upgrading and constructing a modern and advanced transmission and distribution power grids. It can be said that this Resolution not only ensures energy supply for development but also contributes to protecting the ecological environment and promoting domestic industry development.

These three Resolutions mark a comprehensive perspective on the economic development process, environmental protection, and the development of the domestic industry. The combination of energy transition and these national objectives not only generates substantial co-benefits but also paves the way for Viet Nam's sustainable development in the future.

In the context of energy transition, the accelerated use of renewable and sustainable energy sources is considered a practical measure to reduce negative environmental impacts and yield economic advantages. The focus on developing clean energy sources also equates to promoting the industry and enhancing the nation's competitiveness in the international market.

The shift towards an energy structure with an increased share of RE and the encouragement of economic entities to invest in new energy, renewable energy, environmentally friendly raw materials, new materials, and fuels is considered a measure for resource management and environmental protection, aligning with Resolution 06/NQ-CP in 2021 regarding the Action programme to implement Resolution 24-NQ/TW on proactively responding to climate change, strengthening resource management and environmental protection, as specified in Conclusion 56-KL/TW[11]. Furthermore, one of the development tasks within the framework of environmental protection technologies and services as part of the Project for the development of Viet Nam's environmental industry until 2025, as outlined in Decision 192/QD-TTg in 2017, involves researching, developing, applying, mastering, and transferring sustainable technologies using renewable and clean energy and energy recovered from waste treatment, as well as investing and supporting the development of environment, clean energy, and RE consultancy services[12].

Resolution No. 55-NQ/TW in 2020 by the Politburo of the Communist Party of Viet Nam on the direction of Viet Nam's National energy development strategy until 2030, with a vision to 2045, is one of the critical documents related to energy transition in Viet Nam. It outlines the Party's general direction and represents the highest principle of energy in Viet Nam, including *"provide stable and high-quality energy at a reasonable price to facilitate rapid and sustainable socio-economic development, ensure national defence and security, improve people's living standards and contribute to the protection of the ecological environment".*

Resolution 55 underscores the vital goals of providing stable and high-quality energy sources while keeping prices reasonable. These goals are not only related to rapid and sustainable socio-economic development but also ensure national defence, security, and improved living standards for the people.

Resolution 55 also emphasises the importance of protecting the ecological environment. Transitioning from conventional fossil fuel-based energy sources to renewable and cleaner energy sources equates to minimising greenhouse gas (GHG) emissions and negative environmental impacts. This is beneficial not only for the planet's health but also for protecting precious ecosystems and maintaining a natural equilibrium.

In terms of co-benefits in industrial development, Resolution 55 also highlights the necessity to *"gradually master modern technology and strive for self-production of most energy equipment"; "establish incentive mechanisms for energy enterprises to further invest in research and development; and establish innovative centres in the energy sector. Continue to launch national key scientific and technological programs for energy technological research, application and development for the 2021 - 2030 period, with a focus on energy equipment manufacturing, application of new types of energy, RE and smart energy and energy saving".*

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11 Resolution 06/NQ-CP, dated January 21, 2021, on the action programme to implement Resolution 24-NQ/TW on proactively responding to climate change, strengthening resource management and environmental protection, in accordance with Conclusion 56-KL/TW, as specified in section II.3(đ) of Conclusion 56-KL/TW by the government

12 Decision 192/QD-TTg dated February 13, 2017, approving the "Project for the development of Viet Nam's environmental industry until 2025," section 3(b), and section 3(d)

In summary, although Resolution 55 does not explicitly use the term “co-benefits,” it focuses on providing stable, reasonably priced energy and protecting the environment while developing the domestic industry which demonstrates the essential elements of a beneficial energy transition for all stakeholders, including the economy, society, defence, the people, and the environment. These are the most crucial co-beneficial objectives that energy transition can offer, particularly for the industry through the direction to master production technologies.

Previously, the **Resolution No. 23-NQ/TW in 2018** of the Politburo on the orientation for developing the national industry policy until 2030, with a vision towards 2045, also acknowledged the positive structural transformation of the industries, including the energy equipment manufacturing sector. The objective of developing the domestic energy equipment manufacturing sector, closely linked to energy transition goals, not only significantly contributes to the advancement of the domestic industry but also offers numerous essential co-benefits. Shifting from conventional energy sources to renewable and cleaner energy sources requires a concentrated effort on manufacturing, distribution, and utilisation of new energy equipment. This has created both opportunities and challenges for the domestic industries.

The current legal framework also has already provided the highest investment and tax incentives for new and renewable energy technologies, as stipulated in the Investment Law 2020 and Decree 31/2021/ND-CP in 2021, providing guidance on implementing the Investment Law, listing relevant industries and trades entitled to investment incentives, enjoy various investment incentives related to taxation, land use, depreciation, and deductible expenses when calculating taxable income[13]. In particular, the industries and trades related to RE technologies in this list are: Energy production from wind power, solar energy, tidal energy, geothermal energy, and other forms of RE[14]; Application of high technology, including: Power generation technologies using tidal, wave, and geothermal power; High-efficiency RE storage technology; Technologies for designing and manufacturing control equipment, power electronic conversion equipment for RE power stations, and smart power transmission devices[15].

Investing in the domestic energy equipment manufacturing sector establishes a domestic supply chain, encompassing product research and development to massive production. This contributes to generating new job positions, improving training, and nurturing a high-quality workforce in the industry. The creation of a favourable environment for the domestic industry not only enhances competitiveness but also reduces dependence on imported energy equipment.

13 Investment Law 2020, Article 15, Clause 1
14 Decree 31/2021/ND-CP
15 Decision 38/2020/QD-TTg 2020

In **Resolution 31/2021/QH15** on the economic restructuring plan for the 2021-2025 period, the primary objective set forth is to continue the development of specific foundational industries, such as the energy industry, with an emphasis on promoting various high-tech and supporting industries[16]. In Decision 569/QD-TTg in 2022 regarding the Strategy for the development of science, technology, and innovation by 2030, the energy industry is acknowledged as a spearhead industry with a focus on development in various RE-related domains, encompassing (i) energy technologies (emerging energy technologies, RE, smart energy, advanced energy storage technologies, fuel cells, liquefied natural gas thermal power technology), (ii) New material technologies (energy storage materials and conversion technologies, such as high-efficiency batteries, high-efficiency fuel cells, hydrogen storage materials, etc.), and (iii) Manufacturing and automation technologies (manufacturing technologies for energy-efficient equipment and systems)[17]. The emphasis on investing in RE technologies and the development and utilisation of RE technologies in the field of science, technology, and high-tech industry development is further outlined in sectoral strategies such as Viet Nam's RE development strategy by 2030 with a vision towards 2050 and the National strategy for the fourth industrial revolution by 2030[18].

Throughout the process of socio-economic development, the domestic support industry and localisation have also been one of the focal areas for investment and development. Decree 111/2015/ND-CP on the development of supporting industry has stipulated supportive policies and incentives to foster this industry, with components and parts for power generation equipment from RE sources being identified as products in the prioritised industrial support products category[19]. Projects involved in the production of products in this Category will enjoy various incentives related to taxes, investment, and land[20]. Activities related to research and development, technology application and transfer, human resource development, international cooperation, and the development of the supporting industry market, will benefit from other policies, such as funding and financial support through the Programme for the development of supporting industry or from other funds and financial sources, as well as receiving priority to participate in trade promotion programs[21].

In addition, the Technology Transfer Law 2017 also stipulates preferential policies for the transfer of high technology, advanced technology, new technology, clean technology, and technology for the development of national key and priority products, including the production and use of new and RE technologies[22]. To encourage these activities, various measures have been introduced in the Law on Technology Transfer 2017, notable examples include capital support, loan guarantees, interest rate subsidies for loans from the National Technology Innovation Fund, credit institutions, and financial support related to technology transfer activities, etc. Simultaneously, this law also establishes tax policies

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16 Resolution 31/2021/QH15 of 2021 on the economic restructuring plan for the period 2021-2025
17 Decision 569/QD-TTg 2022 on the Strategy for the development of science, technology, and innovation by 2030
18 Decision 2068/QD-TTg in 2015 approving Viet Nam's renewable energy development strategy by 2030 with a vision towards 2050; Decision 2289/QD-TTg 2020 on the National strategy for the fourth industrial revolution by 2030
19 Decree 111/2015/ND-CP
20 Decree 111/2015/ND-CP
21 Decree 111/2015/ND-CP
22 Law on Technology Transfer 2017, Decree 76/2018/ND-CP guiding the Law on Technology Transfer

applicable to entities as specified in Article 39. To benefit from these incentives and support provided by the State, individuals and organisations involved in technology transfer must adhere to certain obligatory regulations, such as technology assessment and appraisal for investment projects and technology transfer contracts, and more.

The quantitative targets for localisation in the energy sector were first introduced in **Decision 2068/2015**[23], which outlined objectives to support the development of the manufacturing of RE equipment, enhance the competitiveness of the industry, and aim towards a local large-scale RE industry with the state's policy support. The goal is to promote the development of RE technology and industry, build a comprehensive RE industry, increase the proportion of domestically manufactured equipment in the RE industry: reaching approximately 30% by 2020, increasing to 60% by 2030, and ensuring domestic demand by 2050, with a portion allocated for export to regional and global markets.

On the demand side, the Prime Minister issued Decision 500/2023 approving the National Power Development Plan for the period 2021-2030, with a vision to 2050 (PDP VIII). The direction is explicitly stated to strongly develop various types of RE sources for electricity production: aiming to achieve a RE share of approximately 30.9% to 39.2% by 2030, and 67.5% to 71.5% by 2050. This includes: Onshore wind power 60,050 - 77,050 MW (12.2 - 13.4%); Offshore wind power 70,000 - 91,500 MW (14.3 - 16%); Solar power 168,594 - 189,294 MW (33.0 - 34.4%).

To achieve these RE goals, the Government and the Ministry of Industry and Trade have issued many documents regulating incentive mechanisms for different RE types assessed as having great potential in Viet Nam, specifically for 05 RE types: small hydropower (<30MW)[24], wind power[25], biomass power[26], waste-to-power[27] and solar power[28]. These documents focus on the following key aspects:

Firstly, regarding the planning and development of power projects using RE, the key focuses are:

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23 Decision No. 2068/QD-TTg of the Prime Minister: approving Viet Nam's renewable energy development strategy by 2030 with a vision towards 2050

24 Circular 32/2014/TT-BCT is amended and supplemented by Circular 29/2019/TT-BCT; Decision 131/QD-BCT 2022 on promulgating the avoidable cost tariff in 2022

25 Decision 37/2011/QD-TTg in 2011 on the mechanism to support the development of wind power projects in Viet Nam, amended and supplemented by Decision 39/2018/QD-TTg in 2018

26 Decision 24/2014/QD-TTg in 2014 on the mechanism to support the development of biomass power projects in Viet Nam, amended and supplemented by Decision 08/2020/QD-TTg in 2020 (Decision 24/ 2014/QD-TTg); Circular 44/2015/TT-BCT regulating project development, avoided cost tariff and standardised power purchase agreement applicable for biomass power projects, amended and supplemented by Circular 16/2020/TT-BCT (Circular 44/2015/TT-BCT)

27 Decision 31/2014/QD-TTg in 2014 on mechanisms to support the development of power generation projects using solid waste in Viet Nam; Circular 32/2015/TT-BCT regulating project development and standardised power purchase agreement applicable to power generation projects using solid waste

28 Decision 13/2020/QD-TTg in 2020 on the mechanism to encourage solar power development in Viet Nam; Circular 18/2020/TT-BCT regulating project development and standardised power purchase agreement applicable to solar power projects

Planning the development of RE projects in connection with the overall power development plan, including potentially viable RE projects into the power development plan; and allocating budgets for the planning of RE-based power development, and so on.[29];

Conditions for investing in and constructing RE projects (compliance with the plan/approved by competent authorities, adherence to regulations on project safety and environmental protection, etc.)[30];

Responsibilities for installing and connecting RE projects; requirements for project commencement, termination, and reporting[31]…

Secondly, concerning power purchase agreements (PPA), for all five RE types, applying the standardised PPA is mandatory when individuals or organisations engage in electricity sales to EVN or EVN-authorised entities. Under the government support mechanism, the Purchaser (EVN) is responsible for buying all the electricity generated by grid-connected wind, solar, biomass power plants, small hydroelectric plants, and solid-waste-to-power plants[32]. For rooftop solar power projects, the Seller is allowed to sell part or all of the electricity to the Purchaser (which can be EVN or other organisations or individuals). The PPA duration is 20 years from the commercial operation date of the projects, with the possibility of extension or the signing of new contracts after this period.

