Kementerian ESDM
PPSDM KEBTKE

REPORT

SWIFT: SPECIALISED WORKFORCE FOR INDONESIA'S FUTURE TRANSITION IN ENERGY

Review of Institutional Roles and Governance Mechanisms

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ENERGY TRANSITION PARTNERSHIP
Powering Prosperity and Enabling Sustainability in South East Asia

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Foreword

Indonesia's energy landscape stands at the threshold of a major transformation. As the country advances towards its net-zero ambitions, the workforce must evolve to meet the demands of a rapidly changing energy landscape, considering the anticipated emergence of new economic activities, particularly in renewable energy and energy efficiency. This parallel transformation will require a strategic approach that can align labor market dynamics with the energy transition agenda.

Propelled by this urgency, the *Specialised Workforce for Indonesia's Future Transition in Energy (SWIFT)* project aims to facilitate adequate workforce development and ensure that Indonesia's future workforce is equipped with the skills and knowledgebase to drive these new economic activities in the energy sector. Through this proactive initiative, the SWIFT project hopes to contribute to the early creation of the appropriate academic and training pathways that can generate skilled workers for when and where they are needed.

It all starts with an effective institutional framework. The findings presented in this report were produced from a study that reviewed the institutional roles and governance mechanisms responsible for workforce development in Indonesia's energy sector. It aimed to identify current challenges and bottlenecks with the goal of formulating recommendations towards enhancing the current framework. Through an effective institutional framework, the country stands a better chance at realizing workforce development processes that can support Indonesia's energy transition.

Findings from the report will inform the development of a roadmap that aims to support policymakers, particularly the Ministry of Energy and Mineral Resources (MEMR), in shaping a resilient and future-ready workforce for Indonesia's energy sector.

We hope that this report serves as a valuable resource for policymakers, industry leaders, and education providers committed to shaping a resilient and future-ready workforce for Indonesia's energy sector.

Prahoro Nurtjahyo
Head of The Human Resources Development Agency of Energy and Mineral Resources

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List of Abbreviations

AEAI	*Asosiasi Energi Angin Indonesia* (Indonesia Wind Energy Association)
AESI	*Asosiasi Energi Surya Indonesia* (Indonesia Solar Energy Association)
APPLTA	*Asosiasi Pengembang Pembangkit Listrik Tenaga Air* (Association of Hydropower Plant Developers)
APROBI	*Asosiasi Produsen Biofuel Indonesia* (Indonesia Biofuel Producer Association)
Bappenas	*Badan Perencanaan Pembangunan Nasional* (National Development Planning Agency)
BLK	*Balai Latihan Kerja* (Vocational Training Center)
BNSP	*Badan Nasional Sertifikasi Profesi* (National Professional Certification Agency)
BPSDM ESDM	*Badan Pengembangan Sumber Daya Manusia Energi dan Sumber Daya Mineral* (Energy and Mineral Resources Human Resources Development Agency)
CII	Confederation of Indian Industry
CRC	Cooperative Research Centres
CSO	Civil Society Organization

DOLE	Department of Labor and Employment
Ditjen EBTKE	*Direktorat Jenderal Energi Baru dan Terbarukan dan Konservasi Energi* (Directorate General of New, Renewable Energy and Energy Conservation)
ETP	Energy Transition Partnership
EU	European Union
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH* (German International Cooperation Society)
GJA	Green Jobs Act
GW	Gigawatts
GWO	Global Wind Organisation
ILO	International Labour Organization
INAGA	Indonesian Geothermal Association
IRENA	International Renewable Energy Agency
JETP	Just Energy Transition Partnership
JREF	Japan Renewable Energy Foundation
KADIN	*Kamar Dagang dan Industri Indonesia* (Indonesian Chamber of Commerce and Industry)
KA-LDP	*Komisi Akreditasi Lembaga Penyelenggaraan Diklat* (Accreditation Commission for Education and Training Organizing Institutions)
MEMR	Ministry of Energy and Mineral Resources (*Kementerian Energi dan Sumber Daya Mineral*)
KKNI	*Kerangka Kualifikasi Nasional Indonesia* (Indonesian National Qualification Framework)
MCDA	Multi-Criteria Decision Analysis
METI	*Masyarakat Energi Terbarukan Indonesia* (Indonesia Renewable Energy Society)
NGO	Non-Governmental Organization
NTT	*Nusa Tenggara Timur* (East Nusa Tenggara)
NZE	Net Zero Emissions
OECD	Organisation for Economic Co-operation and Development
PIH	*Pusat Industri Hijau* (Green Industry Center)
PII	*Persatuan Insinyur Indonesia* (The Institution of Engineers Indonesia)
PLN	*Perusahaan Listrik Negara* (State Electricity Company)
PV	Photovoltaics
REI	Renewable Energy Institute
RPJMN	*Rencana Pembangunan Jangka Menengah Nasional* (National Medium-Term Development Plan)
RPJPN	*Rencana Pembangunan Jangka Panjang Nasional* (National Long-Term Development Plan)
RUKN	*Rencana Umum Ketenagalistrikan Nasional* (National Electricity Planning)

RUPTL	*Rencana Usaha Penyediaan Tenaga Listrik* (Electricity Procurement Plan)
SECO	Switzerland's State Secretariat for Economic Affairs
SCGJ	Skill Council for Green Jobs
SKKNI	*Standar Kompetensi Kerja Nasional Indonesia* (Indonesia's National Competency Standards)
SME	Small Medium Enterprise
SMK	*Sekolah Menengah Kejuruan* (Vocational High School)
STEM	Science, Technology, Engineering, and Mathematics
SWIFT	Specialised Workforce for Indonesia's Future Transition in Energy
TPAK	*Tingkat Partisipasi Angkatan Kerja* (Labor Force Participation Rate)
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UPTD	*Unit Pelaksana Teknis Daerah* (Regional Technical Implementation Units)
UPTP	*Unit Pelaksana Teknis Pusat* (Central Technical Implementation Units)
WIOA	Workforce Innovation and Opportunity Act

Executive Summary

1. Indonesia's energy transition presents both challenges and opportunities for workforce development, requiring a strategic approach to align labor market dynamics with the demands of a green economy. This study is part of the broader initiative entitled "SWIFT: Specialised Workforce for Indonesia's Future Transition in Energy (SWIFT)," which aims to create a substantial number of jobs in low-carbon industries by addressing the workforce shortage through skill development in energy transition sector skills transfer system. The initiative includes creating a roadmap and implementation plan for specialized workforce development, establishing standards, certification programs, and training modules in renewable energy and energy efficiency, and conducting consultations with Ministry of Energy and Mineral Resources (MEMR), and other relevant ministries and stakeholders.

2. The study focuses on identifying key institutions and providing policy and technical recommendations for the government, while highlighting champion organizations with the potential to contribute to workforce development. Drawing on best practices from Indonesia and around the world, it offers a comprehensive understanding of institutional roles and governance mechanisms to inform a national roadmap. This roadmap will support the MEMR and other stakeholders in developing a specialized workforce capable of driving Indonesia's energy transition.

3. Green jobs currently account for only 2.62% of the workforce[1], underscoring the urgent need for policy interventions to expand this segment and mitigate socio-economic impacts. While the renewable energy sector offers significant potential for job creation, with an estimated 1.12 million green jobs in Indonesia[2], the sector faces critical challenges.

4. Indonesia's energy transition presents significant opportunities for workforce development but also highlights systemic challenges that require a coordinated and strategic response. The recommendations below address six key challenges identified in the analysis, providing actionable strategies to build a skilled and adaptable workforce while emphasizing the roles of key institutions identified in the study.

5. The findings from this study will feed into the development of a roadmap to guide MEMR in the development of a specialized workforce for the energy transition.

[1] Bappenas. 2024. Implementasi Peta Okupasi Nasional *Green Jobs* Menunjang Pencapaian NZE 2060.

[2] OECD. 2024. *Towards Greener and More Inclusive Societies in Southeast Asia: Labour market implications of the energy transition: Indonesia case study*. OECD Publishing, Paris.

Improving institutional coordination and reducing fragmentation

6. Fragmented governance among ministries and institutions significantly reduces the effectiveness of workforce development initiatives in Indonesia's energy transition. To address this issue, establishing a central coordinating body is critical for harmonizing policies, aligning strategies, and ensuring effective cross-sectoral collaboration. The Energy and Mineral Resources Human Resources Development Agency (*Badan Pengembangan Sumber Daya Manusia Energi dan Sumber Daya Mineral, BPSDM ESDM*) under MEMR and the Directorate General of New, Renewable Energy, and Energy Conservation (*Ditjen EBTKE*) are the most suitable candidates to assume this role, given their technical expertise and mandates in workforce and renewable energy development.

7. Selecting one of these institutions as the central coordinating body would enhance their ability to lead effectively. This designation would enable either BPSDM ESDM or Ditjen EBTKE to leverage their operational experience and deep technical knowledge while gaining the legitimacy and authority required to mandate cohesive workforce strategies. By formalizing this central role, the chosen body could coordinate efforts across ministries, industries, and regional governments, ensuring that workforce development initiatives are streamlined and aligned with Indonesia's energy transition priorities.

8. The House of Representatives plays a critical role in granting political legitimacy to the coordinating body, approving budgets, and monitoring implementation to ensure alignment with national energy transition goals.

9. Adopting collaborative governance frameworks is equally important to align stakeholders, including ministries, local governments, industries, academic institutions, and NGOs. This approach will enable the development of unified workforce roadmaps that address systemic inefficiencies while promoting inclusivity.

Enhancing data systems for workforce planning

10. A significant constraint in Indonesia's workforce planning for the energy transition is the lack of robust data systems, which hinders effective strategy formulation.

11. The absence of integrated labor market data impedes accurate forecasting and the alignment of training programs with market demands. Developing an integrated Labor Market Information System (LMIS) is critical. The Ministry of Manpower, through the Manpower Planning and Development Agency, can lead the development and implementation of the LMIS by coordinating labor market analyses and establishing mandatory reporting mechanisms for industries and vocational training institutions. The Directorate General of Vocational Training and Productivity Development can oversee the integration of regional labor market data, ensuring alignment between workforce supply and renewable energy sector demands.

12. Implementing data-driven workforce strategies ensures the LMIS serves as more than a static tool. By translating insights from the LMIS and occupational maps into actionable policies, institutions can develop targeted training programs, update certification processes, and align education with labor market demands. For instance, the Ministry of Manpower can adapt training curricula and scale up initiatives focusing on high-demand skills, such as renewable energy technology maintenance. Similarly, MEMR can use analytics to inform workforce policies, such as incentives for upskilling workers in renewable energy.

Improving the quality and capacity of training institutions

13. Vocational and training institutions in Indonesia, such as vocational high schools (*sekolah menengah kejuruan*, SMKs), Regional Technical Implementation Units, Central Technical Implementation Units, and vocational training centers (*balai latihan kerja*, BLKs), face significant challenges in supporting workforce development for the energy transition. These challenges include inadequate alignment with industry needs, insufficient technical expertise, and limited practical training infrastructure. Many programs are not tailored to renewable energy technologies, reducing their relevance to the labor market.

14. To address these issues, Indonesia must focus on enhancing technical expertise and fostering industry collaboration. To enhance these, the National Professional Certification Agency (*Badan Nasional Sertifikasi Profesi,* BNSP) plays a central role in setting and maintaining certification standards. BNSP can collaborate with industries, training centers, and international organizations such as the International Renewable Energy Agency (IRENA) and the International Labour Organization (ILO) to incorporate international benchmarks into certification frameworks.

15. Simultaneously, improving practical training infrastructure is essential. MEMR, particularly through BPSDM ESDM and the Renewable Energy and Energy Conservation Training Center (PPSDM EBTKE), can prioritize resource allocation for upgrading practical training infrastructure at BLKs and other centers.

16. Enhancing instructor training and capacity building is also critical. It requires active involvement from international organizations and academia, facilitated by the coordinating body. BPSDM ESDM or Ditjen EBTKE can lead collaborations with international organizations, such as the Energy Transition Partnership (ETP), ILO, the German International Cooperation Society (GIZ), and the Organisation for Economic Co-operation and Development (OECD), to bring global expertise to local trainers. These partnerships can include train-the-trainer programs, workshops, and certification for renewable energy-focused skills.

Optimizing processes for the development of certification standards

17. A significant challenge in Indonesia's workforce development for the energy transition lies in the development of SKKNI for renewable energy and related sectors. Typically, SKKNI is created based on requests from existing industries to address immediate workforce needs. However, the government has limited experience in proactively developing SKKNI for emerging and potential jobs in the energy transition.

18. To address these challenges, it is crucial to enhance certification quality to ensure that workforce competencies meet global standards and are aligned with the specific demands of the energy transition. BNSP plays a pivotal role in standardizing certification frameworks and ensuring they reflect the competencies outlined in the SKKNI.

19. Furthermore, Indonesia should promote international partnerships to adopt best practices in developing competency standards and certification frameworks. BNSP is central to these efforts, with the ability to act as the primary liaison between international organizations, such as IRENA and ILO, and domestic stakeholders, ensuring that global best practices are integrated into the SKKNI and certification frameworks. By engaging with these organizations, BNSP can incorporate forward-looking approaches to forecasting skill demands and aligning certifications with international benchmarks.

Increasing regional access and capacity

20. Regional Manpower Office and Regional Energy Offices face significant challenges in delivering region-specific training programs necessary to prepare the workforce for the energy transition. These institutions often lack the capacity, resources, and technical expertise to implement effective localized workforce initiatives.

21. To address these issues, it is essential to strengthen regional training centers, by providing targeted funding and technical support to expand renewable energy programs. Regional governments should take the lead role in driving this initiative, supported by key national institutions and stakeholders. Regional governments, particularly through Regional Energy Offices and Regional Manpower Offices, are best positioned to take the lead in identifying specific regional workforce demands, prioritizing skill development in areas with high renewable energy potential. Regional Energy Offices can assess local energy projects and infrastructure needs to guide the development of specialized training programs, ensuring alignment with renewable energy technologies such as solar, hydro, and geothermal energy. Regional Manpower Offices can analyze local labor market trends to determine workforce gaps and provide targeted recommendations for program development.

22. Additionally, efforts should focus on empowering local institutions, including Regional Manpower Offices, Regional Energy Offices, and Regional Technical Implementation

Units, to implement localized workforce programs effectively. The Ministry of Home Affairs, through the Directorate General of Regional Development, should ensure that regional governments integrate workforce development initiatives into their development plans. Regional Manpower Offices and Regional Energy Offices are critical to translating these mandates into action. Regional Manpower Offices can focus on assessing regional labor market needs, identifying skills gaps, and designing programs that prepare the local workforce for renewable energy jobs. Regional Energy Offices can leverage regional energy resources and opportunities to create targeted training programs for sectors such as solar, hydro, and geothermal energy. Regional Technical Implementation Units can operationalize these programs at the community level, delivering practical, hands-on training that equips local workers with industry-relevant skills. The critical role of translating mandates into action falls on Regional Manpower Offices, Regional Energy Offices, and Regional Technical Implementation Units. Regional Manpower Offices can assess and identify regional labor market needs and skills gaps, and then design programs to equip the local workforce with renewable energy skills. Regional Energy Offices can utilize regional energy resources and opportunities to create targeted training programs in sectors such as solar, hydro, and geothermal energy. While Regional Technical Implementation Units can then put these programs into action at the community level, delivering practical, hands-on training that provides local workers with the skills relevant to the industry.

Integrating inclusivity into long-term workforce planning

23. Another challenge in Indonesia's workforce development strategies for the energy transition is the insufficient integration of equity considerations. While long-term plans often emphasize the development of technical expertise, they frequently overlook critical dimensions such as gender equality, regional access, social inclusion, and support for people with disabilities. Additionally, current workforce policies lack robust mechanisms to ensure equitable representation across demographics, leaving significant gaps in inclusivity and access to opportunities.

24. To address these shortcomings, it is essential to integrate equity into workforce roadmaps. This initiative involves embedding gender equality, regional access, social inclusion, and support for people with disabilities as core components of workforce planning. The Ministry of Social Affairs can lead efforts to ensure workforce programs are inclusive of people with disabilities and marginalized communities. Local governments, through Regional Manpower Offices and Regional Energy Offices, play a crucial role in ensuring that workforce initiatives address regional disparities. These institutions can identify specific needs in their communities, such as skill gaps or accessibility issues, and tailor programs to meet these challenges.

25. Additionally, adopting lifelong learning models is crucial to creating an adaptable workforce that meets the dynamic demands of the energy transition. Such models, inspired by Singapore's SkillsFuture Initiative, ensure continuous upskilling opportunities while accommodating various commitments and barriers faced by

underrepresented groups. The Ministry of Primary and Secondary Education and Ministry of Higher Education, Science, and Technology are pivotal in embedding lifelong learning principles into education systems. The Ministry of Manpower plays a crucial role in promoting lifelong learning through its BLKs and workforce development programs. Directorate General of Vocational Training and Productivity Development can oversee the incorporation of modular training pathways into BLK programs, ensuring that training modules align with SKKNI and industry requirements. Meanwhile, the Ministry of Social Affairs ensures that lifelong learning initiatives are inclusive of individuals with disabilities and economically disadvantaged groups.

Introduction

1. Indonesia's Vision for 2045, as outlined in its eight National Priorities (*Asta Cita*), places energy independence at the heart of its strategy to achieve economic resilience and sustainability. The energy transition plays a crucial role in this vision by driving innovation, attracting investments in renewable energy, and fostering the growth of green industries.

2. To achieve these objectives, the Ministry of Energy and Mineral Resources (MEMR), alongside other key stakeholders, introduced the Energy Sector Roadmap towards Indonesia's Net Zero Emissions (NZE) target by 2060.[3] This roadmap charts a clear path forward, emphasizing critical strategies such as the massive development of new and renewable energy (NRE), the gradual phase-out of coal-fired power plants, the adoption of low-emission technologies, and the transition to electric vehicles. It also includes measures to enhance energy efficiency (EE) in industry, transportation, and construction, alongside plans to explore nuclear energy, hydrogen, and ammonia as part of the energy mix.

3. This transformation is anticipated to create a significant demand for workers in RE and EE sectors, while also leading to a gradual decline in the demand for workers in fossil fuel industries as relevant facilities are decommissioned. The roadmap underscores the monumental shift in Indonesia's energy landscape and the workforce opportunities it brings, signaling a pivotal moment in the nation's journey towards sustainable development where no one is left behind.

4. Thus, the energy transition demands not only technical innovation but also a robust and adaptive workforce capable of meeting its unique challenges.

5. Indonesia is forecasted to achieve the second-largest net job growth globally from the energy transition by 2030.[4,5] This transition is projected to create substantial opportunities for women and youth, as rapidly expanding sectors are often more inclusive. Meanwhile, job losses are predicted to be relatively minor compared to the significant number of jobs created.

6. The development of Indonesia's green job sector must align with the principles of decent work as outlined by the International Labour Organization (ILO)[6]. This entails promoting fair wages, safe working conditions, social protections, and equal opportunities for all, with a particular focus on including underrepresented groups such

[3] IEA and Government of Indonesia. 2022. *An Energy Sector Roadmap to Net Zero Emissions in Indonesia*.

[4] Montt, G., Wiebe, K. S., Harsdorff, M., Simas, M., Bonnet, A., &Wood, R. 2018. *Does climate action destroy jobs? An assessment of the employment implications of the 2-degree goal*. International Labour Review, 157(4), 519-556.

[5] OECD. 2024. *Towards Greener and More Inclusive Societies in Southeast Asia*. OECD Publishing, Paris.

[6] ILO. 2023. *Skills for Green Jobs in Indonesia*. ILO, Geneva.

as women and marginalized communities. Ensuring equal pay for equal work and fostering diversity in the clean energy workforce are not only social imperatives but also economic enablers that will drive innovation and productivity.

7. Ample planning and a robust workforce development strategy will be key to ensure that Indonesia's workforce is ready to drive the country's energy transition and, at the same time, unlock these opportunities for the people. This will require the engagement of many different players both in the public and private sector.

8. Central to this endeavor is strong governance, which acts as the backbone for integrating policies, stakeholders, and resources toward shared objectives. Governance frameworks ensure that workforce development initiatives are aligned with the broader goals of the energy transition, fostering coordination and minimizing redundancies. Mapping stakeholders and institutions involved in the workforce roadmap in energy transition provides critical insights into the capabilities, gaps, and synergies required for success. Such an approach underscores the importance of governance in orchestrating a cohesive and forward-looking strategy. Programs must prioritize inclusivity and sustainability, leveraging international best practices and fostering partnerships to create a well-equipped, future-ready workforce. Leading this institutional effort should be a strong championing organization that has the interest and influence to coordinate and mobilize the relevant stakeholders towards robust workforce development to support Indonesia's energy transition.

9. In support of this, the Southeast Asia Energy Transition Partnership (ETP), through the United Nations Office for Project Services (UNOPS), is spearheading a project to advance specialized workforce development for Indonesia's energy transition. Among the principal objectives of the project is to gain a comprehensive understanding of the institutional roles and governance mechanisms necessary to drive Indonesia's workforce towards meaningful contribution to the country's energy transition.

10. This report presents the findings of a study that explores the existing institutional framework related to workforce development in Indonesia's energy sector and aims to identify areas of improvement, including the nomination of potential championing organizations to lead the charge. This report will serve as a foundational resource to guide policy formulation and stakeholder collaboration, ensuring the development of a skilled workforce capable of supporting Indonesia's energy transition objectives.

11. The report includes the following sections:

    a. ***Workforce Transformation Amid Indonesia's Energy Transition*** provides a qualitative look into how Indonesia's energy transition plans require a skilled workforce to power it.

    b. ***Methodology for the Study*** describes the methodology for conducting the study

c. ***Overview of Workforce Development in Indonesia*** provides an overview of the current

d. ***Institutional Framework for Energy Transition Workforce Development*** explores the multitude of institutions involved in workforce development, categorized following the pentahelix framework for collaboration. It also explores the current governance mechanism in place for workforce development in the energy sector.

e. ***Gaps in Workforce Development in Indonesia*** discusses the main gaps related to workforce development in Indonesia based on the study, identifying weaknesses and how an improved institutional framework and governance mechanism can address them.

f. ***International Best Practices in Workforce Development for Energy Transition*** highlights key lessons from efforts in four other countries—India, Singapore, Germany, and the Philippines—that have pursued or are currently pursuing workforce development for their corresponding energy transitions. This section aims to identify key takeaways that Indonesia can consider towards its own workforce development efforts.

g. ***Identification of Championing Organizations*** provides the results of the study identifying potential coordinators for policy framework development and lead training centers.

h. ***Recommendations for Institutional Capacity Enhancement*** outline recommendations for relevant institutions to address the key gaps and constraints identified in the analysis.

12. The findings from this study aim to inform the formulation of a roadmap and implementation plan for specialized workforce development in energy transition. Further outputs include the creation of standards, certification programs, and training modules in RE and EE.

Workforce Transformation Amid Indonesia's Energy Transition

13. Currently, Indonesia's energy system is dominated by fossil fuels. In 2023, fossil fuels contributed to 86.7% of Indonesia's primary energy mix, with renewable energy making up 13.3%. Similarly, for power generation, 85.4% of the total installed capacity amounting to 91.2 GW was sourced from fossil fuels, mostly coal; meanwhile, installed capacity from renewable energy reached only about 13 GW.[7]

14. With Indonesia's commitment to net-zero emissions by 2060, the country's energy system is slated to transform, shifting its dependence away from fossil fuels towards new and renewable energy (NRE). Energy classified as "new", as communicated in Indonesia's National Electricity Master Plan (*Rencana Umum Ketenagalistrikan Nasional,* RUKN) 2024-2060, includes ammonia, hydrogen, nuclear, and waste heat. Meanwhile, those classified as "renewable" include solar, wind, ocean, hydro, geothermal, and bioenergy.[8]

15. Several plans have communicated targets for increasing NRE penetration in Indonesia. The draft National Energy Plan (*Kebijakan Energi Nasional,* KEN) has set a target of 58-61% NRE for the country's primary energy supply by 2050 and 70-72% by 2060.[9] In terms of total capacity, the RUKN 2024-2060 has set a target of 443 GW, with 73.6% powered by NRE. It also provides a more ambitious target that considers additional green hydrogen production in the country—630 GW total capacity, 77.7% of which shall be powered by NRE. In both scenarios, remaining fossil fuel-powered electricity generation shall be equipped with carbon capture and storage (CCS) technology, as well as incorporating co-firing in the case of coal-fired power plants (CFPPs).[10]

16. Such a significant growth in NRE capacity towards sustainable energy systems requires a shift not only in economic structures but also in labor markets. For Indonesia, this presents a dual challenge: mitigating job losses in carbon-intensive industries while building a workforce equipped to drive the low-carbon industry revolution. The Ministry of Manpower has already projected labor market shifts from 2025 to 2034, including a

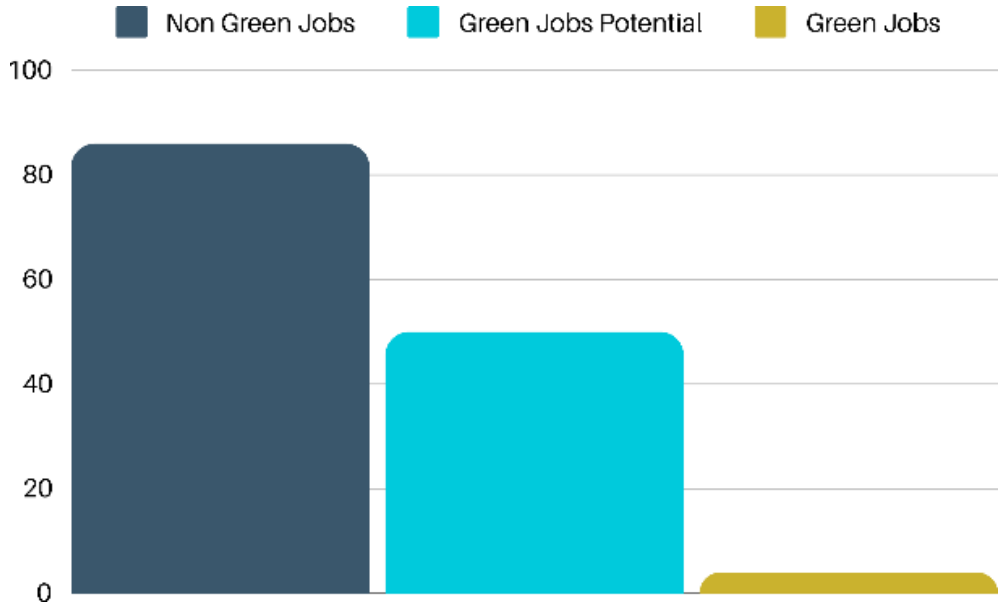
[7] Government of Indonesia. Ministry of Energy and Mineral Resources. 2023. *Handbook of Energy & Economic Statistics of Indonesia*.
[8] Government of Indonesia. Ministry of Energy and Mineral Resources. 2024. *Rencana Umum Ketenagalistrikan Nasional*.
[9] IESR. 2024. *Draft Government Regulation on National Energy Policy (RPP KEN) Slashes NRE Target to 19 Percent in 2025*. 31 January.
[10] Government of Indonesia. Ministry of Energy and Mineral Resources. 2024. *Rencana Umum Ketenagalistrikan Nasional*.

decline in employment in mining and quarrying and growth in electricity and gas supply roles.[11]

17. Recent studies estimate significant job creation due to the planned energy transition, considering how RE technologies are anticipated to create significantly more jobs than fossil fuels. For example, large hydropower is estimated to generate 3.8 times more jobs per unit of electricity, small hydropower 3.2 times more, geothermal 2.8 times more, and solar PV 2.5 times more. A study by Grafakos *et al*. (2020) estimates that the Electricity Supply Business Plan (*Rencana Usaha Penyediaan Tenaga Listrik, RUPTL*) 2019-2028 by Indonesia's state utility company, *Perusahaan Listrik Negara* (PLN), could result in 2.1 million new direct jobs.[12] Meanwhile, the previous RUKN estimated the creation of 3.7 million jobs by 2030. Indonesia could generate 1.12 million new jobs linked to renewable energy.[2]

18. The anticipated increase in jobs in the energy sector comes alongside the need for green jobs. Green jobs are poised to be a cornerstone of the global economy by 2030, with projections estimating the creation of over 100 million green jobs worldwide. However, the current penetration of green jobs in Indonesia is still low, presenting a huge gap that needs to be filled to meet the potential. As shown in Figure 1, green jobs currently represent a mere 2.62% of the total workforce, underscoring the need for aggressive policy interventions to expand this segment. The low adoption rate also reflects structural challenges in integrating green principles into existing economic activities.

Figure 1. Green jobs percentage



Source: Bappenas

[11] Government of Indonesia. Ministry of Manpower. 2024. *Pergeseran Tenaga Kerja Berdasarkan Lapangan Usaha.*

[12] Grafakos, S., Senshaw, D., Quezada, D., & Toro, A. 2020. *Employment assessment of renewable energy: Indonesian power sector pathways*. GGGI Country Report. Global Green Growth Institute.

19. While efforts in Indonesia towards the creation and promotion of green jobs remain in their early and preparatory stages, momentum is starting to build up, signaling a positive transformation in workforce preparation for the energy transition.

20. Indonesia's National Development Planning Agency (*Badan Perencanaan Pembangunan Nasional,* Bappenas*)* has defined green jobs as those that contribute to environmental preservation or restoration while ensuring decent work through the following:

    a. Specialized tasks designed to meet sustainability goals.

    b. Skill sets that align with renewable energy and sustainable practices.

    c. Eco-friendly processes that reduce environmental impact.

    d. Outputs in the form of sustainable products or services.[13]

21. In 2022, Bappenas also developed occupational maps for green jobs, Green Jobs National Occupation Map Volumes 1 and 2. These aimed to provide benchmarks for the expansion of the green job sector in Indonesia. However, these maps may require adjustments to reflect progress towards energy transition targets.

22. In addition, Bappenas has charted a roadmap for human capital development in green jobs, structured across four phases to align with national development plans:

    a. 2025–2029: Laying the foundation for workforce transformation.

    b. 2030–2034: Accelerating the integration of green jobs into key sectors.

    c. 2035–2039: Scaling up green job initiatives nationwide.

    d. 2040–2044: Institutionalizing green jobs for long-term sustainability.

23. These initiatives raised awareness among technical ministries, prompting them to review their existing programs, integrate green job components—particularly in the Ministry of Manpower and MEMR—and initiate cross-ministerial coordination. However, these efforts are still largely at the mapping stage and have yet to materialize into concrete programs.

24. Despite the clear will and effort to drive the creation of green jobs in the country, Indonesia still contends with the immediate challenges posed by the decline of the fossil fuel sector. Indonesia's dependence on fossil fuels, particularly coal, places a significant portion of its workforce at risk. Globally, job losses in the following sectors highlight the scale of the challenge: manufacturing of coke and refined petroleum products (75%); mining of coal and lignite (14%); and extraction of crude petroleum and natural gas (11%)[3.] In Indonesia, the workforce at risk includes:[14]

[13] Government of Indonesia. Bappenas. 2024. *Implementasi Peta Okupasi Nasional Green Jobs Menunjang Mencapaian NZE 2060*.

[14] Labor Committee on Just Transition. 2024

a. 165,984 workers in coal mining

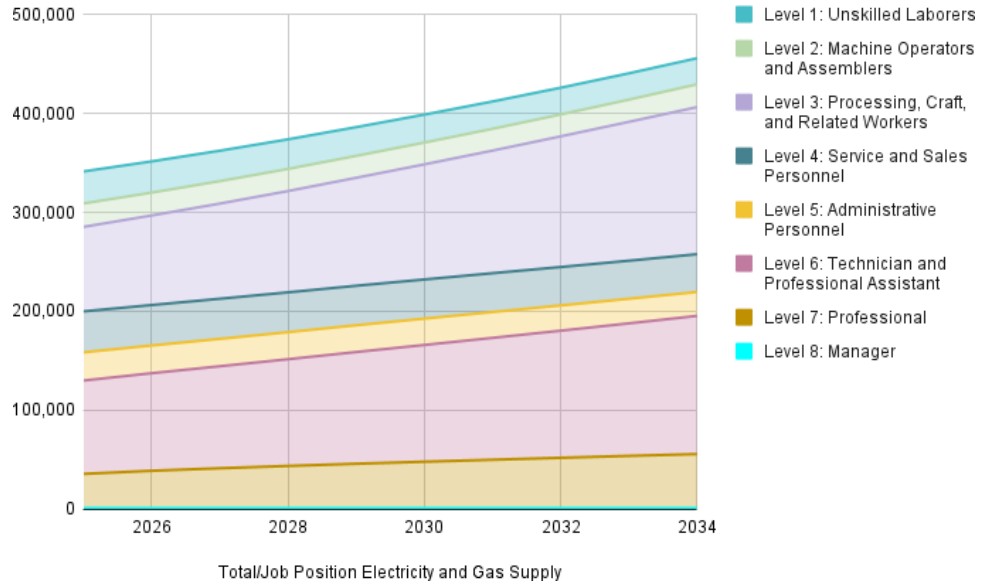
b. 54,129 workers at PLN involved in coal operations

c. 150,000 workers in coal-fired power plants

25. Job losses are not limited to direct jobs but also significantly impact informal workers in surrounding communities, who make up 44% of the fossil fuel workforce. In the coal mining sector alone, 62% of workers are informally employed, making them highly vulnerable to economic shocks.[15] Furthermore, global trends indicate that older workers and those without college degrees are less likely to transition into green jobs,[16] a pattern that could exacerbate unemployment and socio-economic inequalities in Indonesia.

26. The creation and elimination of jobs should also be observed within specific sectors, particularly at the shifting dynamics in the demand for different levels of skilled labor. These offer insights into what specific jobs are vulnerable and which ones will require ample workforce development to ensure that the future workforce is equipped with the appropriate skills to drive the relevant sectors. As illustrated in Figure 2, the electricity and gas industries will see an increase in demand for higher-skilled roles, such as processing workers (Level 3), technicians (Level 6), and professionals (Level 7), up to at least 2034.[17]

Figure 2. Projection of workforce demand by job positions for electricity and gas supply (2025 - 2034)



Source: Ministry of Manpower

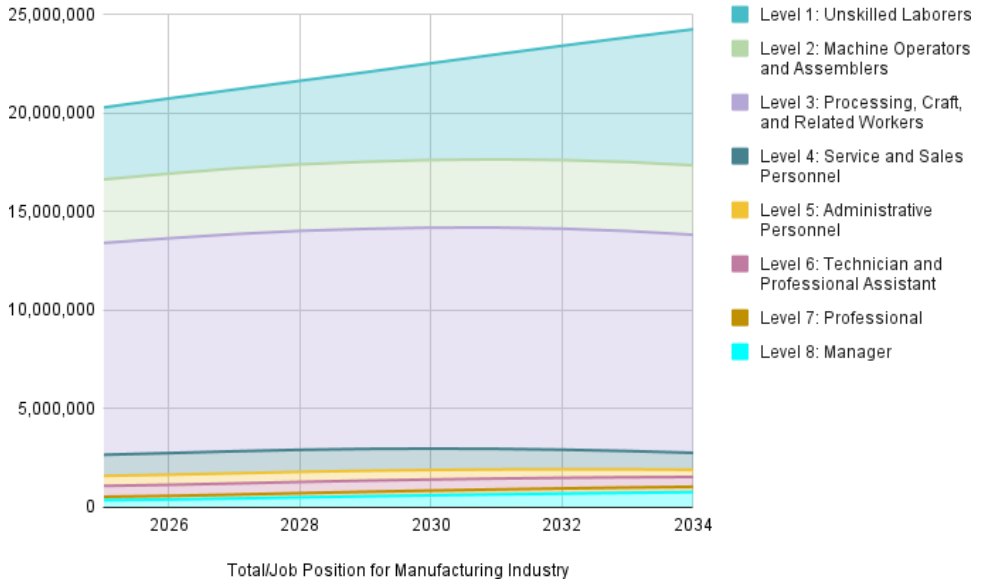
[15] OECD. 2024. *Towards Greener and More Inclusive Societies in Southeast Asia*. OECD Publishing, Paris.

[16] Curtis, E. M., O'Kane, L., & Park, R. J. (2023a, August). Workers and The Green-Energy Transition: Evidence from 300 Million Job Transitions. 1050 Massachusetts Avenue. Retrieved December 2024,.

[17] The levels correspond to the Indonesian Qualifications Framework, with higher levels corresponding to higher levels of education and more highly-skilled jobs.

27. On the other hand, in the manufacturing industry, the largest increase in demand until 2034 will be for unskilled laborers (Level 1), with demand in other jobs remaining fairly consistent until 2034, as seen in Figure 3.

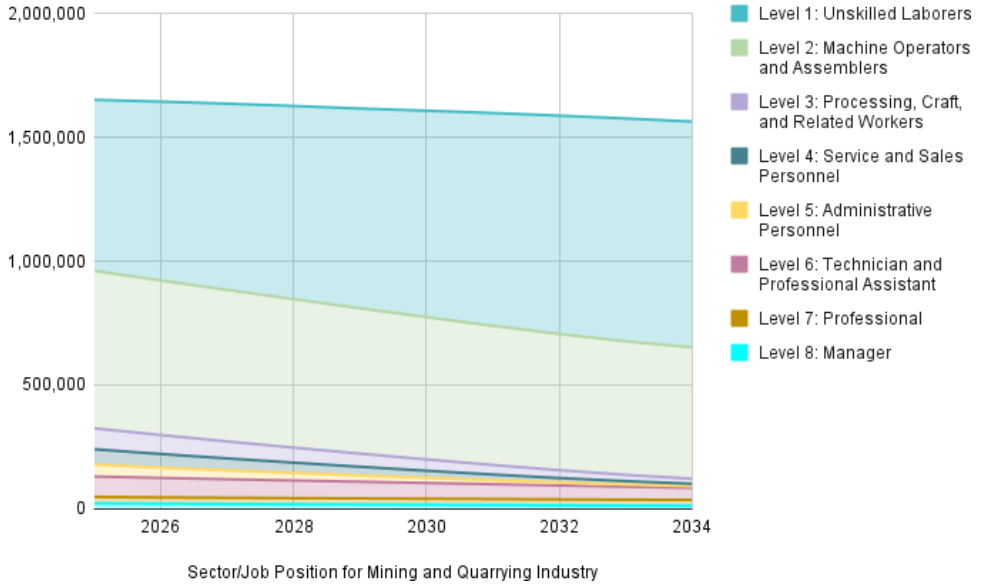
Figure 3. Projection of workforce demand by job positions for the manufacturing industry (2025 – 2034)



Source: Ministry of Manpower

28. Some job levels are expected to experience losses. For example, in mining and quarrying, jobs between Levels 3 and 5 are expected to decline up to 2034: processing, craft, and related workers (level 3); service and sales personnel (level 4); and administrative personnel (level 5), as seen in Figure 4.

Figure 4. Projection of workforce demand by job positions for the mining and quarrying industry (2025 - 2034)



Source: Ministry of Manpower

29. These trends underscore the urgent need for targeted upskilling programs to bridge existing skill gaps for energy transition. This challenge is particularly evident in the existing renewable energy projects, such as rooftop solar installations, which frequently face delays due to a shortage of trained technicians. In remote areas, mini-hydro power plants also struggle with high operator turnover, as non-local operators often leave after only a few months. This lack of locally trained technicians further hampers the operational sustainability of renewable energy facilities.

30. Amid these challenges, the energy transition offers a unique opportunity for economic revitalization through job creation. Workforce development in Indonesia—both through formal and informal education—should anticipate these shifts, with a robust system that can generate workers equipped with the appropriate skills and competencies to contribute to emerging energy activities in Indonesia.

Methodology for the Study

31. The study employed a multi-faceted approach, combining literature review, in-depth interviews, focus group discussions, and surveys. This comprehensive approach allowed for a nuanced understanding of institutional dynamics and governance frameworks, ultimately supporting the creation of an actionable and equitable national workforce development for MEMR (see *Appendix I. Methodology Design*). The information contained in this report reflect insights provided by the stakeholders consulted and those obtained from desktop research.

32. In-depth interviews with stakeholders in ministries and government bodies were designed to gather detailed and nuanced information about their perspectives, experiences, and attitudes. These one-on-one interactions went beyond structured surveys or focus groups by enabling researchers to deeply explore stakeholders' opinions, experiences, and insights into policy design, governance mechanisms, and institutional processes. This method is particularly valuable for understanding the attitudes, values, and decision-making frameworks within institutions and governance structures. For a list of interviewees, please see *Appendix II. List of Stakeholders and Interviewees*.

33. Focus group discussions (FGDs) are a structured yet flexible approach to gathering qualitative insights from a diverse group of participants. For this study, an FGD was held to explore varying perspectives, generate ideas, and uncover deeper insights about the role of institutions. It involved developing a discussion guide that structured the session into three phases: (1) opening questions to break the ice and establish rapport; (2) core questions that focus on the main themes of the discussion; and (3) closing questions to summarize insights and gather concluding thoughts. For a list of participants that attended the FGD, please see *Appendix III. List of Stakeholders and Participants for Focus Group Discussion*.

34. A survey was also conducted with stakeholders related to workforce development to map their interests and influence, identifying which agencies are involved. A stakeholder mapping survey required careful planning and execution to identify and understand key actors, influence, and relationships within a workforce development context. The insights from the document on survey management can be effectively applied to this purpose. First, the questionnaire was carefully designed to capture relevant information, such as stakeholders' interests, priorities, and influence levels, while minimizing potential ambiguities or misinterpretations. To ensure data quality, strategies for reducing sampling and non-sampling errors were essential. This included verifying that selected stakeholders accurately represented the broader network and addressing biases in responses. Monitoring mechanisms were in place to track survey progress and validate data consistency, while avoiding substitutions that might compromise the quality of insights. Finally, real-time updates and structured reporting enabled the team to adapt to challenges and ensure the survey met its objectives.

35. These methods complemented a desk study, which included the review of relevant online sources, including policy documents, research papers, and reports, that could shed light on the current state of workforce development in Indonesia. Literature review was also the primary method for investigating relevant efforts in other countries to gather insights for Indonesia's own efforts.