Thirdly, in terms of electricity pricing support, up to October 2021, in order to create a favourable mechanism for the development of RE projects, the government introduced a Feed-in Tariff (FiT) for wind, solar, biomass, and waste-to-energy projects. According to the regulations, this FiT pricing for RE projects is calculated per kWh excluding taxes, and is adjusted based on the exchange rate between the Vietnamese Dong and the US Dollar. Schemes

For small hydropower projects, the electricity purchase price is applied based on the avoided cost tariff. According to Circular 32/2014/TT-BCT and Circular 29/2019/TT-BCT, small hydropower plants that meet the conditions stipulated *“The electricity seller is allowed to apply the avoidable cost tariff when the installed capacity of the hydropower plant is less than or equal to 30 MW”* will enjoy electricity prices calculated based on the avoided costs.

In addition to incentives on the electricity purchase prices, some RE power projects (wind, solar, solid waste) also enjoy tax, land, and investment incentives. Moreover, the government allows investors of wind and waste-to-energy projects to mobilise capital from domestic and international organisations and individuals for project implementation, and exempts environmental protection fees for waste water discharge in hydropower projects.

29 Decision 31/2014/QD-TTg in 2014.
30 Decision 31/2014/QD-TTg in 2014; Decision 37/2011/QD-TTg; Decision 24/2014/QD-TTg; Decision 13/2020/QD-TTg in 2020
31 Circular 32/2014/TT-BCT,
32 Decision No. 37/2011/QD-TTg

Furthermore, Viet Nam has been actively issuing documents for implementing international commitments related to climate change, notably policies and initiatives on the development of new and renewable energy sources. Most recently, after participating in COP26, the government designated the Ministry of Natural Resources and Environment to develop and submit a National action plan to fulfil Viet Nam's commitments at COP26 to the Prime Minister for approval in the second quarter of 2022. To deliver commitments at COP26, the government of Viet Nam issued Decision 888/QD-TTg in 2022, approving the Scheme setting out tasks and solutions to implement the outcomes of the 26th Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change. In this document, the government set forth specific tasks *"Identifying the offshore wind and wave energy potential in territorial waters of Viet Nam; developing new zero-emission energy projects, such as green hydrogen and green ammonia production...; [...] energy storage technologies, including battery energy storage systems, pumped storage hydropower, thermal energy storage and smart grids"* as well as *"establishing carbon credit exchange and offsetting mechanisms, and a domestic carbon trading market"* [33].

In Decision 500/QD-TTg of 2023 approving the National Power Development Plan for the period 2021-2030, with a vision to 2050, besides determining the optimal power source structure with a foundation based on wind and solar energy, it also includes the direction to build a comprehensive energy industry based on renewable and new energy sources, develop RE industrial centres, establish a complete RE industrial ecosystem linked to production and support services and concentrated industrial parks, and focus on developing the domestic manufacturing industry for renewable energy equipment, energy storage equipment, carbon capture, utilisation, and storage (CCUS) technologies, increasing self-sufficiency and reducing electricity production costs from RE sources, while encouraging domestic enterprises to participate in power projects. It also emphasises enhancing the design, procurement, and project management capabilities of domestic enterprises; Improving domestic design and production capacities to increase the proportion of domestically manufactured/ localised equipment in power generation and grid projects; enhancing capabilities in repair, maintenance, and inspection of power equipment.

33 Decision 888/QD-TTg dated July 25, 2022

In the electricity field, leveraging certain advantages from the operations of Viet Nam Electricity Group (EVN) and other state-owned corporations such as Viet Nam Oil and Gas Group (PVN) or Viet Nam National Coal and Minerals Industries Group (Vinacomin), efforts to increase localisation in the country through construction, installation and mechanical manufacturing have been ongoing for many years. State-owned corporations and groups have facilitated the development of domestic contractor systems and encouraged foreign contractors to form joint ventures with domestic contractors to participate in transparent competitive bidding. This approach has contributed to strengthening the role and position of domestic enterprises.

In summary, the goal of developing the domestic energy equipment manufacturing industry, combined with the goal of sustainable socio-economic development, not only promotes the growth of domestic industries but also brings about significant co-benefits such as job creation, workforce improvement, reduced dependence on import, and enhanced exports. This is undoubtedly one of the most important co-benefit factors that energy transition can bring to the country.

2. Objectives and trends of the energy transition in Viet Nam

2.1 Macro-level orientations

1. As mentioned above, Viet Nam's National Energy Development Strategy to 2030, vision to 2045 under **Resolution No. 55-NQ/TW** dated 11 February 2020 of the Politburo of the Communist Party of Viet Nam is one of the most important documents related to the energy transition. The Resolution sets out a number of main goals, including the share of renewable energy in total primary energy supply reaching about 15-20% by 2030 and 25-30% by 2045; primary energy intensity reaching 420-460 kgOE/1,000 USD GDP by 2030, 375-410 kgOE/1,000 USD GDP by 2045; saving 7% of total final energy consumption (TFEC) compared to the BAU scenario by 2030 and about 14% by 2045; reducing 15% GHG emissions from energy activities compared to the BAU scenario by 2030 and 20% by 2045.

2. The National Green Growth Strategy for the period 2021-2030, vision to 2050 (under Prime Minister's **Decision 1658/QD**-TTgdated 1 October 2021) sets out the overall goal for green growth to promote economic restructuring in association with growth model innovations to achieve economic prosperity, environmental sustainability and social equality; heading towards a green, carbon-neutral economy and contributing to the goal of limiting global warming. Accordingly, its specific targets include average primary energy consumption per GDP decreasing by 1.0-1.5%/year for the period 2021-2030, and 1.0%/year for each 10-year period until 2050; the share of renewable energy in total primary energy supply reaching 15-20% by 2030 and 25% by 2050; greening the transition process under the principles of equality, inclusion, and resilience improvement with the main goal of increasing the Human Development Index (HDI) above 0.75, reaching 0.8 by 2050.

3. The National Energy Master Plan for the period 2021-2030, vision to 2050 (**under Decision 893/QD**-TTg dated 26 July 2023) sets out the goals to ensure national energy security: Total final energy demand reaching 107 million tonnes of oil equivalent (TOE) by 2030 and 165-184 million TOE by 2050. Total primary energy supply reaching 155 million TOE by 2030 and 294-311 million TOE by 2050. The goals for a just energy transition: the share of renewable energy in total primary energy supply reaching 15-20% by 2030 and about 80-85% by 2050. Energy saved in comparison to the BAU scenario reaching about 8-10% in 2030 and about 15-20% in 2050. Strongly developing renewable energy sources for electricity generation, reaching a share of about 30.9-39.2% by 2030, aiming for a 47% renewable energy share if received strong international financial, technological and administrative support under JETP. By 2050, the share of renewable energy is expected to reach 67.5-71.5%. GHG emissions reaching about 399-449 million tonnes by 2030 and about 101 million tonnes by 2050. Reducing GHG emissions compared to the BAU scenario by 17-26% by 2030 and about 90% by 2050. Aiming to reach peak emissions by 2030 on the condition that commitments under JETP are fully and practically implemented by international partners.

4. The National Power Development Plan for the period 2021-2030, vision to 2050 (under Prime Minister's **Decision 500/QD**-TTg dated 15 May 2023) sets out the goals to ensure national energy security: Electricity sales reaching about 335.0 billion kWh by 2025, about 505.2 billion kWh by 2030, and about 1,114.1-1,254.6 billion kWh by 2050. Produced and imported electricity reaching about 378.3 billion kWh by 2025, about 567.0 billion kWh by 2030, and about 1,224.3-1,378.7 billion kWh by 2050. Striving to have, by 2030, 50% of office buildings and 50% of residential homes installed with rooftop solar systems for on-site consumption (without feeding into the national power system). The goals for a just energy transition: the share of renewable electricity in produced electricity is set to be in synchronisation with Decision 893/QD-TTg. GHG emissions from electricity generation is to reach about 204-254 million tonnes in 2030 and about 27-31 million tonnes in 2050. Aiming to reach peak emissions of no more than 170 million tonnes in 2030, provided that commitments under JETP are fully and practically implemented by international partners.

Table 1: Summary of energy transition goals and trends

Goals	Unit	2030				2050		
		Resolution 55	Decision 1658/ QD-TTg	Decision 893/QD-TTg	Decision 500/QD-TTg	Decision 1658/ QD-TTg	Decision 893/QD-TTg	Decision 500/QD-TTg
Primary energy	MTOE	175 - 195		155			294-311	
Power source capacity	GW	125 - 130			150			490,5-573
Power volume (PDP8: including imports)	billion KWh	550 - 600			567			1.224,3 - 1.378,7
Share of renewable electricity in produced electricity	%			30,9 - 39,2	30,9 - 39,2		67,5 - 71,5	67,5 - 71,5
Share of renewable energy in primary energy	%	15 - 20	15 - 20				80-85	
Final energy consumption	MTOE	105 - 115		107			165 - 184	
Primary energy intensity	KgOE/1,000 USD GDP	420 - 460	decreasing by 1.0-1.5%/year			decreasing by 1.0%/year		
Energy saved in TFEC	%	7% compared to BAU		8-10% compared to BAU			15-20% compared to BAU	
Reducing GHG emissions		Reducing GHG emissions by 15% compared to BAU	Decreasing GHG emission intensity of GDP by at least 15% compared to 2014	About 399-449 million tonnes of GHG emissions. Reducing GHG emissions by 17-26% compared to BAU		Decreasing GHG emission intensity of GDP by at least 30% compared to 2014	About 101 million tonnes of GHG emissions. Reducing GHG emissions by 90% compared to BAU	
GHG emissions from electricity generation	MtCO2eq				204 - 254			27 - 31

2.2 International commitments

At the COP26 Conference, Viet Nam strongly committed to achieving net zero emissions by 2050, not developing new coal power from 2030, gradually eliminating coal power from 2040 and reducing 30% of methane emissions by 2030 compared to 2020 levels.

Just Energy Transition Partnership (JETP) agreement: Within the framework of the ASEAN-EU Commemorative Summit 2022 in Brussels (Belgium) which marks the 45 years of diplomatic relations between the two blocs, Vietnamese leaders and the International Partners Group (IPG) including the European Union, the United Kingdom, France, Germany, the United States, Italy, Canada, Japan, Norway and Denmark signed the Just Energy Transition Partnership (JETP) on 14 December 2022. In the immediate future, JETP will mobilise USD 15.5 billion of private and public finance over the next 3 to 5 years to support Viet Nam's green transition. JETP will assist Viet Nam in achieving the following new goals: Reaching peak GHG emissions sooner, by 2030 instead of 2035 as previously expected. Reducing the power sector's annual emissions by up to 30%, from 240 million to 170 million tonnes and accelerating emissions peak by five years to 2030. Limiting Viet Nam's coal power capacity to 30.2 GW from the expected level of 37 GW. Accelerating the deployment of renewable energy to account for at least 47% of total electricity output by 2030 instead of the 36% currently planned. About 500 million tonnes of emissions will be reduced by 2035 if these targets are met.

3 Co-benefit potentials of the energy transition in Viet Nam

3.1 Methodology

This section aims at identifying the market potential achievable through an energy transition, with an emphasis on wind and solar energy technologies, while estimating the localised value of Viet Nam's industry sector.

Before conducting an analysis and assessment of market potential and localised industrial value potential attainable from the energy transition, it is necessary to define the term "localisation". Within the scope of this report, to align with the stated objectives, a broad definition of "localisation" is applied.