Overview of Workforce Development in Indonesia

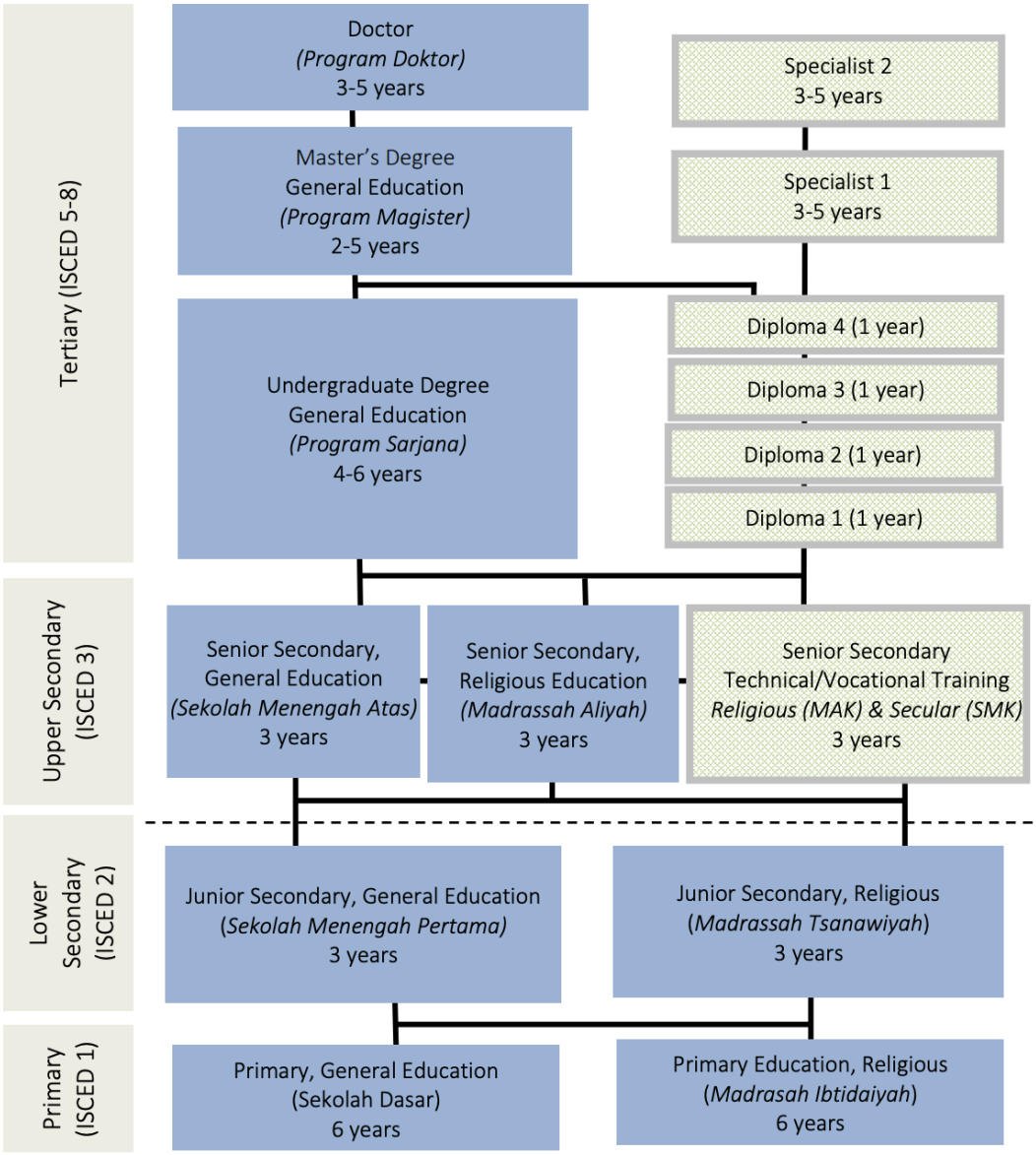
36. This section provides an overview of workforce development pathways in Indonesia, which can be categorized into formal or informal education. Relevant institutions along these different pathways provide the education and the training not only for prospective workers entering the workforce but also for those seeking reskilling and retraining. A discussion of the types of institutions involved in workforce development in Indonesia is provided in the section, *Institutional Framework for Energy Transition Workforce Development*.

37. Preparing the workforce for the various skill levels demanded by relevant sectors will require these different pathways to be robust. While different levels of education have a role to play to build the competencies needed for a skilled workforce to power Indonesia's energy transition, this study focuses on tertiary or higher education, particularly vocational education.

Formal education

38. Formal education in Indonesia is divided into two distinct tracks: academic and vocational, as illustrated in Figure 5.

Figure 5. Indonesia's higher education system.



Source: UNESCO, 2019.[18]

39. In the academic track (blue in Figure 5), students can attain a degree called "sarjana" at the undergraduate level (S1), a "magister" degree at the graduate level (S2), and a "doktor" degree at a doctoral level (S3). An S1 program usually takes four years to complete, following a specialized curriculum based on the chosen program, along with mandatory general education subjects. S2 programs generally last two years and typically require an S1 degree in a related discipline. Afterwards, students can choose to pursue an S3 qualification, which represents the highest academic potential in Indonesia's tertiary education system. These can take at least three years to complete.

40. The vocational track (beige in Figure 5) involves a series of diploma programs focused on vocational fields. These programs prepare graduates to apply learned skills at work.

[18] UNESCO. 2020. *TVET Country Profile: Indonesia*.

The duration of such programs can range from one year (D1) to four years (D4). The denomination for the diploma programs—i.e., D1, D2, D3, and D4—also provides an idea of the program's level of complexity. Achieving D4 certification is typically considered equivalent to an S1 degree. Students in the vocational track may transfer into an S1 program and, in some institutions, may even be admitted into an S2 program in a related discipline. Alternatively, graduates can continue to pursue vocational training through graduate-level specialization programs (Specialist 1 and Specialist 2).[19]

41. The skills and competencies attained at different levels of the academic and vocational tracks correspond to different levels of qualification based on the Indonesian Qualifications Framework (*Kerangka Kualifikasi Nasional Indonesia*, *KKNI)* (Figure 6), one of the national educational standards guiding students and academic and training institutions in assessing learning outcomes or certification based on qualification levels.[20] The higher the qualification level for a specific job, the higher level of education is expected for that job. For example, for jobs classified as Level 6, qualified job seekers are expected to have an undergraduate degree (S1) or a Level IV Diploma (D4).

Figure 6. A mutual equivalence toward KKNI qualifications levels between education pathways and occupational/career pathways.

Source: Authors' elaboration, based on information from the Ministry of Manpower[21]

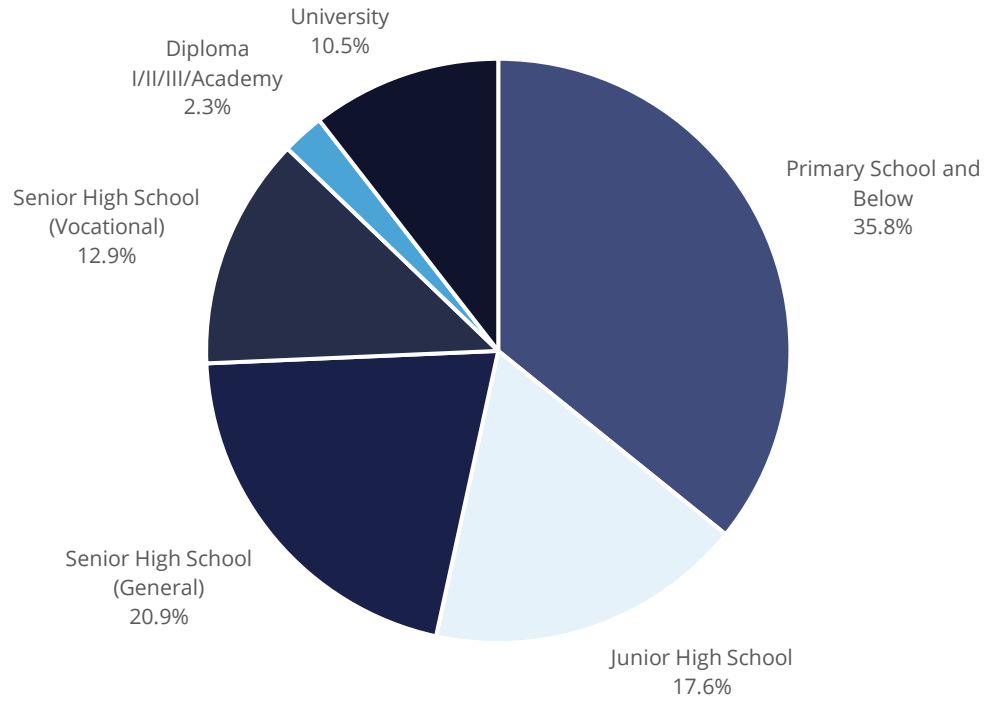
[19] WENR. 2019. *Education in Indonesia*.

[20] Ministry of Manpower. *About KKNI*.

[21] Government of Indonesia. Ministry of Minpower. *Tentang KKNI*.

42. Currently, education levels among the employed population show significant disparities, with a high proportion of workers having primary school education or lower (35.8%), but only 10.5% attaining university-level education in 2024 (Figure 7).

Figure 7. Education levels among the employed population in 2024.



Source: Authors' elaboration based on data from BPS Statistics Indonesia, 2025[22]

43. As illustrated in Figure 2 above, more and more workers at higher occupational levels will be needed for electricity and gas supply. These jobs will require higher education levels, which at the moment there is a shortage in the Indonesian workforce. According to the KKNI, workers at these levels are expected to obtain a Level I Diploma or higher, which only 13% of the Indonesian workforce has been found to possess. With 87% of workers having attained lower levels of education, i.e., vocational senior high school and below, a greater push to propel students to achieve higher levels of education is key to meet the demand for these workers by 2034 and beyond.

Informal education

44. Informal education in Indonesia aims to provide skills for new workers without a background in formal education and workers in industries at risk of disappearing (reskilling), as well as increase skills to assist workers' career development (upskilling).[23]

[22] BPS-Statistics Indonesia. 2025. *Population 15 Years of Age and Over Who Worked During the Previous Week by Main Industry (17 Sectors) and Educational Attainment*. Retrieved on February 6, 2025.

[23] Abdul Malik, Thia Jasmina, and Tauhid Ahmad. 2019. *Chapeau Paper: Indonesia Technical and Vocational Education and Training*. Final Report.

45. Certification plays an important role in Indonesia's informal (and formal) education pathway to ensure that the workforce is equipped with the appropriate skills and competencies for specific jobs in the country, including for many occupations in the energy sector. These certifications enable workers to gain recognition for their skills and increase their employability across industries.

46. Certification in Indonesia relies on the Indonesian National Work Competency Standards (*Standar Kompetensi Kerja Nasional Indonesia*, SKKNI), which define the skills and competencies relevant to the implementation of duties in various job activities. For the energy transition, SKKNI will focus on competencies related to renewable energy technologies, energy efficiency, and sustainability practices. They could include job activities in installation, construction, operation, and maintenance of various NRE generators.

47. In addition to the design and implementation of job training, SKKNI are used also to conduct assessments of training outputs and assess the current level of skills and expertise possessed by a person.[24] Managed by the Ministry of Manpower, SKKNI is developed in collaboration with industries, government agencies, and educational institutions to align with market needs and global best practices. New SKKNIs are typically prepared by technical ministries, e.g., MEMR, depending on specific requests from existing industries.

48. Aside from SKKNI, Indonesia also has a set of competency standards specifically related to jobs in electricity supply named *Sertifikat Kompetensi Tenaga Teknik Ketenagalistrikan*, or SKTTK. Business entities engaged in the electricity supply business and electricity supporting business are required to employ personnel who possess certification in line with the SKTTK.

49. Although Indonesia already has a pipeline for workforce development, there are still gaps and weaknesses in the current context. Existing processes remain underdeveloped, especially with the anticipated emergence of new technologies. These will be discussed in the section, *Gaps in Workforce Development in the Energy Transition in Indonesia*. The next section explores the relevant institutional framework for workforce development for the energy transition in Indonesia to understand the key stakeholders needed to address these challenges, since, as will be explained, many of the identified challenges can be addressed through an improved governance mechanism.

[24] Government of Indonesia. Ministry of Manpower. *Tentang SKKNI*.

Institutional Framework for Energy Transition Workforce Development

50. Preparing the workforce for the energy transition requires the active involvement of multiple institutions with distinct roles and responsibilities. This section details out the various institutions envisioned to take part in this endeavor, in line with a collaborative framework referred to as the pentahelix approach (Figure 8). This approach emphasizes the alignment of efforts among key sectors: government agencies, industry, educational institutions, local communities, and the media.

Figure 8. Pentahelix approach

Source: Authors' elaboration

51. Specific institutions in Indonesia across these key sectors are detailed in the follow sub-sections, highlighting their respective roles and responsibilities in national energy planning and how these roles have the potential to support workforce development for the energy transition

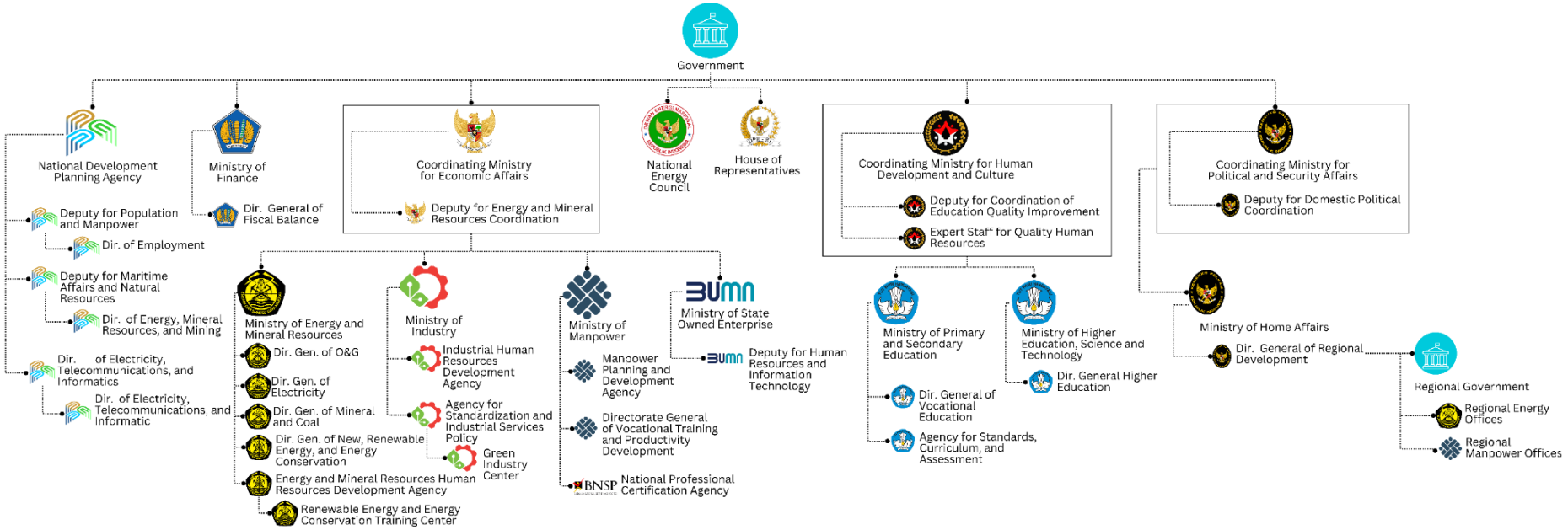
Government

52. Government agencies like Bappenas develop strategic roadmaps and green job descriptions to align workforce plans with national development goals, while MEMR designs SKKNI, conducts workforce assessments, and accredits training institutions. The Ministry of Manpower enhances vocational training and analyzes labor demands, and the Ministry of Industry focuses on industrial competencies aligned with green industries. Regional agencies like Regional Energy Offices and Regional Manpower Offices provide localized training and labor market analysis.

Figure 9 illustrates the government institutions involved for energy transition workforce development.

53. Table 1 provides more detail on the roles and responsibilities for different government institutions.

Figure 9. Government institutions involved for energy transition workforce development.



Source: Authors' elaboration

Table 1. List of government institutions involved for energy transition workforce development

No	Institution	Roles & Responsibilities
Government		
1.	**National Development Planning Agency** *Badan Perencanaan Pembangunan Nasional, Bappenas*	
1.1	**Deputy for Population and Manpower – Directorate of Employment** *Deputi Bidang Kependudukan dan Ketenagakerjaan - Direktorat Ketenagakerjaan*	• Develops long-term strategic roadmaps for workforce readiness for the green economy. • Develop green job descriptions and occupational maps in general. • Aligns workforce development plans with national development targets like the National Long-Term Development Plan (RPJPN) and National Medium-Term Development Plan (RPJMN). • Relay updates on technical energy issues and workforce requirements from Ministry of Energy and Mineral Resources to the Directorate of Employment to inform green job descriptions and occupational mapping
1.2	**Deputy for Maritime Affairs and Natural Resources - Directorate of Energy, Mineral Resources, and Mining** *Deputi Bidang Kemaritiman dan Sumber Daya Alam - Direktorat Sumber Daya Energi, Mineral dan Pertambangan, Dir. SDEMP*	
1.3	**Deputy for Infrastructure – Directorate of Electricity, Telecommunications, and Informatics** *Deputi Bidang Sarana dan Prasarana - Direktorat Ketenagalistrikan, Telekomunikasi dan Informatika, Dir. KTI*	
2.	**National Energy Council** *Dewan Energi Nasional*	
2.1	**National Energy Council** *Dewan Energi Nasional*	• Develops national energy policy • Ensures inter-ministerial coordination for energy transition • Monitors progress in energy development and reports gaps to policymakers
3.	**Ministry of Finance** *Kementerian Keuangan*	
3.1	**Directorate General of Fiscal Balance, Ministry of Finance** *Direktorat Jenderal Perimbangan Keuangan*	• Allocates budget including for workforce development programs • Develops financial incentives to promote workforce readiness for renewable energy • Monitors and evaluates the effectiveness of workforce funding in achieving energy

No	Institution	Roles & Responsibilities
		transition goals
4.	**Coordinating Ministry for Economic Affairs** *Kemenko Perekonomian*	
4.1	**Deputy for Energy and Mineral Resources Coordination, Coordinating Ministry for Economic Affairs** *Deputi Bidang Koordinasi Energi dan Sumber Daya Mineral*	• Facilitates multi-stakeholder collaboration • Ensures alignment of energy policies with economic and industrial growth plans
5.	**Ministry of Energy and Mineral Resources (MEMR)** *Kementerian Energi dan Sumber Daya Mineral Republik Indonesia*	
5.1	**Directorate General of Oil and Gas** *Direktorat Jenderal Minyak dan Gas Bumi*	• Develops policies and regulations for oil and gas industries • Collaborates with stakeholders to align the oil and gas workforce with the skills required for green energy integration within the oil and gas industries.
5.2	**Directorate General of Electricity** *Direktorat Jenderal Ketenagalistrikan*	• Oversees the development and modernization of the electricity sector to integrate renewable energy. • Supports capacity-building programs for energy professionals in renewable energy and grid management. • Regulates workforce standards for roles in power plants as well as electricity transmission & distributions industries.
5.3	**Directorate General of Mineral and Coal** *Direktorat Jenderal Mineral dan Batubara*	• Develops policies for sustainable mining practices, supporting workforce adaptation to clean energy technologies. • Conducts workforce assessments to prepare for a transition from coal to renewable energy sectors. • Coordinates programs for mining professionals to support mineral requirements for renewable energy technologies.
5.4	**Directorate General of New, Renewable Energy, and Energy Conservation** *Direktorat Jenderal Energi Baru, Terbarukan, dan Konservasi Energi, Ditjen EBTKE*	• Developing, promoting, and overseeing renewable energy and energy conservation policies and programs in Indonesia. • Conduct assessments of workforce needs in renewable energy and energy conservation projects, identifying skill gaps and future labor demands • Develop SKKNI for the renewable energy sector, ensuring that workforce competencies align with industry demands and global best practices

No	Institution	Roles & Responsibilities
5.5	**Energy and Mineral Resources Human Resources Development Agency** *Badan Pengembangan Sumber Daya Manusia Energi dan Sumber Daya Mineral, BPSDM ESDM*	• Design a comprehensive policy framework for human capital development in the energy sector, focusing on the energy transition including detailed occupational map outlining roles, required competencies, and skill levels. • Ensure accredited training institutions meet national standards to deliver high-quality education and training in energy and renewable energy fields through Accreditation Commission for Education and Training Organizing Institutions (*Komisi Akreditasi Lembaga Penyelenggara Pendidikan dan Pelatihan*, KA-LDP)-only 38 training center are officially registered- as per MEMR Regulation 21/2019. • Collaborate with relevant ministries, industries, and educational institutions to implement the policy framework, occupational map, and roadmap into national workforce strategies
5.6	**Renewable Energy and Energy Conservation Training Center** *Pusat Pengembangan Sumber Daya Manusia Ketenagalistrikan, Energi Baru, Terbarukan, dan Konservasi Energi, PPSDM EBTKE*	• Deliver specialized training programs focused on renewable energy technologies and energy conservation to prepare a skilled workforce for the energy transition. • Provide competency-based certifications for renewable energy and energy efficiency roles to ensure workforce readiness and compliance with national and international standards.
6.	**Ministry of Industry** *Kementerian Perindustrian*	
6.1	**Agency for Standardization and Industrial Services Policy - Green Industry Center** *Badan Standarisasi & Kebijakan Jasa Industri – Pusat Industri Hijau, PIH*	• Develops programs to support green industry practices, including the adoption of energy-efficient and renewable energy technologies. • Design and implement programs to enhance the skills and competencies of human resources in green industries, aligning with sustainability and energy transition goals.
6.2	**Industrial Human Resources Development Agency** *Badan Pengembangan Sumber Daya Manusia Industri Kementerian Perindustrian*	• Manage vocational education institutions to provide industry-relevant skills, with a focus on energy-efficient and renewable energy technologies. • Develops industrial competencies through SKKNI and KKNI, certification bodies, assessor training, and competency certifications, with PIDI 4.0 as a one-stop solution for Industry 4.0 adoption.
7.	**Ministry of State-Owned Enterprise** *Kementerian BUMN*	
7.1	**Deputy for Human Resources and Information Technology**	• Develops workforce strategies for state-owned enterprises to meet energy transition demands.

No	Institution	Roles & Responsibilities
	Deputi Bidang Sumber Daya Manusia dan Teknologi Informasi	• Promotes digitalization and upskilling initiatives for state-owned enterprises in the renewable energy sector. • Ensures alignment of workforce policies with state-owned enterprise goals in clean energy.
8.	**Ministry of Manpower** *Kementerian Ketenagakerjaan*	
8.1	**Manpower Planning and Development Agency** *Badan Perencanaan dan Pengembangan Ketenagakerjaan*	• Projects future labor demands and identifies key sectors requiring workforce interventions. • Develops labor market analyses and project plans for employment opportunities in renewable energy sectors.
8.2	**Directorate General of Vocational Training and Productivity Development** *Direktorat Jenderal Pembinaan Pelatihan Vokasi Dan Produktivitas*	• Develop and implement policies related to competency standards, vocational training institutions, training programs, apprenticeships, and productivity improvement, with a focus on roles in renewable energy and energy conservation sectors. • Provide technical guidance and supervision to improve the quality of vocational training institutions, instructors, and training personnel involved in preparing the workforce for green jobs. • Conduct evaluations and reporting on the effectiveness of vocational training and apprenticeship programs in addressing the workforce demands of the energy transition
8.3	**National Professional Certification Agency** *Badan Nasional Sertifikasi Profesi, BNSP*	• Develops and standardizes competency frameworks for energy transition-related roles. • Certifies professionals to ensure they meet industry-specific technical and operational standards. • Establishes internationally recognized certifications to enhance the competitiveness of Indonesia's workforce. • There are 53 competition schemes on renewable energy that have been developed by BNSP and the Directorate General of New, Renewable Energy, and Energy Conservation (Ditjen EBTKE) for polytechnic curricula and BLKs.
9.	**Coordinating Ministry for Human Development and Culture** *Kemenko Bidang Pembangunan Manusia dan Kebudayaan*	
9.1	**Deputy for Coordination of Education Quality Improvement** *Deputi Bidang Koordinasi Peningkatan Kualitas Pendidikan*	• Coordinates national efforts to integrate renewable energy topics into education systems. • Collaborates with ministries to develop curricula and vocational training for energy transition roles. • Ensures alignment of education strategies with national workforce needs in renewable

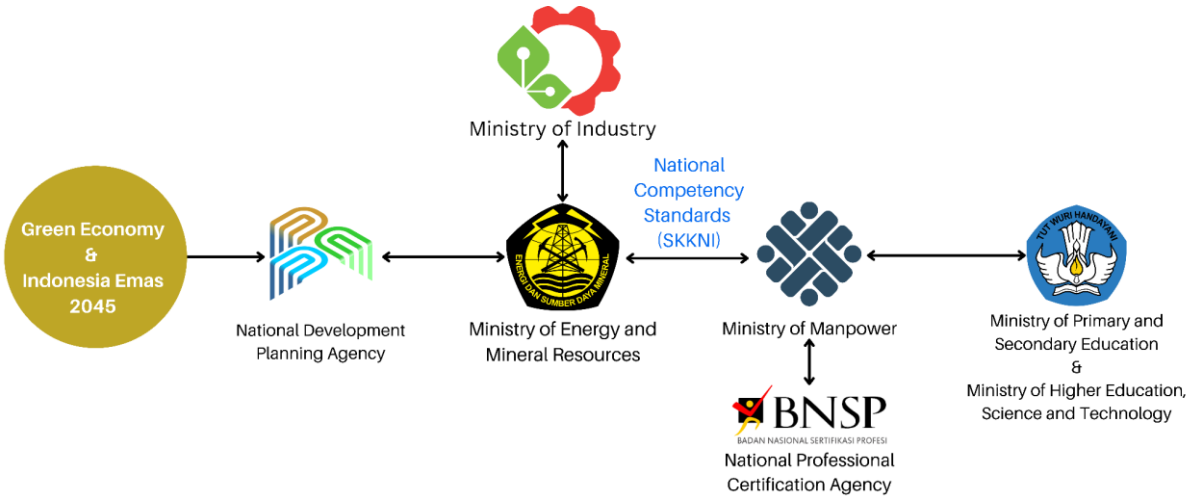
No	Institution	Roles & Responsibilities
		energy.
9.2	**Expert Staff for Quality Human Resources** *Staf Ahli Bidang Sumber Data Manusia Berkualitas*	• Develops policies to improve workforce quality in renewable energy sectors. • Collaborates with stakeholders to address skill gaps in the energy transition workforce. • Provides oversight on workforce readiness for green jobs.
10.	**Ministry of Primary and Secondary Education** *Kementerian Pendidikan Dasar dan Menengah*	
10.1	**Directorate General of Vocational Education** *Direktorat Jenderal Pendidikan Vokasi*	• Updates curricula for SMKs to incorporate renewable energy and sustainability-focused training. • Partners with industries to ensure students acquire market-relevant skills.
10.2	**Agency for Standards, Curriculum, and Assessment** *Badan Standar, Kurikulum, dan Asesmen Pendidikan*	• Develops standardized assessments and certifications for renewable energy-specific skills. • Monitors the implementation of energy-focused programs in secondary and vocational education.
11.	**Ministry of Higher Education, Science and Technology** *Kementerian Pendidikan Tinggi, Sains, dan Teknologi*	
11.1	**Directorate General of Higher Education** *Direktorat Jenderal Pendidikan Tinggi*	• Promotes research and multidisciplinary programs in renewable energy, emphasizing innovation. • Encourages collaboration between universities and the renewable energy industry to address workforce demands.
12.	**Coordinating Ministry for Political and Security Affairs** *Kemenko Bidang Politik dan Keamanan*	
12.1	**Deputy for Domestic Political Coordination** *Deputi Bidang Koordinasi Politik Dalam Negeri*	• Coordinates with local governments to address regional workforce needs in renewable energy projects. • Supports policies to ensure political stability during the energy transition.
13.	**Ministry of Home Affairs** *Kementerian Dalam Negeri*	
13.1	**Directorate General of Regional Development** *Direktorat Jenderal Bina Pembangunan Daerah*	• Guides regional governments in integrating workforce development into regional energy planning. • Allocates resources for regional training programs in renewable energy sectors. • Ensures regional workforce strategies align with national energy transition goals.

No	Institution	Roles & Responsibilities
14.	**Regional Governments**	
14.1	**Regional Energy Offices** *Dinas Energi dan Sumber Daya Mineral Daerah*	• Organize and deliver training programs mandated by MEMR to meet regional workforce needs in renewable energy and energy conservation. • Collaborate with central government agencies, local training institutions, and industries to ensure the effective delivery of training programs.
14.2	**Regional Manpower Offices** *Dinas Ketenagakerjaan Daerah*	• Gather and analyze data on local labor market demands, including workforce needs for energy transition and renewable energy sectors. • Organize local vocational training programs and workforce placement services for renewable energy projects.
15.	**House of Representatives** *Dewan Perwakilan Rakyat*	
15.1	**House of Representatives** *Dewan Perwakilan Rakyat*	• Legislates policies to support workforce development for energy transition. • Approves budgets for training and workforce readiness programs in renewable energy. • Monitors the implementation of energy transition workforce strategies.

Source: Authors' elaboration.

54. The current workflow across involved institutions for energy transition workforce development in Indonesia is illustrated in Figure 10, based on the green jobs initiative tied to the Indonesia Emas 2045 target to implement a green economy as part of the country's economic development strategy. Under this initiative, Bappenas has developed various plans, including those related to green jobs, which are then disseminated to technical ministries such as the Ministry of Industry, MEMR, Ministry of Manpower, and both the Ministry of Primary and Secondary Education and Ministry of Higher Education, Science and Technology.

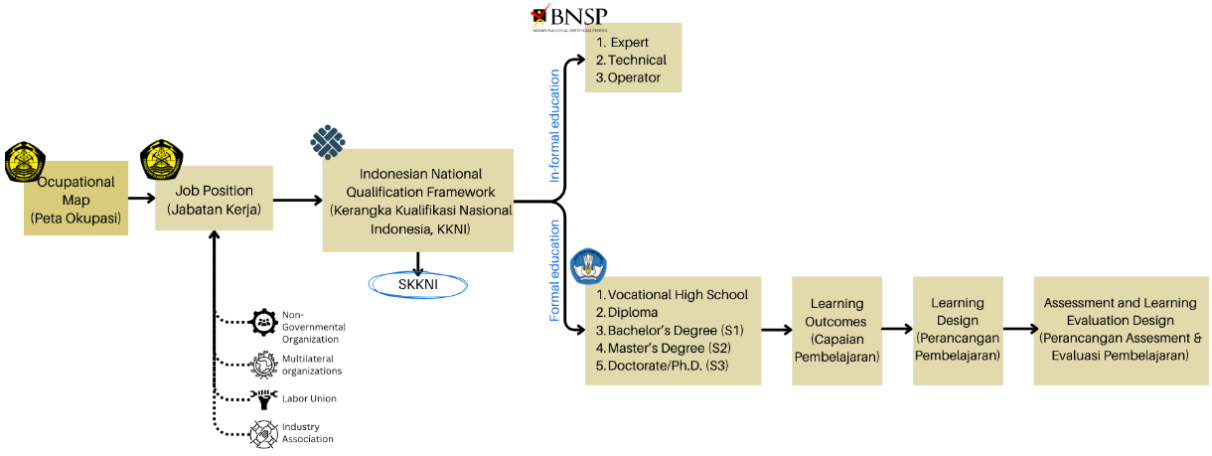
Figure 10. Workflow across involved institutions for energy transition workforce development



Source: Authors' elaboration.

55. The delivery of appropriate academic and training programs related to the energy sector is dependent on MEMR, which is responsible for providing accurate occupational data to downstream institutions, i.e., the Ministry of Manpower, BNSP, the Ministry of Primary and Secondary Education, and the Ministry of Higher Education, Science and Technology. This workflow is further illustrated in Figure 11.

Figure 11. Occupational map and pathway for workforce development



Source: Authors' elaboration

56. To accomplish this, MEMR must undertake workforce calculations and coordinate with the Ministry of Industry to reach a consensus on labor needs related to the energy transition, encompassing both operational workforce requirements for power plants and manufacturing processes. Once the occupational mapping is finalized by MEMR, it will be translated into specific job positions through collaboration with relevant stakeholders. This process will then lead to alignment with KKNI and the creation of relevant SKKNI (through the Ministry of Manpower), which serve as essential frameworks for the design and implementation of academic and training programs.

57. For the informal education pathway, workforce certification will be managed by the BNSP, ensuring that competencies meet national and international standards.

58. For the formal education pathway, the responsibility lies with the Ministry of Primary and Secondary Education and the Ministry of Higher Education, Science and Technology. These ministries will focus on developing learning outcomes, learning designs, and assessment and evaluation frameworks to align vocational and academic programs with the specific skill requirements of the energy transition. This includes updating curricula in vocational high schools (*sekolah menengah kejuruan*, SMKs), polytechnics, and universities to integrate renewable energy technologies, energy efficiency practices, and green job competencies. The integration of these efforts ensures a holistic approach to building a workforce that is not only technically capable but also adaptable to the dynamic demands of the energy transition, as depicted in Figure 11.

Academic and training institutions

59. Educational institutions and training centers, such as SMKs and vocational training centers (*balai latihan kerja*, BLKs), deliver practical and industry-relevant training. Universities play a more prominent role in workforce development related to renewable energy compared to other institutions, with graduates from electrical and mechanical engineering frequently entering renewable energy startups and offering essential technical expertise.

60. Table 2 summarizes the roles and responsibilities for different types of academic and training institutions.

Table 2. List of academic, training, and certification institutions involved for energy transition workforce development

No	Institution	Roles & Responsibilities
Academic & Training Institutions		
1	**Universities and polytechnics**	• Offer academic programs focused on engineering, energy systems, and renewable energy technologies. • Partner with industries and government agencies for research and workforce development initiatives. • Develop specialized programs to prepare

No	Institution	Roles & Responsibilities
		graduates for leadership roles in the energy transition.
2	**BLK – Regional Technical Implementation Units** *Unit Pelaksana Teknis Daerah, UPTD*	• Deliver region-specific training programs to address localized workforce needs in renewable energy projects. • Facilitate outreach and engagement with local communities to build awareness and participation in energy transition initiatives.
3	**BLK – Central Technical Implementation Units** *Unit Pelaksana Teknis Pusat, UPTP*	• Design and establish standardized training modules and certifications for energy transition roles, ensuring alignment with national policies. • Provide guidance and oversight to Regional Technical Implementation Units (UPTD) in implementing energy transition workforce programs across regions. • Train instructors and equip Regional Technical Implementation Units (UPTD) with the necessary resources and tools to deliver high-quality training programs effectively. • Deliver training programs to address workforce needs in renewable energy projects.

Source: Authors' elaboration.

Industry

61. Industries contribute by collaborating with government and educational institutions to align training programs with market needs, offering internships, apprenticeships, and job opportunities.

62. Table 3 summarizes the roles and responsibilities for major institutions related to industry.

Table 3. List of industry institutions involved in energy transition workforce development

No	Institution	Roles & Responsibilities
Industry		
1	**State Electricity Company** *Perusahaan Listrik Negara, PLN*	• Ensures reliable and affordable electricity supply across Indonesia. • Implements national policies such as the General Plan for National Electricity (*Rencana Umum Ketenagalistrikan Nasional, RUKN*) and ensures alignment with the National Energy Policy (*Kebijakan Energi Nasional, KEN*). • Conducts training and development programs for technical staff to manage renewable energy. • Collaborates with vocational institutions to train professionals in smart grid technologies and energy efficiency.
2	**Pertamina**	• Plays a pivotal role in ensuring Indonesia's energy security by managing the exploration, production, refining, and

No	Institution	Roles & Responsibilities
		distribution of oil and gas. • Supports government policies such as the National Energy Policy (KEN) by ensuring a steady and secure energy supply while contributing to Indonesia's renewable energy targets. • Upskills its workforce to transition from oil and gas to renewable energy roles. • Develops and implements workforce strategies for green hydrogen, bioenergy, and geothermal projects. • Partners with academic institutions for research and workforce development in clean energy technologies.
3	**Private industries**	• Collaborate with government agencies on policies aligning workforce development with industry needs. • Collaborate with educational institutions to develop curricula and offer internships/apprenticeships • Provide on-the-job training and specialized programs for technical roles in renewable energy.

Source: Authors' elaboration.

Local communities

63. For workforce development, communities represent workers in the form of associations, labor unions, and NGOs, which advocate for the needs of the workers, not only through adequate training but also on fair labor practices. NGOs also provide upskilling and reskilling programs, promote green job awareness, and connect local labor with energy transition projects. Also included in this category are international organizations that can provide both technical and financial assistance for workforce development.

64. Table 4 summarizes the roles and responsibilities for different types of institutions related to communities.

Table 4. List of community institutions involved in energy transition workforce development

No	Institution	Roles & Responsibilities
Communities		
1	**Associations, e.g.:** • **Indonesian Chamber of Commerce and Industry** *Kamar Dagang dan Industri Indonesia, KADIN* • **Institution of Engineers Indonesia** *Persatuan Insinyur Indonesia*, PII • **Indonesia Renewable Energy Society** *Masyarakat Energi Terbarukan Indonesia, METI*	• Advocates for workforce readiness and the adoption of renewable energy practices across industries. • Conducts capacity-building programs for engineers focusing on renewable energy and sustainability practices.
2	**Labor Union**	• Ensure fair labor practices and advocate for workforce protection during the transition from fossil fuels to renewable energy.
3	**Non-Governmental Organization (NGO)**	• Provide upskilling and reskilling in

No	Institution	Roles & Responsibilities
		renewable energy for local communities. • Promote inclusive workforce policies and green job awareness. • Connect industries and local labor for energy transition projects.
4	**International Organization**	• Assist in developing energy transition workforce policies. • Provide financial support for training and capacity building. • Share global best practices and expertise.

Source: Authors' elaboration.

Media

65. The media amplifies these efforts by raising awareness and promoting workforce development initiatives. However, the lack of an established workflow to coordinate these entities hinders effective collaboration, highlighting the need for a unified mechanism to integrate contributions and ensure sustainable outcomes in workforce development.

66. Table 5 summarizes the roles and responsibilities for different types of institutions related to the media.

Table 5. List of media institutions involved in energy transition workforce development

No	Institution	Roles & Responsibilities
Media		
1	**Media**	• Highlight the importance of workforce development for the energy transition and the opportunities in green jobs through targeted campaigns and educational content.

Source: Authors' elaboration.

Gaps in Workforce Development in the Energy Transition in Indonesia

67. This section elaborates on some challenges identified in the workforce development pipeline that hinders the creation of a qualified workforce to power Indonesia's energy transition. It will be seen that many of these challenges stem from inefficient or ineffective governance mechanisms that are in play.

68. To make the pentahelix framework effective, these systemic issues must be addressed through better coordination among stakeholders, integrated data systems, and proactive workforce planning. The government, as a central actor, must facilitate stronger collaboration between ministries, industries, and educational institutions, ensuring that training programs and policies are aligned with the nation's energy transition goals.

Lack of institutional coordination and fragmented efforts

69. Despite the identified potential contributions of different stakeholders outlined in the section, *Institutional Framework for Energy Transition Workforce Development*, there is currently no coordinated program to support the development of a workforce for the energy transition. Existing approaches remain fragmented, with institutions often operating independently and focusing exclusively on their respective mandates. For instance, MEMR, the Ministry of Manpower, and the Ministry of Industry each conduct renewable energy training programs, but these efforts lack a unified strategy or alignment under a cohesive framework. Moreover, many institutions have yet to be formally assigned roles to support workforce development for the energy transition, further highlighting the need for a coordinated approach.

70. One of the primary challenges in implementing pathways for adequate workforce development in the energy transition in Indonesia lies in the ministries' inexperience with coordinating efforts for such complex and cross-sectoral issues. The energy transition workforce development touches multiple sectors—education, industry, labor, and energy—requiring unprecedented levels of collaboration and communication between ministries such as MEMR, Ministry of Manpower; Ministry of Industry; Ministry of Primary and Secondary Education; and Ministry of Higher Education, Science and Technology. Each ministry often operates independently within its mandate, which complicates the synchronization of policies, programs, and implementation strategies.

71. To overcome this challenge, the establishment of a central coordinating body or a task force focused on workforce development for the energy transition is crucial. This body could facilitate the alignment of objectives, ensure regular communication between ministries, and monitor progress toward shared goals. Furthermore, enhancing the capacity of ministry officials through targeted training and international knowledge exchange programs could provide the necessary skills to manage such complex

coordination effectively. The feasibility and structure of this central coordinating body will be further assessed in the section, *Identification of Championing Organizations*, exploring its interest, influence as well as criteria and focus needed to support Indonesia's energy transition workforce strategy.

Weak data systems for workforce planning

72. Proper planning for workforce development in Indonesia will rely on effective monitoring and robust data systems that can inform on strategies developed by the relevant institutions. However, access to accurate employment data is limited in Indonesia, hindering informed policymaking. For example, while projections estimate that 31,000 jobs will be lost by 2030,[25] the absence of comprehensive government data obscures the full extent of workforce displacement.

73. According to reports, the Ministry of Manpower currently does not have access to detailed employment data for every citizen, as there is no legal obligation for individuals or companies to report this information to the ministry. This lack of data integration hampers the ministry's ability to conduct accurate workforce planning and assess readiness for the energy transition, leading to inefficiencies in meeting labor market demands. Filling this gap could support not only workforce planning now but also monitoring employment trends for future planning.

74. While efforts to consolidate labor market data into a unified system are underway, the target completion date remains unclear. Such data could be coordinated through collaboration with other institutions, such as the Ministry of Finance's tax records or the Social Security Agency for Employment, to provide a comprehensive view of the labor market.

Limited quality and capacity of vocational and training institutions

75. Despite increasing job opportunities in the energy sector, the quality of education in vocational and training institutions, such as SMKs and BLKs, have been found to be insufficient to meet the growing demand for technicians in the renewable energy sector. Graduation rates have been found to be low. Those who do graduate struggle with employability, owing to a variety of factors related to the quality of education.

76. One significant barrier is the misalignment between vocational training programs and industry needs. Training programs simply do not equip students with the appropriate skills and competencies that are needed in relevant industries at the time of need, leading to unemployable graduates. Furthermore, many BLKs focus on training aimed

[25] Montt, G., Wiebe, K. S., Harsdorff, M., Simas, M., Bonnet, A., &Wood, R. 2018. *Does climate action destroy jobs? An assessment of the employment implications of the 2-degree goal*. International Labour Review, 157(4), 519-556.

at supporting small and medium enterprises (SMEs), with only a limited number offering programs related to renewable energy.

77. Even in more forward-thinking programs, the limited capacity of instructors can often serve as an additional barrier. For example, although the now-defunct Ministry of Education, Culture, Research, and Technology made efforts to advance renewable energy curriculum in SMKs, training institutions have often encountered significant challenges in implementing these programs effectively. Teachers often lack the necessary insights to guide students toward career pathways in the energy transition, exacerbating the skills mismatch.

78. The availability of well-equipped facilities can also impede effective practical training. Outdated equipment and insufficient infrastructure in BLKs can hinder the ability of otherwise capable instructors to provide quality training aligned with industry demands.

79. Universities also still face significant challenges in adapting to the evolving demands of the renewable energy sector. While they have started to adopt multidisciplinary approaches, they struggle to create flexible, specialized majors solely focused on energy transition due to the constraints of adhering to existing classifications set by the Ministry of Higher Education, Science and Technology.

80. These interconnected weaknesses in SMKs, BLKs, and universities highlight the urgent need for comprehensive reforms in education and training systems, including better coordination between ministries, alignment with local labor market demands, and a stronger emphasis on renewable energy, to meet the growing challenges and opportunities presented by the energy transition. The immediate priority should be redesigning reskilling and upskilling programs to target blue- and grey-collar workers. Long-term efforts must focus on improving the alignment between vocational education, university programs, and industry needs.

Processes for the creation of certification standards not fully streamlined

81. Due to the current system for the development of new SKKNIs that relies on specific requests from the relevant industries that recognize an immediate need, there is often a misalignment in the time that training programs are needed and the time that they are created and delivered. Even if the resulting SKKNIs are sufficient, this reactive approach limits their effectiveness in preparing for the dynamic demands of the energy transition, with the current workforce not having access to appropriate training programs and not being able to fulfill the roles required at the time of need. The governance mechanism for the development of SKKNIs needs to be forward-looking and anticipatory of future labor demands, rather than being reactive to the immediate needs of existing industries.

82. Without a clear mechanism for coordination, efforts to align SKKNI, KKNI, and workforce preparation programs with the planned energy transition risk inefficiency, redundancy,

and the potential oversight or omission of critical competencies. It can also lead to the omission of certain stakeholders or underrepresented groups, ultimately undermining the inclusivity and effectiveness of workforce development initiatives.

83. Interestingly, technical ministries had previously incorporated workforce elements into their planning processes around 2014–2015, which served as a reference for Ministry of Manpower in preparing labor programs. However, this initiative lacked sustainability as it relied heavily on the directives of specific leadership. When leadership priorities shifted, the practice was abandoned, further emphasizing the need for institutionalized mechanisms rather than leadership-dependent initiatives.

84. A more forward-looking approach, integrated into a long-term roadmap, is necessary to ensure that workforce skills are aligned with Indonesia's energy transition objectives.