"Localisation" refers to the performance of works in Viet Nam by either 100% Vietnamese-owned companies or joint ventures of Vietnamese and foreign

The market potential and local value (at the current price) are estimated according to the following formula:

Market potential:

$$IV^i = \sum_{j=1}^{n} MW^i CC^i share_j^i$$

Where

IV: Market potential (USD)

i: RE technologies (onshore wind, offshore wind and solar)

j: stage j in the value chain of technology i (this report focuses on 3 stages: project development, manufacturing, installation/construction)

MW: expected installed capacity (MW)

CC: capital cost (USD/MW)

$Share_j^i$: share of cost of stage j in the capital cost of technology i (%)

Local value:

$$IV^i localisation = \sum_{j=1}^{n} MW^i CC^i share_j^i LC_j^i$$

LC_j^i : local content of stage j in the capital cost of technology i (%)

3.2 Localisation status and potential assessment for the wind and solar power industry

To date, there is an absence of reports/studies evaluating the local contents of wind and solar value chains in Viet Nam. This may stem from the complexity involved in the initial theoretical framework selection to the collection of data for estimation. Within the scope of this report, a relative estimation method is proposed. This estimation method will be based on the following steps:

- Identifying the main stages in the wind and solar power value chains. This step consists of collecting and analysing available documents and studies that assess the stages in the value chains of wind and solar power technologies in Viet Nam, and surveying/consulting opinions of national experts. The survey should target experts from project development consulting firms, equipment manufacturers, EPC contractors, and solar and onshore wind power project investors.

The localisation status and potential assessment focuses on three stages:
(1) Project development, (2) Equipment manufacturing, (3) Installation/construction

- Accordingly, each stage will be evaluated for localisation potential, with high potential when stages are more amenable for localisation, and low potential when stages are challenging or nearly impossible to localise. The high or low potential for localisation is evaluated both in technical and economic terms. For example, wind turbine blades are labour-intensive components, and their supply chain is easy to localise. From an engineering standpoint, Viet Nam is fully capable of producing and organising supply chains for wind turbine blades. However, Viet Nam may face economic challenges due to the large size of the blades, high transportation costs, and risks associated with large-scale plant investment, resulting in a relatively low potential for domesticating wind turbine blades in Viet Nam.

The main stages in the value chain of wind and solar energy are shown in the following figures:

Technology/ Stage	Project formation	Equipment manufacturing	Installation	Grid connection	Operation and maintenance	Decommissioning
Wind power	Feasibility study	Hub + Nacelle	Site preparation	Cabling concept	Operation	Decommissioning
	Sustainability assessment	Drive shaft and blade	Infrastructure work	Cable	Maintenance	Recycling
	Environmental Impact Assessment	Tower	Foundation	Cabling	Technical management	Disposal
	Permit application		Assembly	Grid connection	Commercial management	
	Approval process				Spare parts	
	Infrastructure planning					

Figure 3. Value chain stages of a wind power project

Sources: IRENA and CEM (2014)

Technology/ Stage	Project formation	Equipment manufactur-	Installation	Grid connection	Operation and maintenance	Decommissioning
Solar PV	Feasibility study	Solar panel	Site preparation	Cabling concept	Operation	Decommissioning
	Sustainability assessment	Inverter	Construction	Cable	Maintenance	Recycling
	Environmental Impact Assessment	Electrical components	Module installation	Cabling	Commercial management	Disposal
	Permit application	Mounting structure	Array cabling	Grid connection		
	Approval process					
	Infrastructure planning					

Figure 4. Value chain stages of a solar power project

Wind power technology[34]

1. **Project development:** Currently, the project development activities are mainly carried out by Vietnamese companies. Key suppliers include Petrovietnam Technical Services Corporation (PTSC), Power Engineering Consulting JSC (PECC), Tan Cang Offshore Services JSC, Portcoast Consultant Corporation (Portcoast), Thien Nam Positioning JSC, Viet Nam Petroleum Institute (VPI), and Vietsovpetro JV. Most of these service providers have carried out relevant surveys and engineering studies in the field of oil and gas and they have the potential to offer services in these areas. This potential stems from their good knowledge of environmental conditions and regulations in Viet Nam, and their advantages in logistics and labour costs. **Their current biggest limitation in this area is the lack of vessels with the required technical capabilities for geotechnical surveys.** Since the entry barrier will still be low as the market develops, international contractors are likely to become increasingly involved and build local presence in the future.

2. **Equipment manufacturing:**

   - **Foundation components:** Viet Nam is currently quite involved in the supply chain of foundation components and equipment. Currently, prominent manufacturers in this field include Alpha ECC, PetroVietnam Marine Shipyard, PTSC Mechanical & Construction Limited Company, Southern Renewable and Green Energy Company Limited (SRE), and Vietsovpetro. Viet Nam has an advantage in producing foundation components and equipment, stemming from its experience in steel production. In addition, Viet Nam also has a large and experienced workforce, and competitive labour costs. These conditions are particularly relevant to jacket production, which requires extensive labour and high transportation costs.

   - **Turbines**

     + Towers: Viet Nam is capable of producing wind turbine towers, but its potential in this field remains risky. Currently, there are two companies in Viet Nam capable of producing tower components: CS Wind and Southern Renewable Energy JSC (SRE). In the future, Viet Nam can fully supply components for wind turbine towers. As demand for towers increases while logistics costs remain high in the future, establishing coastal tower manufacturing facilities in Viet Nam is a reasonable business decision. However, there are high risks associated with investment in tower manufacturing. Firstly, investment costs are high while profit margins are relatively low. A tower factory with an annual capacity of 1GW costs about €100 million. Furthermore, these factories would need at least two customers, while turbine suppliers typically do not commit to long-term contracts with tower suppliers.

34 Viet Nam supply chain study, Equinor, 2021

+ Nacelle + Hub: Viet Nam has no facilities that manufacture nacelles, hubs and turbine assembly. There are a small number of facilities that can manufacture certain components, such as GE which manufactures generators and electrical control systems in Hai Phong, and Thysenkrupp which can supply structural components made from steel. The opportunity for Viet Nam in this value chain is assessed to be very low due to the high cost of constructing new factories and the complexity of forming a supply chain with high reliability and performance requirements.

+ Blades: Viet Nam currently has no wind turbine blade manufacturing facilities. The number of companies active in the supply chain is also very small. Viet Nam's potential in this field is limited despite certain advantages such as high transport costs for blades and an easy-to-localise supply chain. This is because more benefits can be harvested by using finished, already assembled blades. In addition, there are high risks associated with investment in blade factories.

- **Substations[35]:** Viet Nam currently has the capability and potential to participate in the production and supply of components for both onshore and offshore substations. For onshore substation, there are nearly 30 existing and potential suppliers. Key suppliers include FECON, IPC Steel Structure, Khang Duc Construction & Investment JSC, Power Construction Company, Power Plus Viet Nam, PECC1, PECC2 and PTSC. For offshore substations, Viet Nam has about 8 potential suppliers and 19 potential equipment component suppliers. In the future, Viet Nam's potential in this area is likely to be greater since offshore substations are often designed as one-time investment, and new entrants to the market do not need to invest heavily to efficiently produce large quantities. Vietnamese companies will be able to produce without large investments.

- **Cables:** Currently, Viet Nam's participation in the cable production chain is very limited. Viet Nam does not have capability to produce submarine cable and has to import all submarine cables for offshore wind projects. Existing and potential companies in this area include Cadivi, Tran Phu Electric Mechanical JSC, Cadisun, and more. There is no significant potential for this market because the logistical benefits associated with sourcing arrays and export cables from Viet Nam are low. In many cases, a single cable layer can deliver all the cables required for a project, directly from the factory, in one or two trips. Submarine cable factories in China, Japan and Korea are likely to be the suppliers for projects in Viet Nam.

35 To facilitate the calculation process, the equipment in the Grid connection stage is integrated into the Equipment manufacturing stage

3. **Wind plant installation:** The installation involves multiple components and processes, including the installation of turbines and foundation, array cables and export cables, and offshore substations. In general, Viet Nam has a well-structured supply chain capable of supporting installation activities. There are numerous companies with potential to engage in the installation field, but they are faced with technical barriers such as the lack of jack-up rigs/ heavy-lift vessels with suitable lifting capacity (at least 1,500 tonnes) for offshore wind installation, or their substandard vessels and equipment compared to international cable laying competitors.

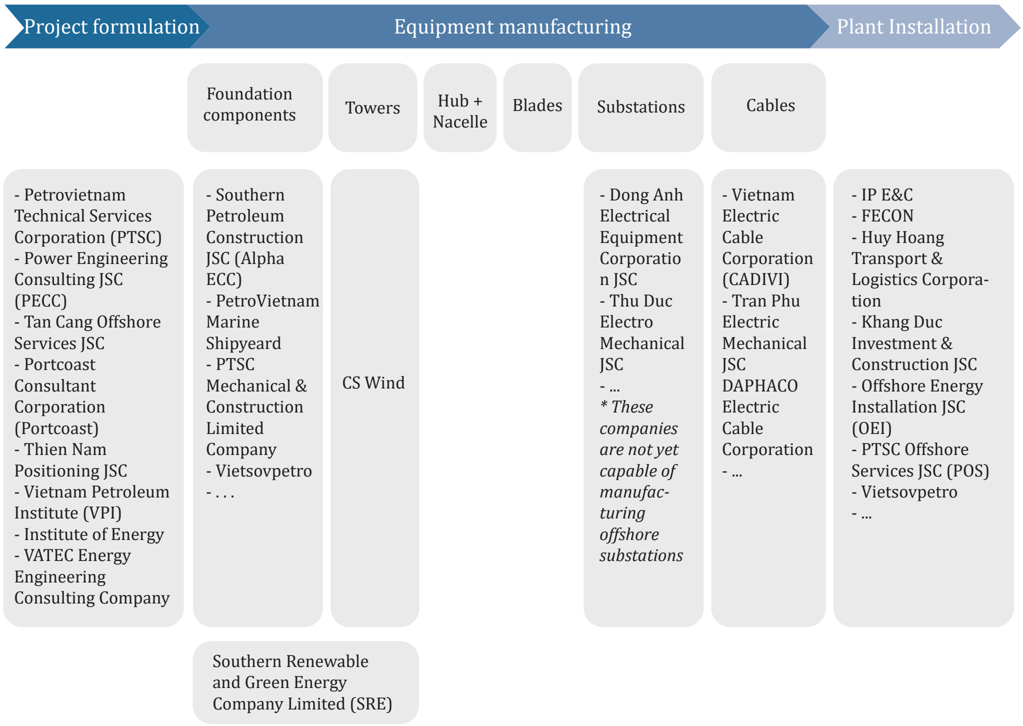

Figure 5. Key contractors in Viet Nam by wind power supply chain components

Based on the above analyses, the status and potential for improvement of local content in Viet Nam's wind power industry are shown as follows.