Limited regional training center capacity

85. Data on training centers highlight the limitations in current workforce development efforts. While there is no definitive data on the total number of training centers nationwide, only 38 have been officially registered and accredited by the MEMR Training Institution Accreditation Commission under MEMR Regulation 21/2019. This limited accreditation poses challenges in ensuring the availability of training programs to support renewable energy workforce development. Without expanding and accrediting more training centers, meeting the workforce demands of the energy transition will remain a significant challenge.

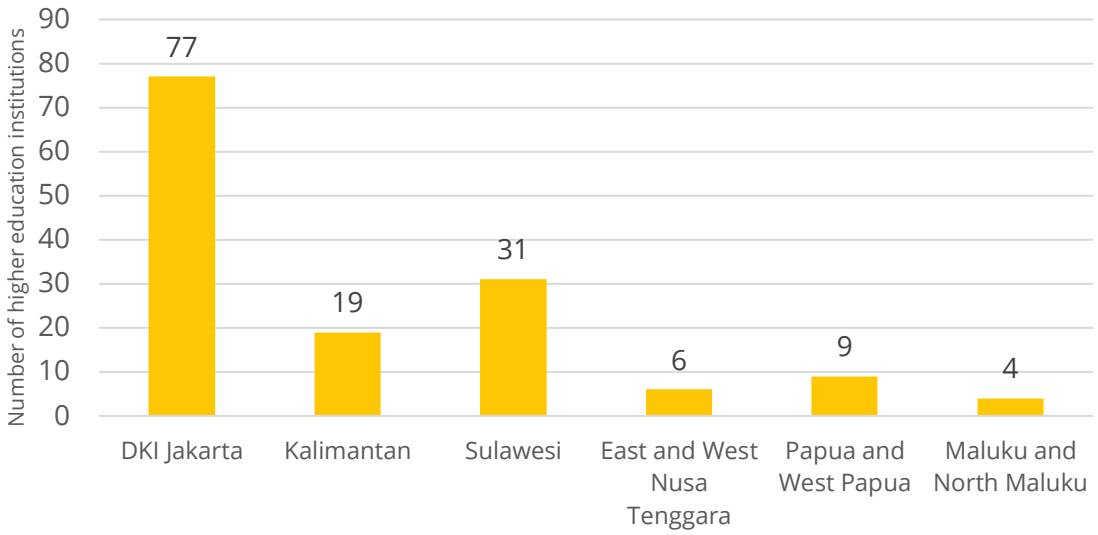
86. In addition, according to a separate study in which various stakeholders in Indonesia's electricity sector—both Indonesian and international—were interviewed, respondents often cited the lack of skilled workers outside of Java island as a challenge in Indonesia's electricity sector.[26] Both fossil fuel and RE power plants in remote regions such as Papua and Maluku often rely on workers from Java for their construction and operation.[27] Not only does this imply higher labor costs for electricity companies that directly impact the cost–benefit analysis and financial performance of these projects in more remote areas; it also means fewer opportunities for local communities, who typically do not have easy access to adequate training programs. In line with this, regional institutions like UPTDs and UPTPs, which deliver region-specific training, have been found to lack standardized support, further highlighting the absence of a central coordination framework.

87. This can be partly attributed to the distribution of higher education institutions throughout Indonesia. For example, in 2018, it was found that Jakarta alone hosted 77 higher education institutions (HEIs) offering programs in mechanical engineering (Figure 12). Meanwhile, entire regions, such as Sulawesi, which consists of 5 provinces, only had 31 HEIs with similar programs. Other regions had even fewer. Similar trends can be observed with other types of engineering programs relevant to the electricity sector,

[26] ADB. 2021. *Improving Skills for the Electricity Sector in Indonesia*.
[27] ADB. 2021. *Improving Skills for the Electricity Sector in Indonesia*.

such as electrical engineering, programs for which are abundant in Java but are scarce in other regions.[28]

Figure 12. Number of HEIs offering mechanical engineering in various regions of Indonesia, 2018.



Source: Authors' elaboration based on information from ADB[29]

88. While this disparity can also be due to the large population of Indonesia's Java region, the scarcity of institutions and programs in other regions cannot be denied, especially when considering planned NRE development around the country. High-quality HEIs and training programs should be pursued in these regions, based on planned additional generation capacity.

Lack of inclusivity in long-term workforce planning

89. As revealed in the FGD, gender disparities remain a significant challenge in Indonesia's energy sector, particularly in technical roles where women are severely underrepresented. Participants in the FGD participants attribute this underrepresentation to discriminatory practices embedded within hiring processes. Companies frequently prioritize male workers for technical positions, creating barriers for women to enter and advance in the field. Internship opportunities, which are critical for gaining practical experience, are often restricted for women, particularly in technical domains where male candidates are typically preferred. Moreover, job requirements frequently disqualify female candidates based on factors such as pregnancy or marital status, further limiting their participation and career growth in the energy sector.

90. Despite these systemic challenges, the energy transition offers unique opportunities to empower women and address gender inequality, particularly in rural areas. For instance, in East Nusa Tenggara (*Nusa Tenggara Timur*, NTT), women have become

[28] ADB. 2021. *Improving Skills for the Electricity Sector in Indonesia*.
[29] ADB. 2021. *Improving Skills for the Electricity Sector in Indonesia*.

central to sustainable bamboo production initiatives, which play a vital role in renewable energy projects. These activities have proven to be transformative, with women benefiting economically and socially by up to 75% from such initiatives. By involving women in renewable energy-related projects, these programs not only enhance gender equity but also demonstrate the potential of women to drive local development and sustainability efforts. However, scaling these successes requires targeted policies that promote female participation in education and employment opportunities within the energy sector, as well as concerted efforts to eliminate discriminatory practices in hiring and workplace environments.

International Best Practices in Workforce Development for Energy Transition

91. While Indonesia has taken important steps toward workforce preparation for the energy transition, these efforts remain at an early stage. Many countries have successfully addressed similar coordination and implementation challenges, offering valuable lessons for Indonesia. This section delves into global examples of successful coordination frameworks, innovative workforce policies, and collaborative approaches. These insights can help Indonesia refine its strategy and create a cohesive and efficient system to prepare its workforce for a sustainable energy future.

92. International best practices offer valuable benchmarks for Indonesia to develop a structured and standardized approach to workforce development for energy transition. Global models highlight the importance of effective governance through policy integration, defined institutional roles, and cross-sector collaboration. Key barriers and levers can be addressed by learning from other countries.

93. Four countries have been selected for case studies:

    a. **India** is undergoing a large-scale energy transition while managing a vast workforce in traditional energy sectors. Strong emphasis on skill development through initiatives such as the Skill Council for Green Jobs.

    b. **Singapore's** strong emphasis on academic excellence, research innovation, and industry collaboration offers valuable insights for Indonesia to enhance its workforce development strategies for the energy transition.

    c. **Germany** has established itself as a global leader in energy transition through its *Energiewende* (energy transition) strategy.

    d. Lastly, **the Philippines** provides a regional perspective, particularly relevant for Indonesia, with its focus on policy-driven green job creation.

94. These examples underscore the need for a clear strategic vision, overcoming technological challenges, and fostering adaptive, locally relevant solutions to ensure a successful energy transition.

India

95. India faces a growing mismatch between the demand for green talent and the availability of skilled workers that can support and implement sustainable practices and technologies. One critical gap lies in future-ready technologies, such as data analytics, the Internet of Things (IoT), and artificial intelligence (AI), which are set to play a pivotal role in driving the shift toward a low-carbon economy.

96. Despite the rising demand for green jobs, India's policy landscape lacks clarity in defining key concepts, such as green jobs, green sectors, and green skills. Policy

documents across various ministries often present these terms in a limited context, focusing mainly on environment-related roles in sectors such as renewable energy, electric vehicles, waste management, and forestry. This narrow framing overlooks a broader spectrum of green jobs, particularly those embedded within global supply chains, which source raw materials and services vital to these sectors.

97. India aims to create 35 million green jobs by 2047 through skill development in sectors like RE, waste management, and sustainable construction.[30] To achieve these goals, India's strategy involves a multi-pronged approach balancing climate action with economic growth and employment generation through the Skill Council for Green Jobs (SCGJ),[31] established in 2015 under the Ministry of Skill Development and Entrepreneurship. This non-profit, industry-led organization is supported by the Ministry of New and Renewable Energy and the Confederation of Indian Industry (CII).[32]

98. SCGJ is tasked with conducting skill gap analyses, designing training programs tailored to green sectors, accrediting training centers, and certifying trainers. These efforts are crucial in addressing the growing demand for skilled workers in renewable energy, waste management, and other sustainable industries, positioning India as a leader in green workforce development.

99. SCGJ works with training partners, employers, and international organizations to foster global competitiveness and ensure its programs prepare workers for international opportunities. By aligning training programs with international frameworks such as those developed by the IRENA and the Global Wind Organisation (GWO), these initiatives ensure that participants are equipped to meet both domestic and global workforce needs. Curricula also incorporate transformative, real-world pedagogies to prepare workers for practical challenges in the energy transition.

100. Encouraging inclusive partnerships with both public institutions and private start-ups fosters innovation and accelerates impact. Acknowledging the "Big Bets" emphasizes focusing philanthropic efforts on key high-impact areas, such as upskilling existing workforces and supporting entrepreneur-led models. In order to enhance human capital for a green economy with equitable skill development.

101. The SCGJ revealed the key industries undergoing energy transitions, including electric vehicles, by targeting 10 million direct and 50 million indirect jobs by 2030, and green construction by shifting towards low-carbon building materials and sustainable practices. Ultimately, prioritizing these sectors can drive systemic change, creating employment opportunities while advancing sustainability goals. Investing in reskilling programs, certifications for emerging technologies, and collaborative industry-

[30] IEA. 2022. Skill Development and Inclusivity for Clean Energy Transition. IEA, Paris

[31] Skill Council for Green Jobs. *About us*.

[32] Bala, Shashi. 2023. Green Jobs in India: Present and Future Prospects. V.V. Giri National Labour Institute, Noida.

academic initiatives can bridge skill gaps and empower a workforce capable of supporting a green economy.

102. Table 6 summarizes the key barriers and levers from India identified in this case study. The key levers can be adapted to the Indonesian context to address similar barriers.

Table 6. Summary of key barriers and levers from India.

India	
Key Barriers	**Key Levers**
• **Skill Gap in Green Talent** • **Limited Integration of Emerging Technologies** • **Insufficient Industry-Academia Collaboration** • **Gaps in Inclusivity and Equity**	• **Role of Skill Council for Green Jobs (SCGJ)** Plays a pivotal role in identifying skill gaps, accrediting training centers, and certifying trainers for green sectors. • **Targeted Skill Development Initiatives** Programs focusing on high-demand sectors like renewable energy, waste management, electric vehicles, and sustainable construction • **Economic and Employment Alignment** Clear targets, such as creating 35 million green jobs by 2047 and prioritizing high-impact sectors like electric vehicles and green construction. • **Inclusive Innovation** Prioritizing "Big Bets" in philanthropy to support high-impact areas like workforce upskilling and entrepreneur-led models

Source: Authors' elaboration.

Singapore

103. The evolving workforce development in the energy transition tends to follow a lifelong learning system, considering technological advancements and the creation of new jobs in energy transition-related sectors. Rapid technological progress and shifts in industry dynamics have expanded the gap between the skills the current workforce possesses and those required by employers, making it difficult for businesses to find workers with the necessary expertise. Such skill gaps can result in lower productivity, diminished competitiveness, and challenges in attracting foreign investment. This growing disparity has heightened the need for both upskilling and reskilling initiatives. Upskilling involves improving existing skills to meet evolving job or industry demands.

104. Singapore has strategically positioned itself to overcome barriers to lifelong learning through a collaborative tripartite partnership involving the government, the workforce (represented by employers and employees), and institutes of higher learning. The SkillsFuture program was developed to enhance workforce capabilities and promote lifelong learning, emphasizing skills development and continuous education for employability in a rapidly evolving economic landscape.[33] The initiative emerged from

[33] Government of Singapore. 2024. *Skills Future*.

Singapore's desire to consolidate lifelong learning efforts and make them more accessible.

105. This approach reflects Singapore's broader education philosophy, which has evolved over time. Initially, Singapore's education system was driven by pragmatism, focusing on national survival and efficiency. Over the years, it transitioned towards a knowledge and abilities model, emphasizing STEM (science, technology, engineering, and mathematics) subjects over arts and humanities. While this pragmatic model has successfully produced a skilled workforce, critics have noted that it often prioritizes economic goals over personal growth and holistic learning.

106. SkillsFuture[34] operates with four main objectives:

    a. helping individuals make informed career choices;

    b. developing a responsive education and training system

    c. promoting skills-based career development

    d. fostering a culture of continuous learning

107. Key programs under SkillsFuture include:

    a. **SkillsFuture Credit:** Provides Singaporeans aged 25+ with credits to fund approved courses.

    b. **SkillsFuture Earn and Learn Programmes:** Combines on-the-job training with education for technical institute and diploma graduates.

    c. **SkillsFuture Work-Study Degree Programmes:** Allows working adults to pursue degrees while employed, blending theoretical education with practical experience.

108. Singapore's lifelong learning strategy emphasizes parallel career development paths, empowering individuals to control their learning, and transitioning from an industrial to a knowledge-based economy by equipping locals with in-demand skills.

109. Table 7 summarizes the key barriers and levers from Singapore identified in this case study. The key levers can be adapted to the Indonesian context to address similar barriers.

[34] Skills Future. 2023. *Skills Demand for the Future Economy*.

Table 7. Summary of key barriers and levers from Singapore.

Singapore	
Key Barriers	**Key Levers**
• **Challenges in lifelong learning accessibility** Lifelong learning initiatives can be difficult to access without a robust, inclusive system that addresses varied individual and industry needs. • **Evolving industry demands** Rapid technological progress requires constant updates to training programs, which can be resource-intensive to design and implement.	• **Collaborative tripartite partnerships** Involvement of the government, employers, employees, and higher learning institutions ensures alignment between workforce needs and educational offerings. • **SkillsFuture initiative** A comprehensive system promoting lifelong learning through key programs • **Pragmatic education system evolution** Transition from an industrial to a knowledge-based economy by focusing on STEM skills and equipping the workforce with in-demand capabilities.

Source: Authors' elaboration.

Germany

110. The integration of fresh graduates into the energy sector and the reskilling of workers transitioning from fossil fuels to renewable energy are essential for addressing workforce challenges in the energy transition. Workforce development programs that combine academic and practical training are critical for equipping individuals with both theoretical knowledge and hands-on expertise. Key elements include clear guidelines, monitoring mechanisms, and support structures that bridge the gap between academic learning and practical application.

111. Germany's experience offers lessons for countries like Indonesia in preparing their workforce for energy transitions. Challenges for workers from traditional sectors such as coal and oil include skill mismatches and financial constraints in reskilling efforts. For example, coal mining jobs in the Lausitz region dropped from 80,000 in 1990 to just 6,202 by 2018. Addressing these challenges requires structured policies, such as Germany's Vocational Education and Training (VET)[35] programs and the Coal Compromise Program, which provides financial assistance, skill development, and regional transformation to ease the workforce transition.

112. Initially, the shift towards renewables, particularly in solar PV and wind energy, created substantial job growth. However, when the government reduced financial incentives for renewable technologies, the solar PV sector experienced a boom followed by a sharp decline, leading to job losses. Employment in solar PV dropped from 150,000 in 2011 to just over 28,000 in 2018, while wind industry jobs fell from 108,000 in 2016 to less than 70,000 in 2018 due to fluctuating policy support and global market pressures.

[35] Hockenos. 2017. Germany's vaunted vocational training programme strains to meet Energiewende's demand for skilled workers. Clean Energy Wire

113. Germany's approach underscores the importance of proactive labor policies, reskilling programs, and regional development initiatives to ensure a just transition while advancing renewable energy goals. Germany's Dual Education System[36], guided by the Vocational Training Act, stands as one of programs in workforce development. This innovative model seamlessly blends classroom learning with practical, on-the-job training, ensuring that graduates acquire industry-aligned skills that are both high-quality and transferable. The system's foundation in standardized national assessment frameworks guarantees that the competencies gained are inclusive and relevant, meeting the evolving needs of renewable energy industries.

114. The dual vocational training system in Germany aims to provide comprehensive expertise that combines theoretical knowledge and practical skills, preparing trainees for a profession. For example, mechatronics trainees learn about vehicle functions, engine mechanisms, fault detection, and repairs, alongside practical training in specialized workshops. This program exceeds simple on-the-job training, emphasizing both general and specialized vocational education.

115. The structure of training is divided into two categories:

    a. **At the workplace:** Trainees are employed and paid by a training enterprise, which must be authorized by relevant chambers like the Chamber of Industry and Commerce (IHK) or the Chamber of Crafts. The enterprise must employ qualified trainers and maintain a trainee-to-specialist ratio.

    b. **At the vocational school (*Berufsschule*):** Trainees attend school one to two days a week or during block teaching periods. They learn occupation-specific content along with subjects like German, politics, sports, mathematics, and English.

116. Trainees undergo an interim exam and a final journeyman's or trade proficiency exam, standardized across Germany by relevant chambers. Successful candidates receive official certification. Alternative training paths includes specialist vocational schools (*Berufsfachschulen*) that offer state-recognized qualifications in various sectors. These programs combine school-based learning with practical internships. This tried-and-tested dual system ensures a blend of theoretical understanding and practical application, contributing to Germany's skilled workforces.

117. Table 8 summarizes the key barriers and levers from Germany identified in this case study. The key levers can be adapted to the Indonesian context to address similar barriers.

[36] European Commission. 2016. The German Vocational Training System

Table 8. Summary of key barriers and levers from Germany.

Germany	
Key Barriers	**Key Levers**
• **Skill mismatches in traditional sectors** Workers transitioning from sectors like coal and oil face significant challenges in acquiring the skills needed for renewable energy jobs. The decline of coal mining jobs (e.g., Lausitz region) highlights the difficulty of reabsorbing displaced workers into new industries. • **Financial constraints for reskilling** Disparities in funding for training exacerbate the challenges of equitable workforce transition. • **Volatile policy support** Fluctuating government incentives (e.g., the reduction of financial support for solar PV) lead to instability in job creation, as seen in the boom-and-bust cycles in Germany's solar and wind industries. • **Regional inequalities** Workforce challenges are often concentrated in specific regions (e.g., Lausitz), making it harder to achieve equitable transitions across the country	• **Proactive labor policies** Germany's *Coal Compromise Program* combines financial assistance, skill development, and regional transformation to smooth workforce transitions. • **Dual vocational education and training (VET) system** Blends classroom learning with on-the-job training, ensuring trainees acquire transferable, high-quality, industry-aligned skills. Standardized national assessment frameworks provide inclusive and relevant training across sectors, including renewable energy. • **Comprehensive training structure** *Workplace training:* Enterprises authorized by chambers (e.g., Chamber of Industry and Commerce) employ trainees, ensuring practical experience under qualified trainers. *Vocational schools:* Trainees attend school for occupation-specific knowledge alongside general subjects, preparing them for a well-rounded profession. • **Standardized certification and exams:** Interim and final proficiency exams ensure trainees meet uniform standards across industries, enhancing their employability.

Source: Authors' elaboration.

Philippines

118. The Philippine Green Jobs Act of 2016 (Republic Act No. 10771) provides a comprehensive framework to promote green jobs, aligning economic activities with environmental sustainability and climate resilience goals. This legislation offers incentives such as tax deductions for green skills training and research and development (up to 50% of expenses) and exemptions on import duties for environmentally friendly capital equipment. It involves key agencies, including the Department of Labor and Employment (DOLE),[37] Climate Change Commission (CCC), and Department of Finance (DOF), to ensure effective implementation, supported by institutions like Department of Science and Technology (DOST), Department of Environment and Natural Resources (DENR), Technical Education and Skilled Development Authority (TESDA), and Department of Trade and Industry (DTI) for technology development, compliance, and workforce training. These measures aim to manage the transition from traditional industries to renewable energy, automation, and

[37] ILO. 2014. Green Jobs Mapping Study in the Philippines

digitalization, mitigating job losses in sectors such as coal mining and transport while creating new opportunities in renewable energy, storage, and recycling industries.

119. The Philippine model demonstrates how targeted policies and incentives can catalyze green job creation while addressing environmental and social objectives. Indonesia's efforts to build a green jobs framework could benefit from adopting the Philippine example, particularly in promoting collaboration among government agencies, private sector investment, and international partnerships. These strategies will support Indonesia in not only addressing job losses but also in building a competitive and resilient green economy that aligns with global sustainability goals. Both nations, through their respective initiatives, underscore the importance of aligning green economic transitions with workforce development and environmental stewardship.

120. The Philippine Energy Plan (PEP) 2020-2040[38] provides a roadmap for transitioning the country's energy sector toward a clean, sustainable, and inclusive future. The plan highlights a shift to RE, EE, and alternative fuels like hydrogen and liquefied natural gas (LNG). Central to the plan is achieving a 50% RE share in the power generation mix by 2040, reducing greenhouse gas (GHG) emissions, and creating green jobs aligned with the country's Nationally Determined Contributions (NDC) under the Paris Agreement. Strategies include expanding renewable energy adoption, integrating digital and smart technologies, and leveraging international partnerships for capacity building and technology transfer. Challenges such as managing costs, grid stability, and social impacts from transitioning away from fossil fuels are addressed through initiatives like the Green Energy Auction Program (GEAP) and renewable portfolio standards.

121. Strategic goals are framed around energy security, affordability, resilience, and consumer empowerment, leveraging international cooperation, innovative technologies, and robust policy frameworks. The plan acknowledges the need for investment in infrastructure, job creation in green industries, and alignment with global commitments such as the Paris Agreement. While challenges include managing costs and ensuring grid stability, initiatives like the Green Energy Auction Program (GEAP) and renewable portfolio standards aim to foster competition and innovation.