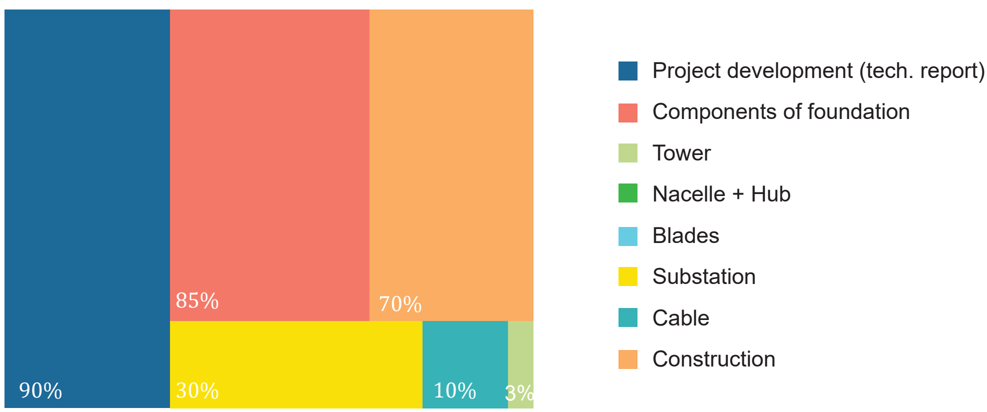

Figure 6. Local content status of onshore wind power sector

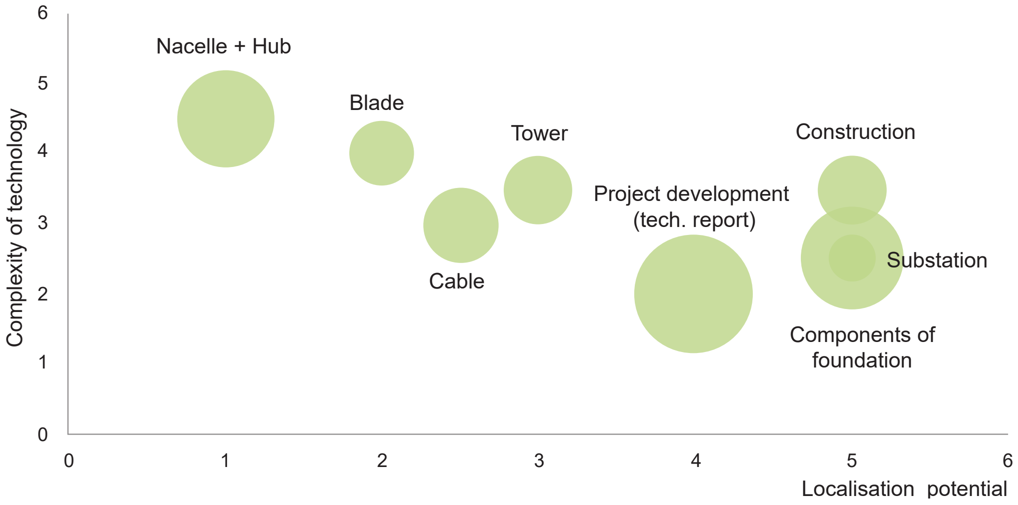

Figure 7. Localisation potential of onshore wind power sector

Note: Circle size represents the respective share of cost in the investment unit cost

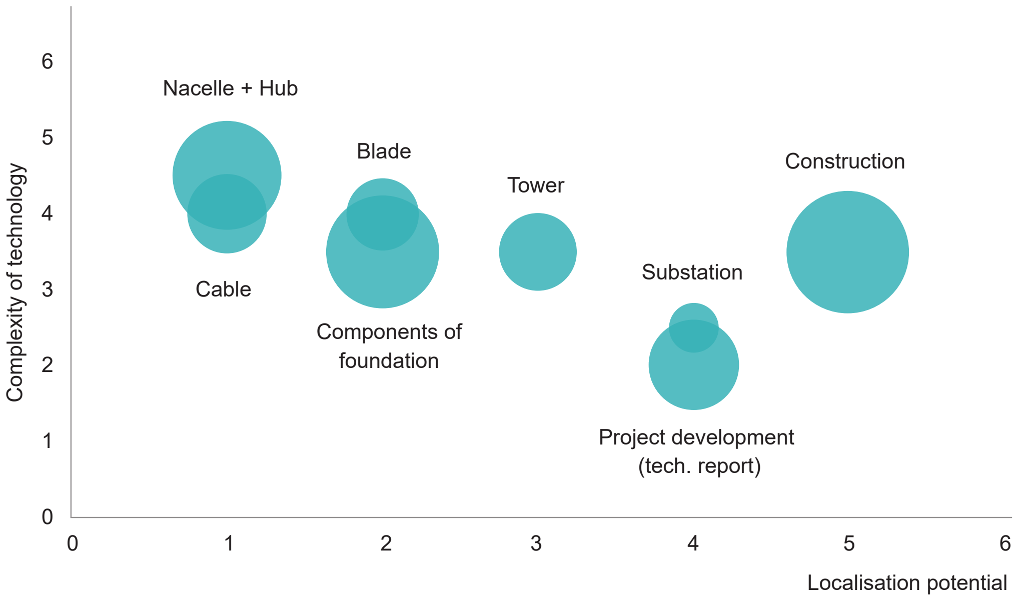

Figure 8. Localisation potential of offshore wind power sector

Note: Circle size represents the respective share of cost in the investment unit cost

Solar PV

1. **Project development:** Currently, the development phase of solar projects is **mainly car-ried out by Vietnamese companies**. Key suppliers include Institute of Energy (IE), PECC3, Power Engineering Consulting JSC 4 (EVNPECC4), VATEC Energy Engineering Consulting Company (VATEC). International consultants typically perform specific packages such as calculating power output for bank approval while the remaining procedures are handled by national consultants. Currently, construction contractors are also involved in supporting in-vestors in implementing projects, such as land compensation, fire protection, etc.

2. **Equipment Manufacturing:**

- Inverters: According to survey data, installed solar power projects used imported inverters. In May 2022, the KSTAR Science and Technology Co., Ltd. (Viet Nam) completed the first-phase construction of its factory on an area of its 47,715 m2. By the end of 2022, after all phase-I machinery and equipment had been installed, the factory went into operation. For phase I, the factory is expected to produce annually 10,000 UPS units, 1,000 modular data centre units, and 1GW of solar inverters. In February 2023, the Chinese solar inverter manufacturer Growatt has also completed phase I of its first manufacturing factory in Nam Dinh Vu Industrial Park, Hai Phong. The factory will produce solar inverters, storage inverters and battery storage products with an annual capacity of 500,000 inverters and 100,000 battery systems.

- Solar panels: Survey data indicates that 95-99% of photovoltaic panels used in solar projects in Viet Nam are imported, mainly from China. Despite the presence of about 10 photovoltaic panel factories in Viet Nam as of August 2023 (mostly invested by Chinese companies, with a few from the United States, Canada and two plants by Vietnamese enterprises). This situation is primarily influenced by two main reasons: (1) the lower cost of importing solar panels from China, (2) some Chinese enterprises, e.g. AD Green, investing in establishing solar panel factories in Viet Nam to leverage the low-cost labour force, aiming for 100% export, especially to the US market to take advantage of the tax exemption announced by the US Government in June 2022, applicable to solar panels from Viet Nam.

Table 2: List of factories producing solar panels in Viet Nam

No.	Factory name	Location	Investor/Country	Capacity
1	First Solar	HCM City	USA	2.4 GW
2	HT Solar	Hai Phong	Haitech Holdings Co., Limited, UK Sun Chance Ltd and 1 Chi-nese Investor.	Solar Cells: 800 MW/ year Solar Panels: 1,000 MW/year.
3	IREX Solar	Vung Tau	Solar BK, Viet Nam	350 MW/year
4	Vina Solar	Lao Cai	Vina Solar Technology Viet Nam Co., Ltd. (Member of Ca-nadian Solar)	
5	IC Energy solar	Quang Nam	Indochina Energy Industry Company (IC Energy)	120 MW/year
6	Trina Solar	Bac Giang	Trina Solar Co., Ltd. (China)	1 GW/year
7	JA Solar	Bac Giang	JA Solar Investment Limited (Hong Kong)	Solar Panels: 1,500 MW/year. Monocrystalline silicon bars: 600 MW/year. Polycrystalline silicon ingot: 900 MW/year.
8	Canadian Solar	Hai Phong	Canada	300 MW/year
9	AD Green	Thai Binh	Viet Nam	0.5GW/year from July 2023, increasing to 3GW/year in the next 12 months
10	CRC Solar Cell	Hoa Binh		300MW/year

Sources: Compiled

- Mounting structure: Currently, domestic enterprises are capable of manufacturing mounting structures, for example:
  + Vimetco Industry and Energy JSC, outputting over 146 different product models, equivalent to 220,000,000 components per year
  + IPC Company Limited
  + Dai Dung Group…

However, assembled mounting structures domestically produced in Viet Nam still account for a small proportion of less than 30% in solar power projects in Viet Nam, mainly due to competitive pricing compared to imported products from China.

3. **Solar farm installation:** Domestic enterprises have largely mastered this stage in solar power projects.

Based on the above analyses, the status and potential for improvement of local content in Viet Nam's solar power industry are shown as follows.

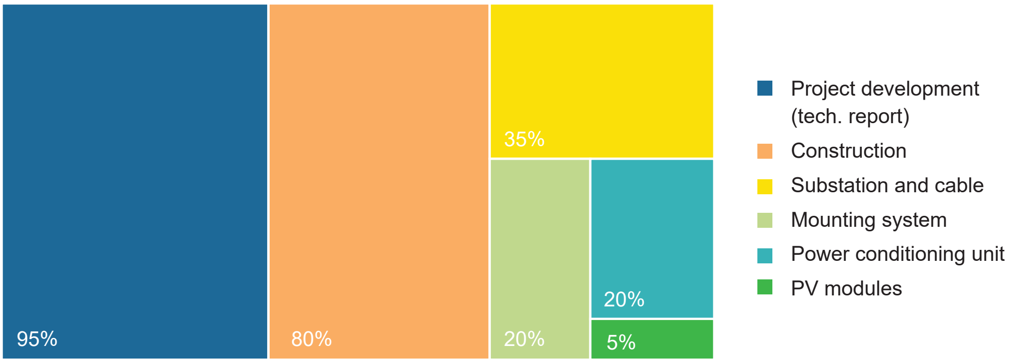

Figure 9. Local content status of solar power

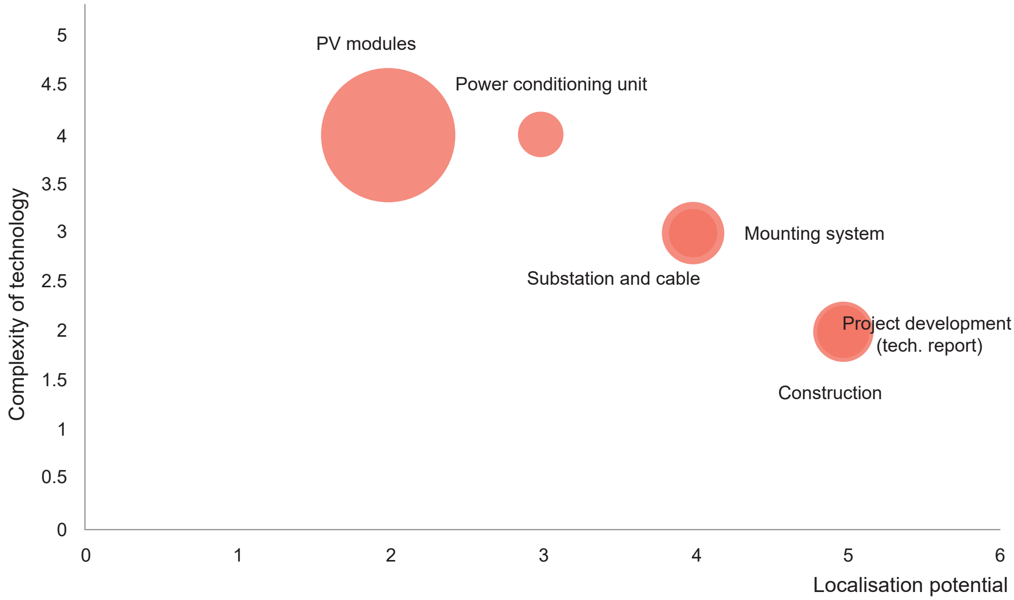

Figure 10. Localisation potential of solar power

Note: Circle size represents the respective share of cost in the investment unit cost

3.3 Input data

3.3.1 Wind and solar installed capacity

The expected onshore, offshore wind and solar installed capacity numbers below were taken from the National Power Development Plan for the period 2021-2030, with a vision to 2050. Accordingly, the installed capacities of wind and solar power sources nationwide are as follows:

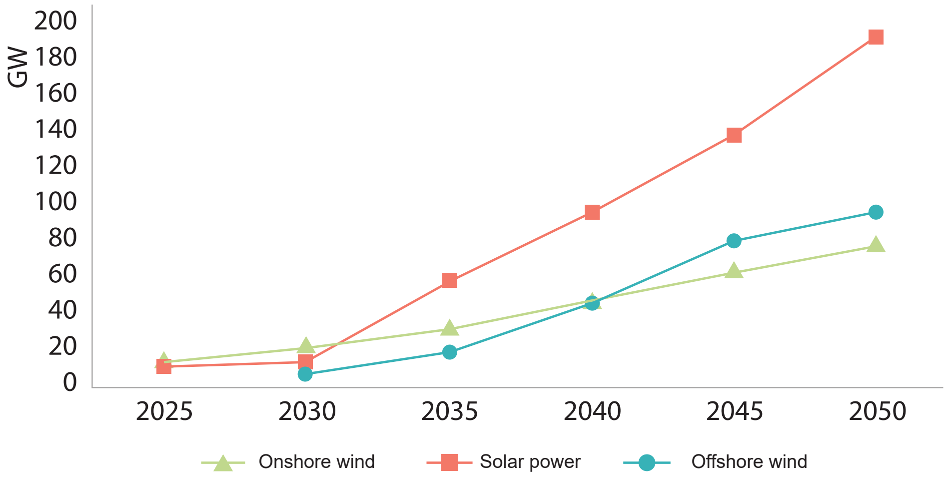

Figure 11. Expected installed wind and solar capacities

Sources: PDP 8, 2023

3.3.2 Investment unit cost

Investment unit costs of wind and solar power technologies are referenced from the capital costs by technology in the US, European Union, China and India regions (IEA, 2022) and adapted to Viet Nam's context after consulting with national experts. Accordingly:

The investment unit cost of solar power, varied across different regions and technologies, is expected to continue decreasing from about 590-1,090 USD/kW in 2021 to about 270-510 USD/kW in 2050 due to cost reductions in solar panel production, improvements in energy conversion efficiency, cost reductions and modular designs in solar power plant construction.