122. Indonesia, in its energy transition, can draw lessons from the Philippine approach, especially regarding the integration of job creation into national energy policies. Indonesia is also embarking on a green economy transformation, driven by the need to reduce dependence on fossil fuels while addressing social and economic challenges linked to job displacement. For instance, the planned phasing out of coal and the shift to renewables like geothermal, solar, and wind necessitate a structured strategy for workforce reskilling and redeployment.

123. This approach resonates with Indonesia's emerging green jobs strategy, which focuses on similar objectives, such as transitioning from fossil fuels to renewables and

[38] Government of the Philippines. Department of Energy. 2020. *Philippine Energy Plan 2020-2040*.

enhancing workforce skills for green industries. Both countries recognize the importance of government and private sector collaboration in advancing sustainability while addressing economic and social challenges during the energy transition.

124. Table 9 summarizes the key barriers and levers from the Philippines identified in this case study. The key levers can be adapted to the Indonesian context to address similar barriers.

Table 9. Summary of key barriers and levers from the Philippines.

Philippines	
Key Barriers	**Key Levers**
• **Job displacement from traditional industries** Transitioning away from sectors like coal mining and transport risks significant job losses, creating social and economic challenges. • **High costs of transition** Shifting to renewable energy and green technologies involves substantial investments in infrastructure, technology, and training, which can strain resources. • **Workforce reskilling challenges** The need to reskill workers from fossil fuel industries for jobs in renewable energy, automation, and digitalization requires a comprehensive and structured strategy. • **Limited coordination Among stakeholders** Effective implementation of green job initiatives demands collaboration across government agencies, private sectors, and international partners, which can be difficult to manage.	• **Comprehensive legal framework** The Philippine Green Jobs Act of 2016 offers tax deductions for green skills training and research, and import duty exemptions for environmentally friendly capital equipment, creating strong incentives for green job creation. • **Strategic energy planning** The Philippine Energy Plan (PEP) 2020-2040 provides a clear roadmap for transitioning to renewable energy, targeting a 50% RE share in the power mix by 2040 and reducing GHG emissions in line with NDC commitments. • **Green Energy Auction Program (GEAP)** Encourages competition and innovation in renewable energy adoption, fostering private sector investment and job creation. • **Focus on workforce reskilling and upskilling** Initiatives like TESDA-led training programs help workers transition to green industries by equipping them with in-demand skills. • **Regional and social equity emphasis** The Philippines prioritizes regional development and inclusivity, addressing social impacts in areas dependent on fossil fuel industries through structured policies and programs.

Source: Authors' elaboration.

Identification of Championing Organizations

125. This section presents the results of the study identifying potential coordinators for policy framework development and lead training centers. These results aim to inform the recommendations for institutional capacity enhancement presented in the next section

Identification of Potential Coordinators or Lead Organizations for Policy Framework Development

126. Developing a cohesive policy framework for human capital development in Indonesia's energy transition requires a thorough analysis to identify the most suitable coordinating or lead organization. This subchapter integrates findings from three key surveys—an influence vs. interest matrix, criteria weighting for a lead organization, and priority assessment for key organizational roles—to establish a foundation for selecting the most capable institutions to assume this coordinating role and determining their roles, complementing initial thoughts by the project team.

127. The surveys were filled by 20 experts in related fields, including representatives from industry, NGOs, labor unions, startup organizations, vocational schools, universities, and associations. The analysis examines the interest and power of key stakeholders, evaluates the criteria for selecting a lead organization, and identifies priority functions. These findings provide a comprehensive overview of the institutional landscape and highlight the strategic actions needed to ensure effective coordination in workforce development.

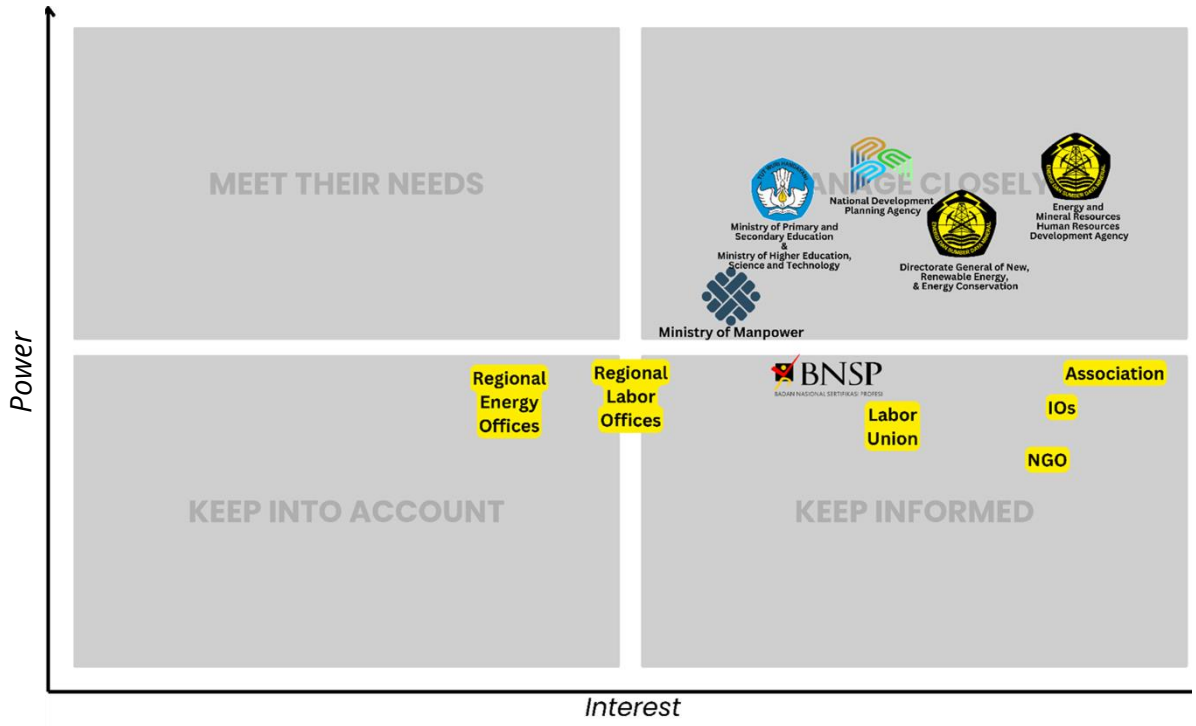
128. The first step in understanding the ecosystem of workforce development for the energy transition involves mapping key institutions based on their level of interest and level of power. This matrix evaluates each institution's ability to influence decisions and their level of engagement with workforce development for the energy transition. The institutions included in the matrix are derived from Table 1 – Table 5, which list all relevant organizations identified during the initial mapping phase. However, not all institutions were included in this analysis, as the focus is on those directly tasked with responsibilities related to workforce development in the context of the energy transition and those with the potential to serve as coordinators or lead organizations.

129. The decision to exclude certain institutions, such as the National Energy Council and the Ministry of Finance, was driven by their limited direct engagement in workforce development programs. While these institutions play critical roles in the broader energy transition—the National Energy Council in policymaking and inter-ministerial coordination, and the Ministry of Finance in budget allocation and fiscal policy—they do not have operational mandates or specialized expertise in workforce development. Including such institutions in the matrix would dilute the analysis and reduce its focus on entities directly involved in developing and implementing workforce training and competency-building initiatives.

130. For instance, the National Energy Council primarily focuses on formulating national energy policy and ensuring inter-ministerial alignment, but it does not design or deliver training programs. Similarly, while the Ministry of Finance facilitates funding for workforce initiatives, it does not actively participate in creating or implementing competency standards, certifications, or training curricula.

131. Figure 13 illustrates the results of the stakeholder influence-interest mapping of institutions that have a clear operational or strategic mandate in workforce development for the energy transition.

Figure 13. Stakeholder influence-interest mapping



Source: Authors' elaboration.

132. The stakeholder mapping exercise highlights critical dynamics among various institutions involved in workforce development for the energy transition.

133. Institutions with high power and interest, such as BPSDM ESDM, Directorate General of New, Renewable Energy, and Energy Conservation (Ditjen EBTKE), Bappenas, and both ministries of education (Ministry of Primary and Secondary Education and Ministry of Higher Education, Science and Technology), emerge as pivotal players (Table 10). These institutions possess both the authority and operational capacity necessary to design and implement effective strategies. Their ability to coordinate across sectors positions them as central actors in ensuring that workforce development aligns with national energy transition goals.

Table 10. Institutions with high power and interest.

Institutions with High Power and Interest (Manage Closely)		
Institution	**Description**	**Justification**
Energy and Mineral Resources Human Resources Development Agency (BPSDM ESDM)	As the primary agency for energy-sector workforce development, BPSDM ESDM designs and delivers training programs, develops renewable energy-specific modules, and ensures alignment with sectoral needs.	These institutions hold strong technical capacities and operational mandates within the energy sector, making them central to workforce development for the energy transition.
Directorate General of New, Renewable Energy, and Energy Conservation (Ditjen EBTKE KESDM)	Ditjen EBTKE promotes renewable energy and energy conservation and contributes technical expertise to workforce training initiatives, particularly for emerging technologies.	
Bappenas	Bappenas, particularly through its Deputy for Population and Manpower, plays a crucial role in aligning workforce development strategies with Indonesia's national development plans, including the National Medium-Term Development Plan (RPJMN) and the National Long-Term Development Plan (RPJPN). This deputy has also developed a green jobs occupational map, which provides a foundational framework for identifying key competencies and roles required for the energy transition and the broader green economy.	Bappenas balances strategic planning authority and operational relevance, positioning it as a crucial player in designing and coordinating long-term workforce roadmaps.
Ministry of Primary and Secondary Education and Ministry of Higher Education, Science, and Technology	These ministries update vocational and higher education curricula to incorporate renewable energy competencies, ensuring alignment with labor market demands.	These ministries demonstrate a balanced level of power and interest, reflecting their critical role in aligning educational curricula and labor policies with the demands of the energy transition.
Ministry of Manpower	The Ministry of Manpower oversees BLKs and ensures that training programs meet SKKNI, focusing on employability in the renewable energy sector.	

Source: Authors' elaboration.

134. On the other hand, institutions like NGOs, labor unions, and industry associations exhibit significant interest but limited power (Table 11). This underscores the importance of fostering partnerships with these entities to leverage their specialized knowledge, advocacy capabilities, and community engagement potential. Similarly, international organizations, such as IRENA and ILO, play an influential role as providers of technical expertise and financial support, complementing the efforts of domestic institutions.

Table 11. Institutions with high interest but low power.

Institutions with High Interest but Low Power (Keep Informed)		
Institution	**Description**	**Justification**
BNSP	BNSP standardizes and certifies workforce competencies, ensuring alignment with both national and international benchmarks.	BNSP is classified as high interest but low power as it ensures workforce certification but lacks authority over policy, training, and funding. It depends on the Ministry of Manpower, MEMR, and the Ministry of Industry to integrate certifications into workforce strategies, placing it in the Keep Informed category, requiring continuous engagement in energy transition workforce planning.
Labor Unions, NGOs, and International Organizations (IOs)	These stakeholders advocate for inclusivity, equity, and fair labor practices, while also providing technical and financial support for workforce programs.	NGOs, labor unions, and industry associations show significant interest in the energy transition but possess limited power to directly influence policy or programs. Their involvement underscores the importance of collaboration with government institutions to amplify their contributions through advocacy, technical support, and social mobilization. International organizations (e.g., IRENA, ILO) also exhibit high interest. They provide valuable technical and financial support but are not decision-making entities in Indonesia's workforce development ecosystem.
Associations (e.g., KADIN, METI, AESI, AEAI, APPLTA, APROBI, INAGA)[39]	Industry associations facilitate public-private collaboration, ensuring that workforce programs are responsive to market needs.	

Source: Authors' elaboration.

135. At the regional level, Regional Manpower Offices and Regional Energy Offices show comparatively lower levels of power and interest (Table 12). Despite this, their proximity to local communities makes them essential for the successful implementation of workforce programs, particularly in addressing region-specific challenges and engaging local workers. Strengthening the capacity of these regional offices through targeted support and collaboration is crucial for ensuring that national strategies are effectively translated into actionable outcomes at the local level.

[39] AESI = *Asosiasi Energi Surya Indonesia* (Indonesia Solar Energy Association); AEAI = *Asosiasi Energi Angin Indonesia* (Indonesia Wind Energy Association); APPLTA = *Asosiasi Pengembang Pembangkit Listrik Tenaga Air* (Association of Hydropower Plant Developers); APROBI = *Asosiasi Produsen Biofuel Indonesia* (Indonesia Biofuel Producer Association); INAGA = Indonesian Geothermal Association

Table 12. Institutions with low power and interest.

Institutions with Low Power and Interest (Keep Into Account)		
Institution	**Description**	**Justification**
Regional Energy Offices and Regional Manpower Offices	These offices localize workforce programs, addressing region-specific training needs and implementing initiatives tailored to local renewable energy projects.	These institutions have limited influence and engagement at present. However, their roles are essential for program implementation at the regional level, particularly in reaching local workers and addressing workforce needs in remote areas.

Source: Authors' elaboration.

136. To determine the most suitable institution for leading workforce development in the energy transition, a survey evaluated eight critical criteria using a Likert scale (1: Not Important to 5: Very Important). These criteria reflect the capabilities and attributes necessary for a lead organization. The results, including normalized weights, are presented in Table 13.

Table 13. Survey Results on Key Criteria for Coordinators or Lead Organizations in Policy Framework Development

Criteria	Average Score	Weighting
Mandate and legitimacy based on national regulations	4.50	13.7%
Cross-sector coordination ability	4.50	13.7%
Technical expertise and operational capacity	4.25	12.9%
Data-driven and monitoring approach	4.25	12.9%
Networks and cross-sector collaboration ability	4.125	12.5%
Focus on innovation and industrial transformation	3.875	11.8%
Inclusive and needs-based approaches	3.75	11.4%
Experience in policy and program implementation	3.625	11.0%

Source: Authors' elaboration.

137. The results showed that "Mandate and legitimacy based on national regulations" and "Cross-sector coordination ability" were the top-rated criteria, each scoring 4.50. These findings emphasize the importance of a strong legal and regulatory foundation, as well as the ability to align policies and programs across multiple sectors. A coordinating institution must be recognized as an authoritative entity capable of navigating the complex, multi-sectoral nature of energy transition workforce development. Technical expertise and operational capacity and data-driven and monitoring approaches also

scored highly, each receiving an average of 4.25. These criteria reflect the need for robust technical skills and evidence-based planning to ensure program effectiveness. The ability to integrate and utilize data to monitor progress and adapt strategies is essential for maintaining relevance and impact. Additionally, networks and cross-sector collaboration ability (4.125) highlights the value of fostering partnerships with diverse stakeholders, including industry, academia, and civil society. Lower-rated criteria, such as inclusive and needs-based approaches (3.75) and experience in policy and program implementation (3.625), suggest that respondents prioritized technical and operational competencies over inclusivity and historical experience. However, these elements remain important for ensuring equitable and sustainable outcomes.

138. The third survey focused on identifying the key priorities for a coordinating institution using a limited-choice method, emphasizing the focus areas that the coordinating body should prioritize in their programs. The results, as shown in Table 14, indicated that technical expertise in the energy sector is the most critical priority, with 100% of respondents selecting it. This reflects the necessity for a lead organization to have in-depth technical knowledge and capabilities to effectively support the energy transition.

Table 14. Survey Results for Key Priorities

Criteria	Percentage of Respondents
Focus on technical expertise in the energy sector	100%
Partnership with industry players	88%
Ability to reach local workers	38%
Gender-inclusive programs	38%
Harmonizing cross-ministerial policies	25%

Source: Authors' elaboration.

139. The second-highest priority, chosen by 88% of respondents, was partnerships with industry players. This highlights the importance of collaboration with the private sector to align training programs with market needs, facilitate job placement, and support innovation in workforce development strategies.

140. Social dimensions, such as the ability to reach local workers and gender-inclusive programs, were each selected by 38% of respondents. While these aspects ranked lower, they remain crucial for ensuring equitable access to workforce initiatives and fostering inclusivity within the energy transition workforce. Harmonizing cross-ministerial policies, chosen by 25% of respondents, reflects the long-term need for policy alignment to streamline and enhance program implementation across sectors.

141. The combined insights from the three surveys highlight the critical attributes, roles, and institutional dynamics necessary for a coordinating body to lead workforce

development in Indonesia's energy transition. A suitable lead institution must possess a strong regulatory mandate, ensuring legitimacy and authority to coordinate policies and programs across sectors. Equally important is the ability to foster cross-sectoral collaboration, aligning diverse stakeholders such as government agencies, industry, educational institutions, and civil society. Technical expertise emerges as a non-negotiable priority, enabling the coordinating institution to design, implement, and evaluate workforce programs that address the specific demands of the energy transition. Partnerships with industry players are also essential, ensuring that training initiatives are market-relevant and that trained workers are seamlessly absorbed into the labor market. While inclusivity and the ability to engage local workers are slightly lower in immediate priority, they remain critical for achieving equitable outcomes and addressing regional workforce disparities.

142. The analysis also reveals systemic gaps that need addressing, such as limited coordination mechanisms and the fragmented implementation of workforce programs. Strengthening partnerships among key stakeholders and building the capacity of regional institutions are essential steps to ensure effective policy execution at all levels. Ultimately, the lead organization must integrate technical, social, and collaborative dimensions into a cohesive strategy to support a just and effective energy transition.

Identification of Potential Coordinators or Lead Training Centers

143. The identification of potential coordinators or lead training centers for workforce development in Indonesia's energy transition requires a nuanced understanding of existing institutional strengths and gaps. Using survey-based Multi-Criteria Decision Analysis (MCDA), this analysis evaluates the reliability and quality of training centers by incorporating weighted criteria and normalized scores. The findings highlight critical factors shaping preferences and offer actionable insights into enhancing the role of training centers in supporting the energy transition.

144. Survey results, as shown in Table 15, reveal that the perceived quality of training centers is relatively uniform, with scores reflecting moderate satisfaction rather than exceptional performance. The highest-rated options are In-House Corporate Training Centers and Internal Ministry Training Centers, both scoring 3.1 on a scale of 1–5. This preference likely stems from their ability to directly align training programs with organizational and governmental priorities. General Training Centers scored slightly lower (3.0), reflecting their broader, less specialized scope. Meanwhile, Regional Government Training Centers (Regional Energy Offices and Regional Manpower Offices) and NGOs received the lowest ratings (2.89). These results suggest a gap in localized and community-driven training programs, which are vital for ensuring equitable access to workforce development opportunities, particularly in underserved regions. The relatively close clustering of scores indicates that no single training center type currently excels. This underlines a systemic need for improvements across all types to meet the complex and diverse demands of the energy transition workforce.

Table 15. Quality of Training Centers

Training Center Type	Average Quality Score (1-5)
In-House Corporate Training Centers	3.1
Internal Ministry Training Centers	3.1
General Training Centers	3.0
Regional Government Training Centers under Regional Energy Offices	2.89
Regional Government Training Centers under Regional Manpower Offices	2.89
Non-Governmental Organizations	2.89

Source: Authors' elaboration

145. Respondents identified two factors as overwhelmingly critical in determining the reliability of training centers based on the MCDA analysis (Table 16):

    a. **Technical Expertise.** The ability of training centers to offer relevant technical skills is paramount. This finding aligns with the growing need for specialized competencies, such as renewable energy system design, energy efficiency, and digital integration, all of which are essential for the energy transition.

    b. **Strong Industry Networks.** Industry connections enable training centers to design programs that match labor market demands. They also facilitate internships, apprenticeships, and job placements, bridging the gap between training and employment.

Table 16. Survey Results on Key Criteria for Coordinators or Lead Training Centers

Criteria	Average Score	Weighting (%)
Technical Expertise	3.889	35.0
Industry Network	3.889	35.0
Training Infrastructure	0.556	10.0
Market-Driven Programs	1.667	20.0
Social Inclusion and Gender Equity	0.00	0.00
Accessibility	0.00	0.00

Source: Authors' elaboration.

146. Other factors, such as *Market-Driven Programs* and *Infrastructure Adequacy*, played secondary roles. *Social Inclusion Gender Equity* and *Accessibility* were not prioritized, reflecting the current focus on technical alignment over broader equity considerations.

This deprioritization may indicate a missed opportunity to address systemic barriers to workforce participation, particularly for marginalized groups.

147. The survey findings emphasize that the development of a skilled workforce for Indonesia's energy transition hinges on the ability of training centers to deliver specialized expertise and establish strong industry connections. In-House Corporate Training Centers and Internal Ministry Training Centers, which scored marginally higher in perceived reliability, are well-positioned to lead workforce development efforts. Their alignment with key factors such as technical expertise and industry partnerships makes them critical players in addressing the immediate demands of the energy sector. However, the narrow performance gap across training center types indicates that systemic improvements are necessary to ensure a comprehensive training ecosystem.

148. To enhance their role as potential coordinators, training centers must prioritize investments in specialized skills development and expand collaboration with industry stakeholders. This approach not only ensures that curricula remain relevant to technological advancements and market demands but also fosters practical pathways to employment. Regional government training centers, which currently face significant challenges related to decentralization and limited institutional support, require enhanced mandates, better funding, and local industry partnerships to improve their effectiveness. Similarly, NGOs and general training centers must focus on niche expertise and strengthen their operational frameworks to contribute meaningfully to the energy transition.

149. Equity and accessibility, while not prioritized in the survey, represent critical areas for long-term workforce sustainability. By embedding inclusion and social equity principles into training programs, centers can address systemic barriers and ensure that underserved communities are not excluded from the benefits of the energy transition. Additionally, integrating gender equity and regional accessibility strategies will enhance the inclusiveness of workforce development efforts.

150. In conclusion, while In-House Corporate Training Centers and Internal Ministry Training Centers emerge as strong candidates to coordinate workforce development, the overall findings highlight the importance of a multi-pronged strategy. This strategy should include enhancing specialization, fostering public-private partnerships, addressing regional disparities, and embedding equity considerations. While training centers may operate under various institutions or maintain their operational independence, robust monitoring is essential to ensure alignment with the policy framework established by the coordinating body. Training centers must demonstrate a strong capacity to deliver specialized expertise and forge meaningful industry connections, with their programs and outcomes consistently evaluated to align with the overarching goals and priorities of the energy transition. By adopting this integrated and well-monitored approach, Indonesia can develop a resilient, skilled workforce capable of driving its energy transition, ensuring both economic growth and social progress in the years ahead.

Recommendations for Institutional Capacity Enhancement

151. The recommendations outlined are structured around the key constraints identified in the analysis, as elaborated in the section *Gaps in Workforce Development in the Energy Transition in Indonesia*.

152. Each constraint is addressed with a set of actionable recommendations, informed by international best practices and adapted to Indonesia's specific context.

Improving institutional coordination and reducing fragmentation

153. The absence of a clear framework and occupational map from technical ministries has resulted in workforce development initiatives related to the energy transition being poorly coordinated. This issue is further compounded by the lack of a central coordinating mechanism that could lead ministries such as MEMR, the Ministry of Manpower, and the Ministry of Industry to independently implement training programs. As a result, this has led to program duplication, resource inefficiencies, and a lack of strategic alignment among stakeholders, while also neglecting critical competencies that remain unsupported by existing training programs. Table 17 summarizes the recommendations to address this constraint.

Table 17. Recommendations to improve institutional coordination and reduce fragmentation.

Recommendation	Description
Establish a Central Coordinating Body	A Central Coordination Body is essential for workforce development in Indonesia's energy transition, with Bappenas or MEMR as the top alternative candidates, provided its authority is strengthened.
Adopt Collaborative Governance Frameworks	Collaborative governance frameworks, are essential for aligning stakeholders, creating unified roadmaps, and ensuring inclusive workforce development for the energy transition.

Source: Authors' elaboration.

Establish a Central Coordinating Body

154. The establishment of a **Central Coordinating Body** is necessary to harmonize workforce development strategies for the energy transition. For example, Singapore's SkillsFuture Initiative illustrates how a centralized body can integrate national training strategies, aligning workforce needs with economic priorities, including those in the green energy sector. A central coordinating body can also operate within an existing ministry, as seen in the Philippines, where the DOLE leads the implementation of the Green Jobs Act. These examples showcase how such bodies can coordinate workforce strategies, curriculum updates, and training programs to effectively support green economy goals.

155. In Indonesia, the Energy and Mineral Resources Human Resources Development Agency (BPSDM ESDM) and Directorate General of New, Renewable Energy, and Energy Conservation (Ditjen EBTKE) have emerged as the two most suitable candidates to serve as the central coordinating body for workforce development in the energy transition, based on the stakeholder mapping exercise. However, each institution faces limitations that must be addressed to ensure effective and cohesive coordination.

156. BPSDM ESDM possesses significant technical expertise and has an established role in workforce development, making it a strong candidate. However, its scope extends beyond renewable energy, potentially diluting its focus on energy transition-specific needs. Additionally, BPSDM ESDM lacks the authority to issue policies or regulations, limiting its ability to enforce and mandate cohesive workforce strategies across institutions.

157. On the other hand, Ditjen EBTKE has a clear mandate to promote renewable energy and energy conservation and possesses the ability to issue policy and regulatory documents, giving it a strategic advantage. However, its focus is primarily technical and does not comprehensively address all aspects of the energy transition. Additionally, certain responsibilities related to NRE—particularly when utilized in power generation—fall under the purview of the Directorate of Electricity. This overlap creates potential challenges in coordination and could lead to fragmented efforts in implementing cohesive energy transition strategies.

158. The survey results highlight that "Mandate and Legitimacy Based on National Regulations" and "Cross-Sector Coordination Ability" are the two most critical criteria for selecting a coordinating body. This suggests Bappenas and the Coordinating Ministry of Economic Affairs as strong candidates for the role, given their robust mandates anchored in national regulations and their demonstrated ability to facilitate cross-sector collaboration. However, the technical expertise and sector-specific focus of MEMR, particularly through BPSDM ESDM and the Directorate General of New, Renewable Energy, and Energy Conservation, offer significant advantages that neither Bappenas nor the Coordinating Ministry of Economic Affairs can fully replicate, even with substantial resources. These advantages are crucial for addressing the specialized needs of workforce development in the energy transition.

159. Nevertheless, both Bappenas and the Coordinating Ministry of Economic Affairs can play vital roles in supporting the coordination of initiatives. Bappenas, with its overarching planning authority, can align workforce development strategies with national development goals, ensuring training programs are integrated into broader economic and sustainability policies. Similarly, the Coordinating Ministry of Economic Affairs is well-positioned to ensure workforce strategies are closely tied to economic policies, such as fostering job creation in NRE sectors that drive industrial growth.

160. For BPSDM ESDM, its inability to issue policies or regulations can be mitigated through collaboration with other directorates within MEMR, such as Ditjen EBTKE or the

Directorate of Electricity, to issue the necessary regulatory documents that formally mandate BPSDM ESDM as the central coordinating body. This approach would allow BPSDM ESDM to leverage its technical expertise and operational experience while ensuring the legitimacy and authority needed to harmonize workforce development strategies.

161. While Ditjen EBTKE has the capability to issue regulatory documents, its focus on technical aspects and the division of responsibilities within MEMR—particularly with the Directorate of Electricity—can lead to fragmentation. Structural adjustments and regulatory support would be necessary to expand its scope and ensure alignment with the broader goals of the energy transition.

162. Establishing a new central coordinating body is not recommended, as it would likely exacerbate the already overlapping interests and responsibilities among ministries. Additionally, new institutions tend to lack the authority and influence necessary to lead effectively, making them less capable of driving the level of coordination and strategic alignment required for workforce development in the energy transition.

163. Overall, regardless of the chosen option, the House of Representatives has a critical role in ensuring the effectiveness of the appointed coordinating body. The House of Representatives can provide political legitimacy to the central coordinating body by endorsing its establishment and scope through legislative processes. Additionally, the House of Representatives plays a pivotal role in approving the necessary budgets to support the coordinating body's operations and ensuring that adequate resources are allocated for workforce development initiatives. Through its oversight function, the House of Representatives can monitor the implementation of strategies by the coordinating body, ensuring accountability, transparency, and alignment with national energy transition goals. Its involvement is essential to reinforce the authority and effectiveness of the coordinating body in harmonizing efforts across institutions.

164. Table 18 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 18. Summary of recommended roles and responsibilities for different institutions for establishing a central coordinating body.

Institution	Roles and Responsibilities	Justification
BPSDM ESDM	Acts as the central coordinating body for workforce development in the energy transition. Leverages technical expertise to harmonize training programs, develop workforce strategies, and oversee skill development initiatives. Collaborates with other MEMR directorates to formalize policies and mandates.	BPSDM ESDM has strong technical expertise and an existing role in workforce development but lacks regulatory authority. It requires collaboration with regulatory units to ensure effective implementation.
Ditjen EBTKE	Supports the coordinating body by issuing policy and regulatory documents related to workforce development in renewable	Ditjen EBTKE has regulatory authority in the renewable energy sector but lacks a comprehensive

	energy. Aligns training programs with sectoral needs and ensures integration with broader energy transition policies.	workforce development mandate, necessitating collaboration with BPSDM ESDM and the Directorate of Electricity.
Bappenas	Provides strategic oversight and ensures alignment of workforce development strategies with national development plans (RPJMN, RPJPN). Facilitates inter-ministerial collaboration and resource allocation.	Bappenas has a mandate to coordinate national planning and has developed the Green Jobs Roadmap, making it a key institution for integrating workforce strategies into broader economic and sustainability policies.
Coordinating Ministry of Economic Affairs	Ensures workforce strategies align with economic policies and industrial growth, particularly in renewable energy sectors. Facilitates inter-ministerial coordination and private sector engagement.	The Coordinating Ministry of Economic Affairs plays a key role in ensuring that workforce development policies support job creation in NRE-related industries and are integrated into national economic strategies.
Ministry of Manpower	Oversees labor market data, ensures workforce mobility, and integrates training programs with labor demand. Implements workforce strategies through vocational training centers and regulatory oversight.	The Ministry of Manpower is responsible for labor market policies and plays a key role in ensuring that workforce development initiatives address employment gaps in the energy transition.
Ministry of Primary and Secondary Education	Updates SMK curricula to incorporate renewable energy training and technical skills. Ensures students gain industry-relevant competencies through vocational education.	The Ministry of Primary and Secondary Education is responsible for vocational education at the secondary level and must align curricula with emerging workforce needs in renewable energy sectors.
Ministry of Higher Education, Science, and Technology	Develops academic programs and research initiatives supporting renewable energy workforce needs. Strengthens collaborations between universities, industries, and international organizations.	The Ministry of Higher Education, Science, and Technology oversees higher education and research institutions, making it essential for advancing technical expertise and innovation in workforce development.
BNSP	Ensures certification programs align with SKKNI and international benchmarks. Expands accreditation and certification capacity for workforce training.	BNSP plays a central role in ensuring workforce competencies meet industry and global standards, improving the employability of skilled workers.
Regional Energy Offices	Implements workforce development programs tailored to regional energy sector needs. Collaborates with local industries and training centers.	Regional governments play a crucial role in ensuring workforce development programs address local energy transition priorities and skill demands.

Regional Manpower Offices	Collects local labor market data, facilitates job placements, and supports vocational training initiatives. Aligns regional workforce policies with national strategies.	Regional labor offices ensure that workforce programs are accessible and responsive to local employment needs.
Labor Unions	Advocates for fair labor practices, worker protections, and reskilling initiatives in the energy transition. Ensures workforce policies consider worker welfare and rights.	Labor unions provide representation for workers, ensuring that workforce development strategies address job security and just transition concerns.
NGOs & IOs	Supports capacity-building, promotes inclusivity in workforce programs, and facilitates international knowledge exchange. Provides funding and technical expertise.	NGOs and IOs contribute to strengthening workforce policies by integrating global best practices, advocating for equity, and mobilizing resources.
Industry Associations	Collaborates with the central coordinating body to align training with industry needs. Provides internships, apprenticeships, and workforce development initiatives.	Industry associations ensure that workforce programs are demand-driven and reflect the skills needed in the renewable energy sector.

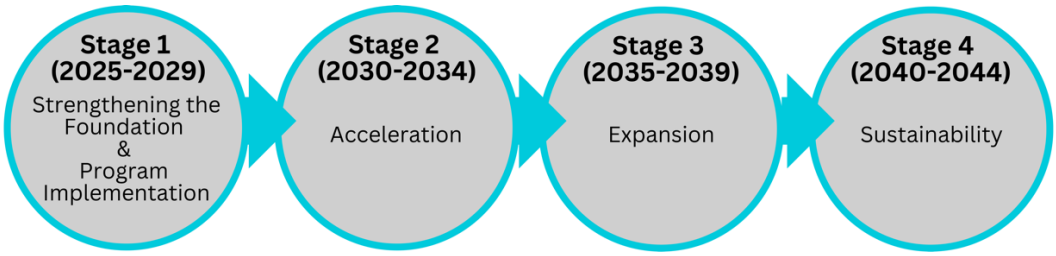
Source: Authors' elaboration.

Adopt Collaborative Governance Frameworks

165. A unified workforce roadmap, led by the appointed central coordinating body, should **adopt collaborative governance frameworks** and involve contributions from multiple stakeholders, each of which would bring distinct expertise and responsibilities to the table. This roadmap can be derived from the Green Jobs Roadmap developed by Bappenas, which prioritizes the energy and industrial sectors as key focus areas.

166. The implementation of the workforce roadmap for green jobs follows a phased approach, structured over four stages, with each phase spanning five years (Figure 14). Given its foundational role, integrating the workforce roadmap for the energy transition into Stage 1 of the Green Jobs Roadmap, which focuses on strengthening the foundation and program implementation, is critical to ensuring a well-structured and sustainable workforce transition strategy.

Figure 14. Bappenas Green Jobs Roadmap



Source: Authors' elaboration.

167. MEMR, through its key units such as BPSDM ESDM, Ditjen EBTKE, and the Directorate General of Electricity, will provide technical guidance and sector-specific expertise.

MEMR's roles include identifying skill gaps, developing competency standards, and aligning training programs with national energy transition goals. Its regulatory authority can be leveraged to formalize policies that mandate collaboration among stakeholders in workforce initiatives.

168. The Ministry of Industry, through its Agency for Standardization and Industrial Services Policy and its Industrial Human Resources Development Agency, will focus on workforce development for green industries by aligning vocational training programs with industry demands. The Ministry of Industry can ensure that industrial practices adopt renewable energy technologies and energy-efficient processes. Additionally, it can facilitate partnerships with private industries to provide internships, apprenticeships, and on-the-job training opportunities, ensuring that the workforce is prepared to meet industry-specific needs.

169. The Ministry of Manpower plays a crucial role in projecting future labor demands and integrating these projections into national workforce strategies. The Manpower Planning and Development Agency and the Directorate General of Vocational Training and Productivity Development are responsible for overseeing the implementation of vocational training and productivity improvement programs. These programs ensure that training institutions and apprenticeships align with the needs of energy transition roles. The Ministry of Manpower can also facilitate workforce mobility across regions and ensure job placements meet the demands of renewable energy projects.

170. The Ministry of Primary and Secondary Education, through the Directorate General of Vocational Education and the Agency for Standards, Curriculum, and Assessment, is responsible for updating vocational high school (SMK) curricula to incorporate renewable energy and sustainability-focused training. By collaborating with industries and technical institutions, the Ministry of Primary and Secondary Education ensures students acquire practical skills relevant to the energy transition. Furthermore, it oversees the development of standardized assessments and certifications for renewable energy-specific skills.

171. The Ministry of Higher Education, Science, and Technology, through the Directorate General of Higher Education, promotes interdisciplinary research and innovation in renewable energy technologies. Universities under this ministry can develop specialized academic programs, foster collaborations with industries, and partner with international organizations to exchange knowledge and build capacity in green technologies.

172. Local governments play a vital role in localizing and implementing workforce strategies. Regional Energy Offices are tasked with tailoring centrally designed training programs to meet region-specific needs, while Regional Manpower Offices gather and analyze local labor market data to align training efforts with regional demands. Local governments can facilitate partnerships between industries, training providers, and communities to ensure effective workforce strategies at the regional level.

173. The private sector contributes by offering internships, apprenticeships, and on-the-job training programs, bridging the gap between theoretical knowledge and practical skills. Industries can collaborate with technical ministries to ensure that workforce competencies meet market needs and invest in reskilling and upskilling initiatives for employees transitioning to greener technologies and processes.

174. Academic institutions, including universities and polytechnics, play a critical role by conducting research on renewable energy technologies and workforce trends. They offer specialized programs and certifications in renewable energy engineering, energy management, and sustainability. As hubs for innovation and knowledge dissemination, these institutions contribute to workforce development by collaborating with industries and government agencies.

175. Finally, NGOs advocate for inclusivity and equity in workforce strategies, addressing gender disparities and supporting marginalized communities. NGOs also provide upskilling and reskilling programs to prepare local communities for employment in renewable energy sectors. Acting as intermediaries, they connect industries, local governments, and communities to align workforce development initiatives effectively.

176. By defining and coordinating these roles within a collaborative governance framework, Indonesia can ensure cross-sectoral alignment, foster meaningful partnerships, and develop a skilled workforce to meet the demands of the energy transition.

177. Such efforts have been observed in other countries. The GJA in the Philippines provides a robust example of a legal framework that promotes decent jobs in sustainability-focused sectors, ensuring collaboration across government agencies, businesses, and educational institutions. This act, implemented by the DOLE, integrates workforce planning, curriculum updates, and skills training, fostering equitable transitions to a green economy. Similarly, India's SCGJ demonstrates a practical model for aligning industry demands with workforce development. Operated as an industry-led initiative under the Ministry of Skill Development and Entrepreneurship, SCGJ collaborates with government, academia, and private sector players to identify skill gaps, implement training programs, and standardize certifications for green jobs. Supporting institutions, including NGOs, industry associations, IRENA, and ILO, could further contribute technical expertise, advocacy, and financial support to enhance the coordination and implementation of workforce strategies. Another example related to whole-institution approaches for embedding green skills throughout educational systems is discussed in Box 1. These collaborative governance examples underscore the necessity of multi-stakeholder approaches in creating a cohesive and inclusive framework for workforce development in the energy transition.

BOX 1. Whole-institution approaches for embedding green skills throughout educational systems.

Whole-institution approaches foster collaboration among various stakeholders to embed green skills throughout educational systems. The United Nations Educational, Scientific and Cultural Organization (UNESCO) highlights the importance of partnerships between schools, civil society organizations (CSOs), and the private sector, as well as orientations for key stakeholders like textbook writers and examination boards. By training educators and aligning institutional efforts, these initiatives ensure cohesive and effective implementation of green education programs.

Designing, implementing, and improving efforts to integrate learning outcomes into the curriculum involves a strategic, step-by-step process, beginning with reviewing existing education policies to identify opportunities for incorporating greening education. Next, inclusive participation ensures diverse stakeholders, such as educators, youth, and community members, contribute to the process.

Curricular strategies are then defined to integrate greening education across subjects and grade levels, followed by developing a detailed, action-oriented curriculum using transformative, real-world pedagogies. Piloting instructional resources helps refine the curriculum through stakeholder feedback. Finalizing and distributing resources involve comprehensive strategies, including assessments and communication plans. Orientation for stakeholders ensures textbook writers, examination boards, and others are aligned with the curriculum goals. Educator training provides pre- and in-service support, bolstered by partnerships with higher education and civil society organizations. The curriculum is implemented through whole-institution approaches, fostering collaboration between schools, CSOs, and private sectors. Finally, monitoring and assessment ensures continuous improvement and evaluates the program's impact on climate change competencies. This roadmap creates an inclusive, practical, and adaptable framework for greening education, guided by resources like UNESCO[1] and Tibbitts *et al.*[2]

[1] UNESCO. 2024. *Greening Curriculum Guidance: Teaching and Learning for Climate Action*.
[2] Tibbitts, F., Loni, S., Abrom, A., & Chacon-Ugarte, G. 2023. *From Commitment to Action: Integrating Sustainable Development into National Education Priority: a Practical Guide for Policymakers, Practitioners, and Researchers*. Global Schools Program

178. Table 19 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 19. Summary of recommended roles and responsibilities for different institutions for adopting collaborative governance frameworks.

Institution	Roles and Responsibilities	Justification
MEMR	Provides technical guidance, develops competency standards, and aligns training programs with energy transition goals. Issues policies to mandate collaboration.	Ensures workforce competencies match energy transition needs.
Minstry of Industry	Aligns vocational training with green industry demands, promotes RE technology & energy-efficient processes, and facilitates industry partnerships.	Supports industry-aligned workforce development for green manufacturing and renewable energy tech.
Ministry of Manpower	Integrates labor market projections into workforce strategies, oversees vocational training, and ensures job placements meet renewable energy demands.	Aligns labor policies with energy transition needs to ensure a skilled workforce.

Ministry of Primary and Secondary Education	Updates SMK curricula for renewable energy, standardizes competency assessments, and ensures education meets industry needs.	Prepares vocational graduates for jobs in the energy transition.
Ministry of Higher Education, Science, and Technology	Promotes research, innovation, and specialized academic programs in renewable energy, collaborating with industries.	Advances research and innovation to support workforce readiness.
Local Governments (Regional Energy Offices and Regional Manpower Offices)	Develops region-specific workforce strategies, implements training programs, and aligns them with local energy projects.	Addresses regional workforce disparities and ensures accessibility.
Private Sector	Provides internships, apprenticeships, and workforce upskilling programs for renewable energy roles.	Ensures workforce competencies align with market needs.
Universities & Polytechnics	Conduct research, offer specialized programs, and collaborate with industries on renewable energy workforce development.	Supports knowledge generation and workforce specialization.
NGOs	Advocate for inclusivity, run upskilling programs, and connect stakeholders for workforce development.	Advocate for inclusivity, run upskilling programs, and connect stakeholders for workforce development.

Source: Authors' elaboration.

Enhancing data systems for workforce planning

179. A significant constraint in Indonesia's workforce planning for the energy transition is the lack of robust data systems, which hinders effective strategy formulation. The Ministry of Manpower faces challenges in accessing comprehensive employment data due to the absence of mandatory reporting mechanisms, making it difficult to gather accurate and timely insights into workforce dynamics. The lack of integration among labor market data sources further exacerbates these issues, limiting the ability to plan for future skill demands and design relevant training programs. Additionally, the absence of an occupational map specifically tailored to the energy transition prevents institutions like the Ministry of Manpower, MEMR, the Ministry of Primary and Secondary Education, and the Ministry of Higher Education, Science, and Technology from aligning their workforce development strategies and educational programs with the specific needs of the NRE sector. Table 20 summarizes the recommendations to address this constraint.

Table 20. Recommendations to enhance data systems for workforce planning.

Recommendation	Description
Develop Integrated Labor Market Information Systems (LMIS)	Indonesia requires an integrated labor data system and occupational map for energy transition jobs to align training with market needs, led by MEMR and the Ministry of Industry
Implement Data-Driven Workforce Strategies	Data-driven workforce strategies using labor analytics and an occupational map can help the Ministry of Manpower, MEMR, and Ministry of Industry adapt training to emerging skill demands in renewable energy.

Source: Authors' elaboration.

Develop Integrated Labor Market Information Systems (LMIS)

180. Developing an Integrated Labor Market Information System (LMIS) tailored to energy transition needs should be developed to serve as a centralized platform for collecting, analyzing, and disseminating data on workforce dynamics. With clearly defined roles for key institutions, the LMIS would ensure that labor market insights inform decision-making at all levels. The Ministry of Manpower, through the Manpower Planning and Development Agency, can lead the development and implementation of the LMIS by coordinating labor market analyses and establishing mandatory reporting mechanisms for industries and vocational training institutions. The Directorate General of Vocational Training and Productivity Development can oversee the integration of regional labor market data, ensuring alignment between workforce supply and renewable energy sector demands.

181. MEMR can provide sector-specific insights to ensure that the LMIS reflects the real-time needs of the energy transition. BPSDM ESDM can develop detailed occupational maps tailored to NRE projects, which can guide the design of competency standards and training programs. The Ditjen EBTKE can contribute data on workforce requirements for renewable energy technologies and energy conservation initiatives, while the Directorate of Electricity can focus on grid modernization and the integration of renewable energy into the national grid. Together, these contributions ensure the LMIS covers critical technical roles.