According to IEA (2022), investment unit costs in 2021 ranged between 930-1,590 USD/kW for onshore wind, and between 2,780-4,040 USD/kW for offshore wind, varied by the region-specific wind potential, favourable financial conditions (long-term loans, low interest rates, land use incentives, etc.), and technology maturity levels that would lower turbine costs. By 2050, investment unit costs are forecast to decrease to 830-1,450 USD/kW for onshore wind and 1,300-1,820 USD/kW for offshore wind. As wind power in Viet Nam is at the initial stages of development, its investment unit cost will likely be in the higher end of the world's average range due to high cost of development, logistics, O&M, and high capital costs, as presented in the figure below:

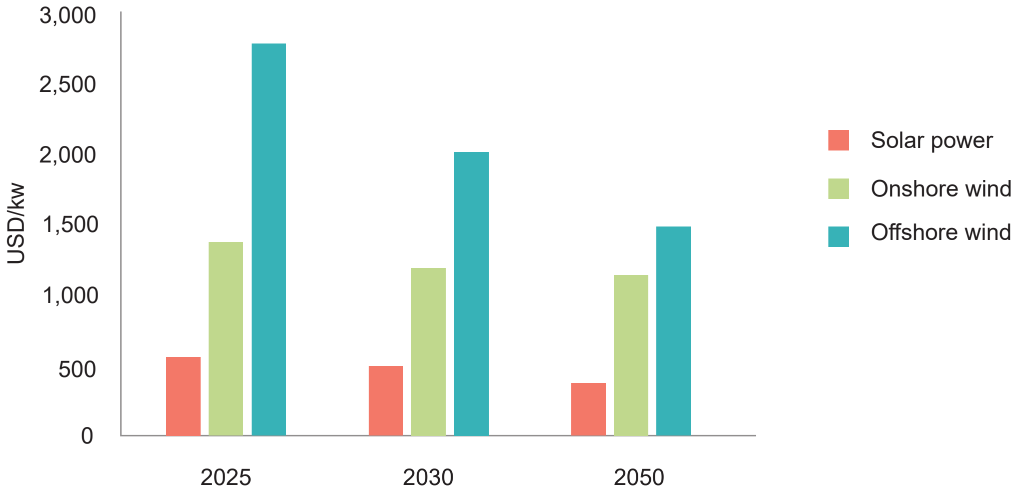

Figure 12. Investment unit cost of solar and wind power for the period 2025-2050

Sources: World Energy Outlook, IEA, 2022; expert survey

3.3.3 Cost shares of stages

The estimated cost shares of the main stages of investment (project development, equipment manufacturing and installation) were based on the synthesis and analysis of available reports and national expert opinion surveys. The results show that equipment costs account for the largest share of about 60-80% for both technologies:

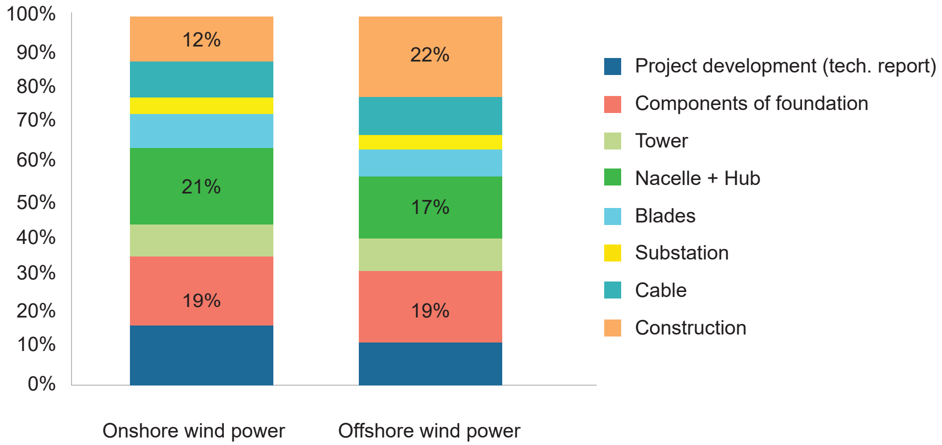

Figure 13. Cost shares breakdown by stage for wind power capital cost

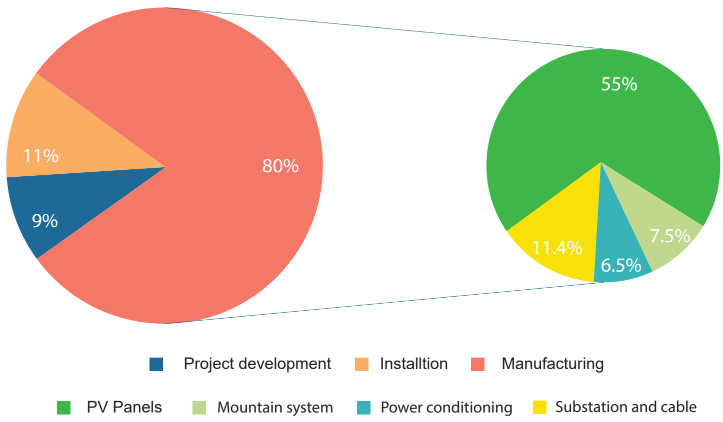

Figure 14. Cost shares breakdown by stage for solar power capital cost

3.4 Results

3.4.1 Market potential

The total market potential of wind and solar power technologies across the three stages of project development, equipment manufacturing, installation/construction and for the period 2025-2050 is estimated at nearly USD 160 billion (at current price 2023), accounting for 1.02% of Viet Nam's GDP[36] for the whole period. This figure is equivalent to the 2022 GDP contribution at current prices of the Industry and Construction sector with a value of USD 155 billion.

Of which, the market potential of offshore wind accounts for the largest proportion of 51.8% (USD 82.5 billion), followed by onshore wind (24.3%) and solar (24%).

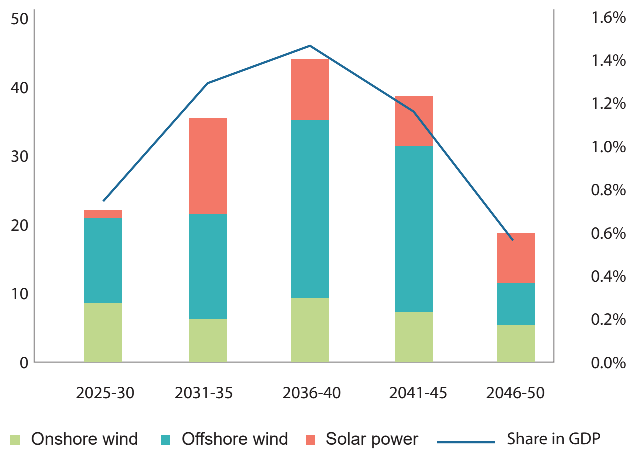

Figure 15. Market potential of wind and solar power

36 GDP is forecast according to the growth rate referenced from PDP8, which averages at about 7%/year for the period 2021-2030, and 6.5%/year for the period 2021-2050

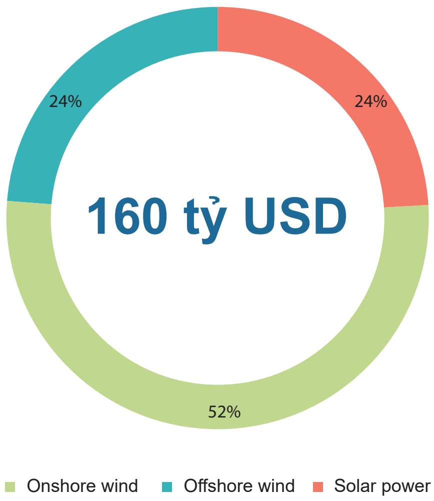

Figure 16. Shares of market potential by technology for the period 2025-2050

As the total investment in solar power is expected to regain its strong pace in the period after 2030, enterprises can leverage the period 2023-2029 to build up their capability to maximise the localisation of high-potential components and gradually increase the local content of currently low-potential components in the solar value chain.

3.4.2 Localised values

The capability to localise wind and solar power technologies depends on various factors such as policies of the state, the competitiveness and development orientation of domestic enterprises, and the implementation progress of PDP8. To arrive at a more comprehensive and accurate evaluation, it is necessary to carry out more detailed value chain surveys and assessments. As stated above, within the scope of this report, the study estimates the localised value using assumptions about the local content of components which the preliminary surveys and expert consultations assessed as having high localisation potential. Accordingly, the following are assumed for the period to 2050:

- Maximum localisation for components with high localisation potential and low technological/implementation complexity, including project development and plant installation (both wind and solar technology), manufacturing of foundation components/equipment (offshore wind), substations, and mounting structures (solar);

- Moderate localisation (about 50%) for components with high localisation potential and higher technological/implementation complexity, or with economic efficiency issues such as manufacturing of towers and cables (wind), and solar panels and electrical control units (solar).

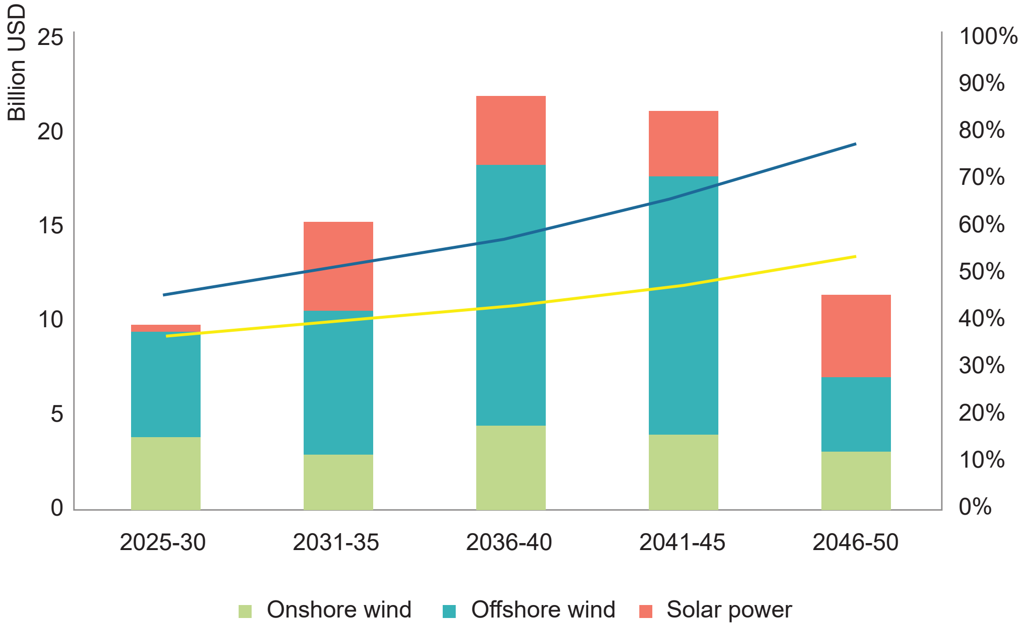

Figure 17. Estimated localised values

With the above assumptions, the average local content will increase from the current 45% to nearly 78% by 2050 for the solar power technology, and from 37% to 54% for the wind power technology. Accordingly, for the entire period 2025-2050, the localisation value will reach nearly USD 80 billion, accounting for 50% of the total market potential of wind and solar power technologies across the three stages of project development, equipment manufacturing, installation/construction.

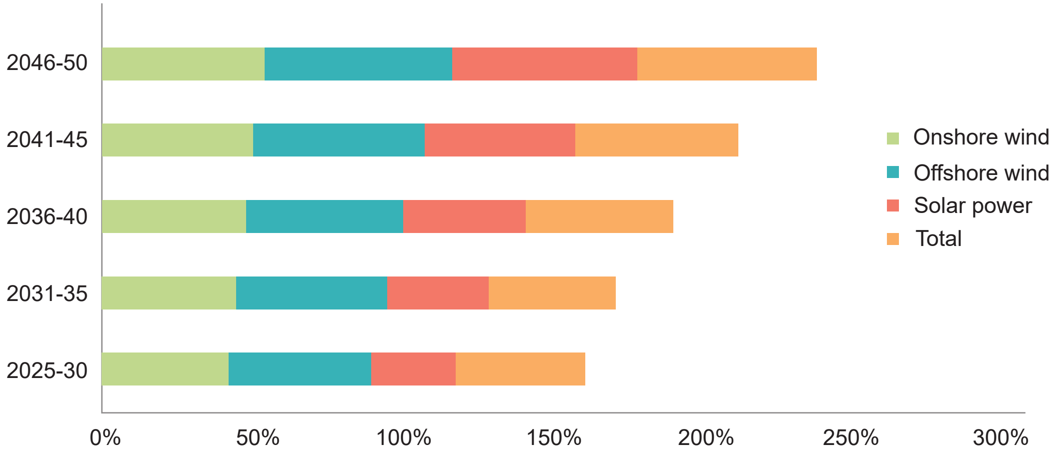

Figure 18. Shares of localisation values in the total market potential of wind and solar technologies

4. Conditions required to promote localisation in the industry sector

4.1 Setting appropriate localisation objectives

Viet Nam's industrial development has been playing an essential role in promoting economic growth and achieving the country's industrialisation and modernisation objectives. The objective regarding localisation and self-sufficient production was first introduced in the Resolution of the 10th National Party Congress in 2006, with an emphasis on synchronous development of a number of industries, including processing and manufacturing, high-tech, key material production, and national defence, contributing to building an industrialised country while enhancing its economic sovereignty. However, clearly defining an appropriate localisation objective and designing the necessary roadmap to achieve that objective is a critical policy development issue. In hindsight, this was also a significant challenge Viet Nam had to face in previous localisation programmes.

Viet Nam has developed localisation programmes for various industries, some of which have been successful with positive impacts. For instance, the motorcycle industry now has a manufacturing capacity of 3 million units per year with a high level of local content (approximately 90%), exporting to over 20 countries. In the electronics sector, local content in electronics components reaches approximately 30-35% for consumer appliances and about 40% for electronic components serving the automotive and motorcycle industries. However, the local content in computer electronics and telecommunications only reaches 15%, and roughly 5% in specialised and high-end electronics sectors. The majority of electronic products available in the Vietnamese market are either fully imported or assembled domestically, primarily using imported components. Domestic enterprises supporting the electronic industry have participated in the industry's value chain but mainly provide simple products with low technological content.

One of the biggest failures of Viet Nam's localisation policies might be in the automotive sector. To date, Viet Nam's automotive industry has only participated in the low-end segment of the automotive value chain, relied heavily on outsourced contracts by global automobile corporations, and has not yet mastered the core technologies such as engine, transmission and control system. Viet Nam's Automotive Industry Development Strategy to 2025, vision to 2035, was announced in Decision No. 1168/QD-TTg of the Prime Minister on July 16, 2014. The strategy set a 2020 objective to establish a supporting industry for automotive manufacturing and attempt to meet about 35% (by value) of domestic demand for automobile components and assemblies. For the period 2021-2025, the objective is to start production of some key components in drivetrains, transmissions and engines (especially for buses and light trucks), etc. However, to date, except for light trucks and buses, none of the objectives have been achieved. The local content for passenger vehicles with a maximum capacity of nine seats averages at only 7-10%, significantly lower than that of other countries in the region.

The main problems leading to the failed automotive industry localisation were the lack of preparation in terms of resources and inaccurate assessment of domestic scientific and technological capabilities, which resulted in inappropriate targeting. In addition, the lack of connections between enterprises and universities/research institutes has played a part in weakening the ability to grasp and apply new technologies. This leads to the inability to master core elements of the automotive technology and unable to manufacture products with high technological content .

The main reason for this situation is the limited capability of domestic industrial enterprises to offer products with quality that meets the high level of requirements of both the market and foreign direct investment (FDI) firms. The linkage between domestic suppliers and FDI firms as well as multinational corporations is still weak and not clearly defined.

On the government side, policies regulating the local content and the use of domestic contractors have been bound to international commitments. The policies implemented so far are not strong enough or commensurate with the scale and role of industries and supporting industries. Investment resources and support from the state for priority and supporting industries remain limited. There is a lack of large-scale regional and global corporations as well as key industrial products that can create spillover effects and lead the industry. The production level as guided for basic materials has not been achieved. Raw materials for the production of supporting industrial products, such as structural steel, plastics, and textiles for the garment and footwear industries, still rely heavily on imports.

On the enterprise side, small and medium-sized enterprises in Viet Nam mainly focus on the service sector and have not fully assumed a role in industrial development, especially in supporting industries that significantly require capital and technical knowledge.

4.2 Promoting investment in R&D and technological capability

Insufficient investment and poor technological capacity have become significant challenges for Vietnamese enterprises engaging in supporting industries. This will also greatly affect the localisation objectives in the RE industry. **Out of a total of one million Vietnamese businesses, only about 0.2% are involved in production and manufacturing activities in the RE industry**[37]. Meanwhile, most countries with successful localisation policies, such as China and Taiwan, have solid supporting industrial foundations.

The limited industrial production scale of these enterprises can be attributed to their low starting point and the inability to meet the technological and technical requirements of global production chains and customers. **One of the main barriers that Vietnamese enterprises have been facing is limited technological capability**. Many domestic enterprises have difficulty meeting the technological and technical requirements of global production chains and customer needs. This technology gap limits their ability to compete and integrate into the value chains of multinational corporations. As a result, industrial production and social ecosystems have not been fully established. This is reflected in the small number of industrial enterprises as well as the lack of engineering students, indicating a lack of interest and investment in this field. **Future efforts should prioritise improving technological capabilities through investment in R&D, innovation, and the adoption of advanced manufacturing technologies.**

37 https://baochinhphu.vn/du-dia-de-phat-trien-nganh-cong-nghiep-ho-tro-con-rat-lon-102221102083830939.htm

As a matter of fact, Vietnamese enterprises have chosen niche markets and avoided direct competition with foreign direct investment (FDI) firms. While this strategy may have provided short-term advantages, it has resulted in a lack of access to advanced technologies and global market standards of products. As a result, it is difficult for Vietnamese enterprises to keep up with international standards, leading to the limited ability to produce high-quality products and widening the technology gap.

Furthermore, supporting industries are also facing challenges in attracting social resources for investment. Global corporations and enterprises often prefer to work with conventional suppliers or companies of the same nationality for supporting industry products, especially in the case of Asian corporations from Japan and Korea. This preference, therefore, limits the opportunities for Vietnamese enterprises to participate in the value chains of multinational corporations, hindering their development and integration into the global market.

4.3 Localisation objectives should be integrated into FDI attraction policies

Dưới Under FDI attraction policies, Viet Nam's trade structure depends on the import of intermediate goods, indicating the strong participation of Viet Nam in the downstream instead of the upstream segments of global value chains. This development model, driven by multinational corporations and export strategies, has contributed to job creation, foreign exchange reserves increase and living standard improvement over the past decade. However, it poses challenges for the transition from the low-skilled labour market to the high-skilled labour market, especially in the context of multinational corporations implementing supply chain strategies that involve multiple supporting suppliers, as seen with companies such as Samsung, Toyota, Intel, etc.

Participation in the supply chain of a particular product often presents opportunities for all parties involved. Still, domestic businesses often face limitations in technological and management capabilities when competing with foreign investors in the Vietnamese market. Although domestic enterprises might be unable to develop or receive transfer of certain technologies, in other cases, it is the **limitations in human resources and management skills that hold back Vietnamese businesses from seizing opportunities.**

For example, the motorcycle industry has high local content, but most are manufacturers and component suppliers with foreign investment. From the industrial production perspective, there should be no distinction between domestic and foreign investors. However, from a "just" perspective, **domestic enterprises lack the opportunities and support compared to their competitors from other countries. Furthermore, policies aimed at attracting foreign investment also cause difficulties for domestic enterprises to access the market, which results in an unfair playground.**

To address these challenges, Viet Nam needs to implement development support programmes specifically for domestic enterprises to improve their technological capabilities and management skills. In addition, it is necessary to review and adjust FDI attraction policies to ensure a more balanced playground for domestic enterprises that can help promote their development and allow them to seize opportunities in the global market.

By enhancing the capability of domestic enterprises and improving access to technological advances, management skills and market opportunities, Viet Nam can facilitate a more inclusive and sustainable industrial development roadmap. This will not only contribute to the country's economic growth but also create more job opportunities and boost the overall competitiveness of Vietnamese enterprises in the global economy. During the renewable energy booming phase in Viet Nam in 2017-2020, the inferiority of Vietnamese enterprises compared to foreign EPC contractors was clearly witnessed, as well as the scarcity of high-quality human resources for project management and plant operations. This is also a significant challenge for Viet Nam as the demand will keep increasing rapidly in the near future.

5 Experience of energy transition's co-benefit policies in the industrial sector of some typical countries

In practice, there is ample evidence to suggest that a low-carbon development strategy can provide a more efficient roadmap to promote socio-economic development. This is especially relevant in developing countries like Viet Nam, where it is indicated that a faster transition can help increase global GDP by an additional 2.4% over the next decade (World Energy Transitions Outlook). Countries that have proactively embraced energy transition from the beginning have often set socio-economic development goals for the energy transition process rather than purely setting environmental goals, which resulted in gaining significant economic advantages from their leading position in clean energy.

5.1 Germany

TIn Germany, numerous studies and policy discussions over a long period of time have emphasised the importance of thoroughly assessing the benefits during the policy development process, including the evaluation of co-benefits in policies related to climate change, emissions, and energy. In particular, co-benefits in the industrial sector have always been a top priority in Germany.

In the German economy, value-added production accounted for approximately 20% of the Gross Domestic Product (GDP) in 2014, playing a significant role in the country's economy (UNIDO 2016). It was the highest in Europe, excluding the Czech Republic, and decreased to around 18.45% by 2022.

Environmental goods and services have held a crucial position in the German economy, creating approximately 260,000 jobs and generating around EUR 66 billion in revenue in 2013. Of these, about 77% of the jobs were in the manufacturing sector, generating approximately EUR 51 billion in revenue. The German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMUB) estimated the environmental and resource efficiency technology market to be valued at EUR 344 billion in 2013, equivalent to 13% of Germany's GDP (BMUB 2014). By 2020, green technologies contributed 15% to Germany's economic output and created 1.5 million jobs. While Germany accounts for only 3% of global economic output, German energy technology and energy efficiency companies hold up to 14% of the global market share (BMU 2021). Germany estimates that this market will grow at an average annual rate of 6.6% to EUR 740 billion by 2025. By 2030, the estimated value is expected to increase to EUR 856 billion with an annual growth rate of 8.1%. One of the key markets is energy efficiency and conservation, which is currently making the most significant contribution to Germany's green economy, with an annual transaction volume reaching EUR 117 billion.

The development of Germany's renewable energy industry is strongly supported by appropriate policies, mainly through the Energy Transition strategy (Energiewende). With a clear goal to enhance Germany's economic competitiveness, the Energiewende is not just an environmentally focused policy but also a green industrial policy. It is one of the most ambitious energy transition directions in the world. It aims to steer Germany's energy sector towards sustainability by achieving a combination of targets related to GHG emission reduction, renewable energy and energy efficiency. The main objectives of the Energiewende have been categorised into two strategic goals: increasing the share of renewable energy and improving energy efficiency. Both strategic goals are monitored and evaluated in the electricity, heat, and transportation sectors. The German government has set a number of targets for these sectors in the medium and long term[38].

One of the remarkable successes of this policy is the wind power industry in Germany, represented by the energy technology centre in four northern states: Lower Saxony, Schleswig-Holstein, Bremen, and Hamburg. This energy technology centre has developed into a closely interconnected network with more than 300 partners, including leading wind turbine manufacturers, specialised component suppliers, plant operators, local governments, and advanced research institutes. The system also owns several significant technological innovations in the industry, such as the development of offshore turbines with 5 MW capacity and the offshore test site Alpha Ventus. It can be said that without a foundation of manufacturing and high technology capabilities across the entire industry, Germany's wind energy sector would not have achieved its current global position. It can be considered that this energy technology centre represents a high-level development model with enterprises along the value chain, jointly funded by state resources and membership fees from enterprises.

In the solar energy sector, on the other hand, Germany couldn't secure a strong position in the market due to fierce competition from China. Several German solar energy companies went bankrupt during this period, such as Solon, Q-Cells, and Odersun. China's global market share proliferated, from less than 5% in 2004 to 45% in 2014 and over 80% in 2021, making China the dominant nation in the global solar panel manufacturing and export market. Germany's failure in developing the solar energy equipment manufacturing industry is often attributed to policies that didn't provide continuous support, leading to market disruptions on the demand side and insufficient support for the supply side. The interruption in support policies for the industry is considered the primary cause of Germany's stagnant and less

38 Altenburg, T., & Assmann, C. (Eds.). (2017). Green Industrial Policy. Concepts, Policies, Country Experiences. Geneva, Bonn: UN Environment; German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE).

competitive solar panel manufacturing industry on the international market, despite many production technologies originating from Germany. For many years, most orders for manufacturing core equipment in module production, wafers, or photovoltaic cells came from Chinese enterprises, with only a few recently from India and a few other countries.

The Energiewende, with its renewable energy and energy efficiency aspects in the electricity, transportation, and heating sectors, is a comprehensive and complex trend. In renewable energy technologies, Germany has somewhat succeeded in building a competitive advantage. Despite increasing competition from emerging economies, Germany has leveraged its strong technological capabilities to create an innovative edge.

The impact of the Energiewende in Germany has been a source of remarkable inspiration for energy policies in other countries and global technological advancements in renewable energy, especially in China. China's success in establishing a competitive solar and wind power industry has led to a sharp decrease in global wind and solar investment costs, resulting in a competitive advantage in scale and technology diffusion. To some extent, China's success is based on Germany's pioneering efforts in solar and wind energy technology and substantial technology transfer between Germany and China.

5.2 Taiwan

The global renewable energy industry is witnessing a growing policy trend of increasing local content requirements. According to the Organisation for Economic Co-operation and Development (OECD) and the Peterson Institute for International Economics (PIIE), the number of solar and wind energy markets implementing local content requirements has risen from 4 in 2000 to 31 in 2021. This includes major wind power markets like the UK, Japan, Taiwan, South Korea, and the United States.

Taiwan has achieved significant success in its offshore wind power programme, and until recently, this market was primarily funded by international sponsors and international banks, along with a few Taiwanese commercial banks. However, the Taiwanese government's policy now requires further localisation in offshore wind projects, along with the trend of decreasing the Feed-in Tariffs (FiT).

The energy transition is a critical issue receiving high interest in Taiwan. In 2016, Taiwan launched an ambitious energy transition plan aimed at changing the nation's energy mix. To achieve this political goal, government agencies issued a series of energy directives and policies, with offshore wind programmes being a vital component of the government's energy strategy. One prominent policy in Taiwan's offshore wind programme is the promoting localisation in the offshore wind industry, including a range of local content requirements in nearly every segment of the supply chain[39].

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39 Comparison of local content requirements for offshore wind power: Case studies from Taiwan, Japan, South Korea, and the United States-Industry-InfoLink Consulting (infolink-group.com)

The Taiwanese government has promoted a national development programme for offshore wind power comprising three phases: Phase 1: Pilot projects; Phase 2: Project development in shallow waters (with a commitment to install 5.5 GW from 2020 to 2025); and Phase 3: Project development in deep waters (with an estimated 10 GW to be installed from 2026 to 2035). For the Taiwanese government, offshore wind development not only ensures energy security but also aims to develop the relevant domestic construction and industry. This will transform Taiwan into a hub for supplying equipment and services in the booming Asian offshore wind market. In 2018, Taiwan developed a comprehensive policy framework to promote supply chain localisation. This framework includes various key development targets for different stages such as foundations, towers, and onshore electrical infrastructure during the preparation phase (2021-2022), and 14 other targets, including blades, shaft assembly for Phase 1 (2023), and Phase 2 (2024-2025). Developers awarded contracts in Phase 2 are required to submit detailed plans to achieve their localisation targets, along with relevant commercial contracts within specific time frames. If a Taiwanese supplier cannot meet their commitments due to issues like low product quality or incompetent production capability, the government may require the developer to propose a support plan. Failure to fulfil their commitments may result in actions by the Ministry of Economic Affairs, such as forfeiture of deposits, feed-in tariff (FIT) reduction, or contract termination.

While the Taiwanese government has not disclosed the specific reasons for the localisation rates, this policy is understandable in the context of global trends. Analysing Taiwan's economy from the 2009 financial crisis shows that Taiwan's export-oriented economy experienced another recession in 2015 due to reduced global demand for consumer electronics products coupled with falling oil prices. However, the situation improved from 2016 onwards. While the recent economic growth has been more modest due to the impact of the U.S.-China trade disputes, domestic production development resulting from the recovery of manufacturing companies has helped offset and mitigate the adverse effects of the U.S.-China trade tensions. From January to February 2020, economic growth rebounded, with exports and imports increasing by 6.4% and 5.3%, respectively, and the total trade value rising by 5.9% compared to the same period in the previous year. Although there is no statistical data directly linking the effects of the inclusive industrial localisation policies, it can be observed that 2016 marked a turning point, coinciding with the beginning of Taiwan's offshore wind industry development plan. While there are no clear signs that the overall economic growth of Taiwan has been directly impacted by the localisation policies in the offshore wind industry, the recovery of the industrial manufacturing sector in Taiwan could potentially be linked to the success of the localisation programme in the renewable energy sector.[40]

Recently, there have been calls from the industry and investors to reduce local content requirements because maintaining high levels of localisation can limit energy providers' ability to fully leverage the international supply chain to ensure the most competitive energy

40 Yachi Chiang, The Legitimacy and Effectiveness of Local Content Requirements: A Case of the Offshore Wind Power Industry in Taiwan

prices. Therefore, the renewable energy industry is facing the challenges of high costs and project delays due to these requirements.

Nonetheless, the successful development of Taiwan's offshore wind industry still serves as an excellent example for other countries. The localisation policies have helped build a local industry, create numerous employment opportunities, and contribute to the recovery of the manufacturing sector in Taiwan. Furthermore, robust localisation policies have opened up opportunities for exporting Taiwanese products and services to other countries, including Viet Nam and other Southeast Asian countries.

5.3 China

China is one of the prime examples of a country that initially lagged in the energy transition but succeeded in boosting local content requirements and exports. China achieved significant success in promoting local content requirements within the renewable energy sector through a series of robust policies from 1997 to 2009 and achieved dominance in both of the most critical sectors, solar and wind energy. China holds a dominant market share in wind energy and nearly absolute dominance in solar energy.

China's solar energy sector benefited from certain technological advantages in space science and strong policies to promote the semiconductor electronics industry. Nevertheless, China's solar power industry has only developed significantly over the past 20 years.

Currently, China holds approximately 80% of the global market share across all segments of the solar industry value chain, including polysilicon, ingot, wafer, cell, and module production. According to the IEA report, China dominates up to 80% of the market share in photovoltaic modules, 85% in photovoltaic cells, and over 95% in wafer production. Along with the trend of supporting domestic industries in various countries like the United States and India, China's market share in the global solar panel supply chain is expected to decrease to 64% for modules and 76% for wafers by 2027, but it will continue to maintain its dominant position in the world market. By the end of 2019, China had the capacity to produce silicon wafers of up to 173.7 GW, accounting for nearly 97% of the global production, according to the China Photovoltaic Industry Association.[41]

Dominating nearly the entire domestic market and a significant share of the international market has significantly contributed to the trade surplus and the socio-economic development of China. In 2022, the export revenue from photovoltaic solar equipment in China reached USD 52 billion, a 63% increase from the previous year. In 2018, China's export revenue from photovoltaic solar equipment was only USD 15 billion. Furthermore, almost the entire domestic market in China uses domestic products and services, with an installed capacity of around 390 GW in 2022 and approximately 1200 GW of new wind and

41 Renewable Energy: Is China's Innovation System Adequate to Enable a Low-Carbon Transition? - Groupe d'études géopolitiques (geopolitique.eu)

solar installations to be expected by 2030. This is also the reason why China no longer maintains localisation policies after the 2009 period because the competitive advantage of domestic products is certain both in the domestic and international markets.

Solar energy in China has indeed been in development for an extended period, starting in the 1950s due to the country's involvement in space exploration. The Chinese government began supporting research and development (R&D) for solar energy from the 1950s for space applications. However, the production of solar photovoltaic (PV) modules only really started in the 1990s. By the end of 1994, there were about 5 MW of solar PV modules produced in China, with around 3 MW used domestically. From the mid-1990s, the Chinese government implemented a series of policies to develop the solar industry, such as subsidies and feed-in tariffs (FIT). The Brightness Programme, launched in 1996, was the first national policy to provide electricity to unelectrified areas in western China through renewable energy sources.

In the mid-2000s, China's solar energy policy shifted to promote manufacturing for export. The Chinese government provided export credits, increased R&D investment, and established national laboratories in some leading corporations. Technology transfer was mainly conducted by purchasing manufacturing equipment from advanced countries, especially from Germany, and attracting skilled labour back to China through attractive policies for overseas Chinese. During this period, China used its domestic market to develop the wind and solar industries to serve export markets. In this phase, approximately 95% of the solar PV modules manufactured in China were exported, primarily to Germany and the United States[42]. These policies, along with solid policies post-2009, laid the foundation for China to achieve significant milestones in solar PV module manufacturing and a rapid increase in installed capacity of domestic solar power systems.

China's wind power industry is also a successful example of utilising the competitive advantage of the market, along with suitable localisation policies to boost the domestic industry. While China's wind industry may not dominate the market to the extent solar does, Chinese wind turbines still capture nearly 60% of the global market in 2022. Goldwind, a Chinese enterprise, is one of the leading companies in the domestic market and ranks second globally with a 13% market share, following Denmark's Vestas with a 14% market share. Out of the top 15 wind turbine manufacturers in the world, 10 have headquarters in China. Companies like Envision, ranking fifth with a 9% market share, and Mingyang Smart Energy, ranking sixth with a 7% market share, are among the prominent Chinese players. In total, China accounts for 56% of installed wind turbine capacity[43].

42 He Nuoshu and Fabio Couto Jr, Can Brazil replicate China's successful solar industry?
43 Chinese manufacturers dominate wind power, occupying 60% of the global market for wind turbines | REVE News of the wind sector in Spain and in the world (evwind.es)

There are various appropriate policy approaches that China has implemented to transition from producing small-scale turbines to having three out of the top ten manufacturers globally in just six years.[44]

Firstly, China possesses an enormous domestic wind energy resource estimated at approximately 700 to 1,200 GW, both onshore and offshore. Due to its large population and land area, China also has a significant and growing domestic electricity market. This domestic market advantage is something that China has successfully leveraged in various industries, including the renewable energy sector.

China's domestic localisation policies for the wind power industry are strategically combined with other wind energy incentive policies to promote well-integrated localisation goals effectively. One of the initial policies was the "Ride the Wind" programme in 1997, which required 20% local content for two joint ventures This program laid the groundwork for subsequent domestic localisation requirements.

During China's wind industry boom from 2003 to 2009, two significant policies played a vital role in developing China's wind energy industry. First, China designed a national bidding system for projects with a capacity of over 100 MW. Within this system, localisation criteria were introduced as scoring items with increasing weight, starting at 20% in 2005 and reaching 35% in 2007. This meant that domestic localisation, in theory, was optional, but due to its high weight in the scoring system, almost all bidders strived to achieve the highest possible level. Additionally, China maintained a separate approval system for wind projects with a capacity of over 50 MW under the jurisdiction of the National Development and Reform Commission (NDRC). In 2005, the NDRC imposed localisation requirements in their project approval jurisdiction with a minimum of 70% in-country value. This policy was maintained until the end of the 2009 period[45], mainly because domestic companies already held dominant market shares.

Before 2000, Chinese companies only held a 10% market share in the domestic wind turbine market. Alongside the wind power investment-promoting policies to drive demand, China's wind turbine equipment manufacturing industry also flourished with the support of domestic localisation policies. China's top three, top five, and top ten wind turbine equipment manufacturers accounted for 55.5%, 70.7%, and 85.3% of new installed capacity in 2009, respectively. They also represented 59.7%, 70.4%, and 84.8% of the total cumulative installed capacity. This is why China no longer needed to apply domestic localisation criteria to its renewable energy investments after 2009.

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44 ICTSD, Local Content Requirements and the Renewable Energy Industry - A Good Match?, June 2013
45 International Energy Agency, 2021

6. Proposals for promoting co-benefits of the energy transition

6.1 Integrating co-benefits of the energy transition into regulatory and policy impact assessment process

Regarding Viet Nam's industrial development, the latest regulations in development include the Law on Industrial Development (will be reviewed at the 6th session and expected to be passed at the 7th session of the National Assembly[46]). In this Law, Chapter II, Section 3 is expected to specify provisions on the development of ancillary industries, including the list of ancillary industries, responsibilities of related agencies in the development of ancillary industries, regulations on ancillary industry development, and the duty to develop ancillary industries. In the Proposal for the formulation of the Law on Industrial Development, Policy 1 concerning Industrial Development Orientations identified one of its content as *"Specific mechanisms for developing ancillary industries and other key industries"* and the corresponding solution of *"Supplement mechanisms to encourage the development of foundation industries and ancillary industries (access to credit, land use, human resource training, market development and brand promoting, public procurement, public investment, state capital investment in enterprises, etc.)".*

46 Government's Proposal regarding the 2024 Law and ordinance making programme and adjustment of the 2023 Law and ordinance making programme, section II.3, Documents of the Meeting on the Government's Proposal regarding the 2024 Law and ordinance making programme and adjustment of the 2023 Law and ordinance making programme, 13 January 2023. Details provided at: https://moj.gov.vn/qt/tintuc/Pages/chi-dao-dieu-hanh.aspx?ItemID=3686

In Policy 6 on decentralisation and allocation of duties for industrial development, it is expected that the Government shall promulgate the List of foundation and ancillary industries as well as the mechanisms and policies for them. The provincial People's Committees, on the other hand, shall develop and promulgate the Lists of foundation and ancillary industries, their areas of business activity and products prioritised for development. Accordingly, it is apparent that the Law on Industrial Development will be an important piece of legislation for promoting localisation in Viet Nam. In addition, the Proposal also preserves the potential to integrate with other co-benefits. Specifically, Policy 6 of the Proposal, regulating decentralisation and task allocation in industrial development, suggests that the Ministry of Industry and Trade be assigned the duty of developing energy transition programmes for sustainable development and the economical, efficient use of energy[47]. This represents the opportunity to integrate into the proposed law the energy transition's co-benefits related to energy security, green economy and environmental protection.

The recognition of the co-benefits of the energy transition in legal documents is essential, however, expert opinions suggest that applying the co-benefit approach in policy impact assessments is of equal importance. The assessment of co-benefits at an early stage of policy development represents a potentially effective approach to arrive at comprehensive and optimal policy decisions. Specifically, co-benefits of the energy transition can be considered when assessing policy impact in various sectors. These are not limited to energy, climate, environment, green economic development and biodiversity, but can also include employment, health, education, etc.

International experience indicates that co-benefit assessment is applicable in many aspects of policy impact assessment, notably economic and social impacts. However, the co-benefits approach is still absent in Viet Nam's regulations and technical requirements on economic and social impact assessment. Specifically, Viet Nam's regulations require the economic impact assessment of a policy to be based on the cost-benefit analysis of one or several aspects including production and business, investment, competitiveness, etc.[48] Social impacts, on the other hand, must be assessed on the basis of the analysis and forecast of impacts on one or several of the 13 specified social aspects, including the environment[49]. Accordingly, to ensure the presence of a co-benefit approach in policy decisions, it is advisable to develop and promulgate guidelines on identification and assessment of co-benefits of the energy transition in policy decision-making, with a focus on impact assessment in industrial sectors.

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47 Policy impact assessment report regarding the Law on Industrial Development (Attached to Proposal No. 492/BCT-CN dated 28 January 2022 of the Ministry of Industry and Trade), section II.6.3
Details provided in the Documents for the appraisal of the Proposal for the development of the Law on Industrial Development (10 February 2022), available on the Ministry of Justice's portal:
https://moj.gov.vn/qt/tintuc/Pages/chi-dao-dieu-hanh.aspx?ItemID=3404

48 Decree 34/2016/ND-CP dated 14 May 2016 of the Government detailing a number of articles of, and providing measures for implementing the Law on Promulgation of Legal Documents, Article 6, Clause 1

49 Decree 154/2020/ND-CP dated 31 December 2020 of the Government amending Decree 34/2016/ND-CP detailing a number of articles of, and providing measures for implementing the Law on Promulgation of Legal Documents, Article 1, Clause 3, Point a

6.2 Determining socio-economic development targets of the energy transition trend through local content targets

As analysed previously, one of the most important socio-economic benefits for developing countries is the establishment of the national industry, which entails the localisation of parts of the value chains to further economic growth. In many developing countries, policies often focus on the creation of jobs in the consumption stage, rather than sustainable jobs in the manufacturing stage. In addition, without strategic policy incentives on localisation, Viet Nam risks missing out on important benefits of the creation of national value chains in the international market, with repercussions on economic development speed. Economic development has always been the top priority in developing countries, including Viet Nam. Therefore, the socio-economic benefits of the energy transition, if maximised, will arguably determine the speed of energy transition in each of its phases. During the start-up and take-off phases, Viet Nam can opt for a slower transition to focus on long-term, fundamental factors such as localisation, training, science and technology, which will enable greater acceleration and maximised socio-economic benefits in the later phases.

Local content requirements impose an obligation for project developers to purchase a specific proportion of equipment from within the country. The required shares of local content typically take the form of a percentage of total project cost (per unit of installed capacity) and often increase over time.

One of the potential benefits of local content requirements is providing opportunities for domestic enterprises to learn by doing and to promote innovation. This is especially instrumental as international RE supply chains are consolidating with high entry barriers. In addition, by accumulating capabilities, domestic companies can enhance the competence needed to meet domestic demand. Once an internationally competitive industry is established, the local content requirements can be gradually lowered.

Few barriers are anticipated for the localisation of certain parts of the RE value chain where it is relatively easy to transfer technology and reinforce the workforce in the low- and medium-skilled segments of the job market. Obligations to meet local content requirements can be focused on specific parts of the value chain (e.g. design, transport, installation, production, manufacturing, operation). Alternatively, regulations on local content may provide more flexibility for project developers by giving them the opportunity to decide the parts in which domestic products or expertise should be included.

In the context detailed above, Viet Nam will need to thoroughly break down current market conditions and existing value chains to develop appropriate local content targets for each period. In addition, the strategy must be in line with the training and upskilling activities for future RE professionals.

To mitigate the increase in prices of RE equipment and slow expansion of RE electricity capacity due to local content requirements, localisation policies should include measures to encourage the cost competition among domestic enterprises.

According to a number of assessments by GIZ, rooftop solar power and offshore wind power stand out as the two RE sectors with higher localisation potential in Viet Nam. These are the areas with ongoing legal framework development, including the bidding and self-consumption mechanisms, into which Viet Nam can integrate incentive policies.

6.3 Increasing in-country value through human resource development

Viet Nam has established effective “demand pull” policies, including FIT tariffs, rooftop solar power development supporting policies, etc. However, “supply push” measures have not yet been implemented strategically. Viet Nam’s value creation can be promoted by combining product R&D with human resource training and development of domestic service providers. This will also help reduce the dependence on foreign experts.

A large-scale, 50MW solar project can provide a total of 230,000 person-days across all segments of the solar value chain, of which the highest share (56%) comes from operation and maintenance (O&M), followed by manufacturing (22%) and construction/installation (17%). Similarly, a 50 MW onshore wind project, a total of 144,000 person-days is needed, of which the largest share (43%) belongs to O&M, followed by construction/installation (30%) and manufacturing (17%). On the other hand, a 500 MW offshore wind farm provides a total of 2.1 million person-days where manufacturing and procurement account for the largest share (59%), followed by O&M (24%) and installation and grid connection (11%).

Viet Nam has relatively attractive rooftop solar (RTS) power incentive policies. By switching from the net metering mechanism (2017) to a “buy-all-sell-all” FIT model (2019), the RTS market has grown significantly. With attractive FIT for RTS and the regulatory eligibility of private power purchase agreements, the sector is now thriving. In addition, the rooftop leasing model is becoming increasingly popular.

Analyses from other countries have shown that the job creation potential from RTS is 10 times higher than that of utility-scale solar and other power generation technologies. Although smaller-scale solar projects are slightly more expensive due to their lower economies of scale, the high labour intensity of these systems should also be considered by policymakers when they decide the ratio between utility-scale and distributed power sources. Policy programmes for rooftop solar could also produce positive short-term employment effects. Small-scale, modular technology solutions such as RTS systems can be further researched and developed domestically, and replicated relatively quickly, bringing timely stimulations to the Viet Nam’s economy.

Unlike equipment manufacturing, human resource training represents a way forward that does not require large-scale investment and research, can quickly increase in-country value in RE supply chains, and can help Viet Nam avoid adverse effects of other country's competition for high-quality human resources, which would otherwise slow down the national energy transition. The training approach, if done right, can potentially give Viet Nam significant advantages in the energy transition, locally and globally. This is also an area that has always been prioritised for support and in a good position to receive technology transfer from developed countries.

Viet Nam can establish a general strategy to integrate RE into vocational and university curricula. This would require coordination between ministries, including the Ministry of Industry and Trade, Ministry of Labour - Invalids and Social Affairs, Ministry of Education and Training, and Ministry of Science and Technology. Accordingly, curricula and university programmes need to be periodically updated to keep up with the demand for skills of an ever-evolving RE industry. To ensure that skills development meets the needs of the RE industry, vocational training in the manufacturing sector must go beyond conventional skills such as metalworking and welding to train workers in other sectors such as advanced material development and digital design. In the long term, Viet Nam can fabricate closer linkages between industrial and skills development policies. To successfully localise parts of any value chain, Viet Nam must first ensure domestic workers in those parts are properly trained to the required qualifications.

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