182. Educational institutions also play a pivotal role in aligning education with labor market demands. The Ministry of Primary and Secondary Education, through the Directorate General of Vocational Education, can update SMK curricula based on insights from the occupational maps integrated into the LMIS. This alignment ensures that SMK graduates are equipped with relevant skills for the renewable energy sector. Additionally, the Agency for Standards, Curriculum, and Assessment can integrate standardized competency-based assessments into the LMIS, ensuring consistency between educational outcomes and labor market needs. Similarly, the Ministry of Higher Education, Science and Technology, through the Directorate General of Higher Education, can ensure university and polytechnic programs align with workforce requirements by incorporating energy transition-focused research and innovation into their curricula.

183. Strategic oversight for the LMIS can be provided by Bappenas and the Coordinating Ministry for Economic Affairs. Bappenas can ensure that the system aligns with national development plans such as the RPJMN and RPJPN, while guiding resource allocation for its development and maintenance. Meanwhile, the Coordinating Ministry for Economic Affairs can facilitate inter-ministerial collaboration, ensuring that the LMIS supports workforce strategies that foster green job creation and align with economic policies.

184. Regional governments, through Regional Energy Offices and Regional Manpower Offices, can utilize LMIS outputs to implement localized workforce strategies. For

example, regions with high renewable energy potential, such as solar or geothermal, can prioritize relevant skills training programs and workforce initiatives. These governments can also collaborate with local training providers and industries to enhance workforce capacity tailored to regional needs.

185. Private sector stakeholders, including PLN, Pertamina, and other NRE companies, can utilize LMIS insights to design on-the-job training programs and upskilling initiatives. Their active participation ensures that strategies remain relevant to industry needs and reflect the evolving demands of the renewable energy market. Furthermore, these stakeholders can provide real-time data on job openings, required competencies, and workforce performance, contributing to the accuracy of the LMIS.

186. BNSP can enhance the relevance of certifications by integrating labor market analytics from the LMIS. By identifying gaps in certification programs and updating competency frameworks, BNSP can ensure that certifications align with emerging roles in renewable energy. Regular updates to certification schemes will also enhance the credibility and employability of certified professionals.

187. Table 21 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 21. Summary of recommended roles and responsibilities for different institutions for developing integrated labor market information systems.

Institution	Roles and Responsibilities	Justification
Ministry of Manpower	Leads LMIS development through the Manpower Planning and Development Agency, mandates workforce data reporting, and integrates regional labor data via the Directorate General of Vocational Training and Productivity Development.	Responsible for labor market data and workforce planning.
MEMR	Provides sector-specific insights, develops occupational maps via BPSDM ESDM, and integrates NRE workforce needs through Ditjen EBTKE and Directorate of Electricity.	Ensures LMIS reflects real-time NRE workforce demands.
Ministry of Primary and Secondary Education	Updates SMK curricula via the Directorate General of Vocational Education and integrates competency assessments via the Agency for Standards, Curriculum, and Assessment	Aligns vocational education with NRE workforce needs.
Ministry of Higher Education, Science, and Technology	Ensures universities & polytechnics align curricula with workforce needs via the Directorate General of Higher Education.	Supports upskilling and innovation in renewable energy.
Bappenas	Oversees LMIS alignment with RPJMN & RPJPN, guiding resource allocation; Oversees LMIS alignment with RPJMN and RPJPN, guiding resource allocation.	Ensures workforce planning integrates national development goals.
Coordinating Ministry for Economic Affairs	Facilitates inter-ministerial collaboration to link LMIS with economic and green job strategies.	Ensures LMIS aligns with industrial and economic priorities.

Regional Energy & Manpower Offices	Use LMIS for local workforce planning, skill training, and industry collaboration.	Tailors programs to regional NRE potential and labor market needs.
Private Sector (PLN, Pertamina, NRE Companies)	Provides real-time workforce data, designs on-the-job training, and upskilling programs.	Ensures strategies are market-relevant and responsive to industry trends.
BNSP	Integrates LMIS analytics into certification and updates competency frameworks.	Aligns workforce certifications with evolving industry needs.

Source: Authors' elaboration.

Implement Data-Driven Workforce Strategies

188. Implementing data-driven workforce strategies ensures the the LMIS serves as more than a static tool. By translating insights from the LMIS and occupational maps into actionable policies, institutions can develop targeted training programs, update certification processes, and align education with labor market demands.

189. The Ministry of Manpower plays a crucial role in ensuring that vocational training adapts to market needs. Using LMIS insights, the Manpower Planning and Development Agency can refine workforce planning, while the Directorate General of Vocational Training and Productivity Development can update training curricula and expand programs in high-demand areas, such as renewable energy (NRE) technology maintenance and energy efficiency. These adjustments will improve employability and address skill gaps in the labor market.

190. MEMR, through BPSDM ESDM, Ditjen EBTKE, and the Directorate General of Electricity, can leverage LMIS data to design policies supporting workforce upskilling and NRE job growth. By identifying trends in labor demand, MEMR can implement targeted workforce incentives, ensuring a steady supply of skilled professionals for NRE projects. Additionally, aligning workforce policies with grid modernization and renewable energy integration will further strengthen Indonesia's transition to a sustainable energy system.

191. Educational institutions also play a critical role in translating labor market insights into practical learning pathways. The Ministry of Primary and Secondary Education, through the Directorate General of Vocational Education and the Agency for Standards, Curriculum, and Assessment, can revise SMK curricula to incorporate NRE-specific competencies and standardized competency assessments, ensuring that graduates are job-ready. Similarly, the Ministry of Higher Education, Science, and Technology, through the Directorate General of Higher Education, can enhance university and polytechnic programs by integrating renewable energy research and industry collaboration into higher education.

192. At the regional level, Regional Energy Offices and Regional Manpower Offices can utilize LMIS outputs to tailor training programs to local workforce demands. This ensures that workforce strategies reflect regional industrial needs, particularly in provinces with

strong renewable energy potential, such as geothermal, solar, or hydro-based industries.

193. Private sector involvement is equally important, with PLN, Pertamina, and NRE companies contributing real-time workforce data and collaborating in curriculum development. These industry players can design on-the-job training programs and upskilling initiatives, ensuring that training efforts remain relevant and responsive to market trends.

194. BNSP plays a critical role in refining certification standards based on labor market analytics. By regularly updating competency frameworks to match industry requirements, BNSP ensures that workers' certifications remain credible and competitive, strengthening Indonesia's position in the global energy transition workforce.

195. Table 22 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 22. Summary of recommended roles and responsibilities for different institutions for implementing data-driven strategies.

Institution	Roles and Responsibilities	Justification
Ministry of Manpower	Uses LMIS insights to adapt training curricula, scale up programs for high-demand NRE skills, and ensure labor market alignment.	Ensures vocational training evolves with industry needs.
MEMR	Uses workforce data to inform upskilling incentives, workforce policies, and NRE job projections.	Ensures labor policies support a skilled NRE workforce.
Ministry of Primary and Secondary Education	Adjusts SMK curricula based on labor analytics and industry trends.	Prepares graduates for emerging green jobs.
Ministry of Higher Education, Science, and Technology	Uses labor market data to update university and polytechnic programs, ensuring research and training match industry needs.	Supports long-term workforce adaptability and innovation.
Regional Energy & Manpower Offices	Use LMIS data for localized workforce planning, ensuring training meets regional NRE industry needs.	Supports tailored workforce initiatives for different regions.
Private Sector (PLN, Pertamina, NRE Companies)	Provides real-time workforce data, collaborates in designing upskilling programs, and supports curriculum development.	Ensures training is market-driven and meets industry demands.
BNSP	Uses LMIS analytics to refine certification standards, ensuring credentials match industry needs.	Enhances certification credibility and workforce competitiveness.

Source: Authors' elaboration.

Improving the quality and capacity of training institutions

196. Vocational and training institutions in Indonesia, such as SMKs, Regional Technical Implementation Units (UPTD), Central Technical Implementation Units (UPTP) and BLKs, face significant challenges in supporting workforce development for the energy transition. These challenges include inadequate alignment with industry needs, insufficient technical expertise, and limited practical training infrastructure. Many programs are not tailored to renewable energy technologies, reducing their relevance to the labor market. The lack of accreditation and inconsistent certification standards further hinder the effectiveness of these institutions. Additionally, considerations for social inclusion and accessibility are often deprioritized, limiting the reach and impact of training programs, particularly for marginalized groups and underserved regions.

197. While In-House Corporate Training Centers and Internal Ministry Training Centers emerge as strong candidates to coordinate workforce development efforts, the findings highlight the need for systemic improvements across all training center types. To ensure these efforts are effectively implemented, the recommended coordinating body—either BPSDM ESDM or Ditjen EBTKE—should take the lead in aligning these initiatives with national energy transition priorities. This coordinating body can provide strategic oversight, ensuring that training center programs are aligned with broader workforce development strategies and address key gaps in the renewable energy sector. Table 23 summarizes the recommendations to address this constraint.

Table 23. Recommendations to improve the quality and capacity of training institutions.

Recommendation	Description
Enhance Technical Expertise and Industry Collaboration	Working with industry stakeholders to co-develop competence-based training programs and establish advisory boards comprising academia, industry, and policymakers
Improve Practical Training Infrastructure	Investments in renewable energy equipment, simulation tools, and modernized facilities at SMKs and BLKs will provide hands-on learning opportunities, preparing graduates for real-world challenges
Promote Instructor Training and Capacity Building	Equip trainers with the skills needed to deliver high-quality and up-to-date programs

Source: Authors' elaboration.

Enhance Technical Expertise and Industry Collaboration

198. Indonesia can improve the quality of vocational and training institutions by first enhancing technical expertise and fostering industry collaboration. To enhance these, BNSP plays a central role in setting and maintaining certification standards. BNSP can collaborate with industries, training centers, and international organizations such as IRENA and ILO to incorporate international benchmarks into certification frameworks. These collaborations will ensure that certifications are aligned with global standards, enhancing the credibility and employability of certified professionals.

199. MEMR is instrumental in developing renewable energy-specific certifications. Through BPSDM ESDM, the ministry can lead the creation of detailed certification schemes for critical roles in renewable energy sectors such as solar, wind, and geothermal energy. Ditjen EBTKE can provide technical expertise and ensure certifications reflect the skill requirements of NRE projects and energy conservation initiatives. Additionally, the Directorate of Electricity can support the development of certifications for roles in grid modernization, renewable energy integration, and energy efficiency technologies.

200. The Ministry of Industry also plays a key role in enhancing certification quality, particularly for industrial applications of renewable energy. Through the Industrial Human Resources Development Agency, the Ministry of Industry can develop certification schemes tailored to industrial processes that incorporate energy-efficient and renewable energy technologies. The Agency for Standardization and Industrial Services Policy can ensure that certification standards are consistent with industry demands, particularly for roles in green manufacturing and renewable energy equipment production. These contributions will help bridge gaps between industry needs and workforce skills, ensuring alignment with market demands.

201. The Ministry of Manpower, through the Directorate General of Vocational Training and Productivity Development, can work closely with BNSP, MEMR, and the Ministry of Industry to integrate certifications into vocational training programs. BLKs and other training institutions under the Ministry of Manpower can update their curricula to align with certification requirements, ensuring graduates are prepared for the demands of the energy transition. The Manpower Planning and Development Agency can also identify areas where certified training programs are most needed, prioritizing renewable energy-related roles and regions.

202. The Ministry of Primary and Secondary Education and the Ministry of Higher Education, Science, and Technology further support certification quality by aligning their education systems with SKKNI and certification requirements. The Directorate General of Vocational Education can embed certification pathways into SMK programs, ensuring that students graduate with both academic qualifications and industry-recognized certifications. Similarly, the Directorate General of Higher Education can encourage universities and polytechnics to integrate certification readiness into their training programs, fostering collaboration with industries and accrediting bodies.

203. Table 24 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 24. Summary of recommended roles and responsibilities for different institutions for enhancing technical expertise and industry collaboration.

Institution	Roles and Responsibilities	Justification
BNSP	Sets and maintains certification standards, collaborates with industries and international	Ensures that certification standards align with international requirements,

	organizations (IRENA, ILO) to integrate global benchmarks into certification frameworks.	increasing workforce credibility and employability in the energy transition sector.
MEMR	Develops renewable energy-specific certifications through BPSDM ESDM for solar, wind, and geothermal sectors. Ditjen EBTKE provides technical expertise to align certification with NRE projects. The Directorate of Electricity ensures certification covers grid modernization and renewable energy integration.	Strengthens technical qualifications in renewable energy, ensuring that workforce competencies match the needs of emerging clean energy industries.
Ministry of Industry	The Industrial Human Resources Development Agency develops industry-specific certifications for energy-efficient processes and renewable energy applications. The Agency for Standardization and Industrial Services Policy ensures certification standards meet market demands for green manufacturing and energy technology production.	Aligns certification with industrial workforce needs, ensuring that training programs are tailored to industry demands and global sustainability standards.
Ministry of Manpower	Through the Directorate General of Vocational Training and Productivity Development, integrates certification pathways into vocational training at BLKs and other institutions. The Manpower Planning and Development Agency identifies high-priority regions and sectors for certified training programs.	Ensures that training programs produce skilled professionals with relevant certifications, improving workforce readiness for the energy transition.
Ministry of Primary and Secondary Education	The Directorate General of Vocational Education embeds certification pathways into SMK curricula, ensuring that graduates obtain both academic and industry-recognized credentials. The Agency for Standards, Curriculum, and Assessment ensures that certification standards are reflected in competency assessments.	Strengthens vocational education by aligning training programs with certification requirements, enhancing students' employability in the renewable energy sector.
Ministry of Higher Education, Science, and Technology	The Directorate General of Higher Education promotes certification readiness in university and polytechnic programs, encouraging collaboration with industries and accreditation bodies.	Encourages higher education institutions to integrate industry-recognized certifications, ensuring graduates are prepared for specialized roles in the energy transition.

Source: Authors' elaboration.

Improve Practical Training Infrastructure

204. Simultaneously, improving practical training infrastructure is essential. MEMR, particularly through BPSDM ESDM and the Renewable Energy and Energy Conservation Training Center (PPSDM EBTKE), can prioritize resource allocation for upgrading practical training infrastructure at BLKs and other centers. This includes investing in renewable energy equipment, simulation tools, and modernized facilities to provide hands-on learning opportunities. The Ministry of Industry, through the Agency for

Standardization and Industrial Services Policy, can guide the development of standards for training facilities to ensure consistency and quality across regions.

205. Local governments, through Regional Energy Offices and Regional Manpower Offices, can contribute by identifying region-specific training needs and collaborating with the central government to allocate resources effectively. For instance, regions with high renewable energy potential, such as geothermal or solar power, can prioritize investments in facilities aligned with those technologies. Bappenas can provide strategic oversight, ensuring that infrastructure investments align with long-term workforce development plans in the energy sector.

206. Table 25 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 25. Summary of recommended roles and responsibilities for different institutions for improving practical training infrastructure.

Institution	Roles and Responsibilities	Justification
MEMR	BPSDM ESDM and PPSDM EBTKE prioritize resource allocation for upgrading practical training infrastructure at BLKs and other centers. Investments focus on renewable energy equipment, simulation tools, and modernized facilities.	Ensures hands-on learning opportunities, equipping the workforce with practical skills needed for the energy transition.
Ministry of Industry	The Agency for Standardization and Industrial Services Policy develops standards for training facilities to ensure consistency and quality across regions.	Establishes national benchmarks for training centers, maintaining high-quality facilities for industry-aligned training.
Regional Governments (Regional Energy Offices & Regional Manpower Offices)	Identify region-specific training needs and collaborate with the central government to allocate resources effectively. Prioritize investments in facilities for renewable energy-rich regions like geothermal and solar power.	Ensures that training centers address local workforce demands and align with regional energy sector priorities.
Bappenas	Provides strategic oversight to ensure infrastructure investments align with long-term workforce development plans in the energy sector.	Guarantees that training infrastructure improvements support national economic and sustainability goals.

Source: Authors' elaboration.

Promote Instructor Training and Capacity Building

207. Enhancing instructor training and capacity building is also critical. It requires active involvement from international organizations and academia, facilitated by the coordinating body. BPSDM ESDM or Ditjen EBTKE can lead collaborations with international organizations, such as ILO, to bring global expertise to local trainers. These partnerships can include train-the-trainer programs, workshops, and certification for renewable energy-focused skills.

208. The Ministry of Primary and Secondary Education, through the Directorate General of Vocational Education, and the Ministry of Higher Education, Science and Technology, through the Directorate General of Higher Education, can also contribute by incorporating instructor capacity-building initiatives into national education policies. Universities and polytechnics can act as hubs for developing teaching resources, offering specialized programs for trainers in renewable energy technologies.

209. BNSP can ensure trainers meet standardized competency requirements, supporting the professionalization of instructors across training institutions. The Ministry of Manpower, through the Directorate General of Vocational Training and Productivity Development, can monitor and evaluate the impact of capacity-building programs, ensuring that instructors are equipped to deliver high-quality training that meets labor market demands.

210. Table 26 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 26. Summary of recommended roles and responsibilities for different institutions for promoting instructor training and capacity building.

Institution	Roles and Responsibilities	Justification
MEMR	BPSDM ESDM or Ditjen EBTKE leads collaborations with international organizations such as ILO to bring global expertise to local trainers. Implements train-the-trainer programs, workshops, and certification for renewable energy-focused skills.	Ensures instructors are equipped with globally recognized skills and methodologies to enhance workforce training effectiveness.
Ministry of Primary and Secondary Education	The Directorate General of Vocational Education incorporates instructor capacity-building initiatives into national education policies and ensures that SMKs provide adequate training for instructors in renewable energy programs.	Strengthens the capacity of vocational instructors to align SMK curricula with industry demands and energy transition needs.
Ministry of Higher Education, Science, and Technology	The Directorate General of Higher Education enables universities and polytechnics to act as hubs for developing teaching resources, offering specialized programs for trainers in renewable energy technologies.	Facilitates research-based training, ensuring that instructors receive advanced knowledge and best practices in renewable energy education.
BNSP	Ensures trainers meet standardized competency requirements and supports professionalization across training institutions.	Establishes national standards for instructor competencies, ensuring consistency in training quality.
Ministry of Manpower	The Directorate General of Vocational Training and Productivity Development monitors and evaluates the impact of capacity-building programs, ensuring that instructors are well-equipped to deliver high-quality training that meets labor market demands.	Provides oversight and quality assurance, ensuring training remains relevant to evolving workforce needs.

Source: Authors' elaboration.

Optimizing processes for the development of certification standards

211. A significant challenge in Indonesia's workforce development for the energy transition lies in the development of SKKNI for NRE and related sectors. Typically, SKKNIs are created based on requests from existing industries to address immediate workforce needs. However, the government has limited experience in proactively developing SKKNI for emerging and potential jobs in the energy transition. This reactive approach delays the establishment of comprehensive competency standards, leaving gaps in preparing the workforce for future demands. Additionally, the limited accreditation of training centers further restricts the availability of certified programs, reducing access to quality training aligned with global standards. Table 27 summarizes the recommendations to address this constraint.

Table 27. Recommendations to optimize processes for the development of certification standards.

Recommendation	Description
Enhance Certification Quality	Identifying potential job roles and skill requirements in renewable energy and ensuring that SKKNIs align with international benchmarks
Promote International Partnerships	Collaborations with organizations such as IRENA and ILO can provide expertise in forecasting future skill demands and creating forward-looking competency frameworks.

Source: Authors' elaboration.

Enhance Certification Quality

212. It is crucial to enhance certification quality to ensure that workforce competencies meet global standards and are aligned with the specific demands of the energy transition. BNSP plays a pivotal role in standardizing certification frameworks and ensuring they reflect the competencies outlined in the SKKNI.

213. MEMR, particularly through BPSDM ESDM, can oversee the development of renewable energy-specific certifications, ensuring they cover technical and operational roles in sectors like solar, wind, and geothermal energy. BPSDM ESDM can also provide guidance and technical support to training centers, ensuring that their programs align with certification requirements and meet accreditation standards.

214. The Ministry of Manpower, through the Directorate General of Vocational Training and Productivity Development, can ensure that vocational training institutions, including BLKs and SMKs, offer certified programs that meet the requirements of the SKKNI. This involves updating curricula and providing resources for trainers to deliver high-quality programs that produce job-ready graduates.

215. To further enhance certification quality, the Ministry of Primary and Secondary Education and the Ministry of Higher Education, Science, and Technology can integrate certification readiness into their respective education frameworks. The Directorate

General of Vocational Education can incorporate certification requirements into SMK programs, while the Directorate General of Higher Education can encourage universities and polytechnics to include certification pathways as part of their training offerings.

216. Finally, local governments (Regional Energy Offices and Regional Manpower Offices) can support the dissemination and adoption of certifications in their regions, ensuring that certified training programs are accessible to local communities. This includes identifying skill gaps in the local labor market and working with accredited training centers to address these gaps. By aligning certifications with national and regional priorities, Indonesia can build a highly skilled workforce capable of supporting the energy transition effectively.

217. Table 28 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 28. Summary of recommended roles and responsibilities for different institutions for enhancing certification quality.

Institution	Roles and Responsibilities	Justification
BNSP	Standardizes certification frameworks and ensures alignment with SKKNI competencies.	Establishes nationally recognized competency standards, ensuring workforce readiness for energy transition roles.
MEMR	BPSDM ESDM oversees the development of renewable energy-specific certifications for technical and operational roles in solar, wind, and geothermal sectors. Provides guidance and technical support to training centers.	Ensures training programs align with certification requirements and meet accreditation standards for energy transition workforce development.
Ministry of Manpower	The Directorate General of Vocational Training and Productivity Development ensures vocational training institutions (BLKs and SMKs) offer certified programs aligned with SKKNI. Updates curricula and provides training resources for instructors.	Strengthens workforce qualifications by ensuring vocational graduates meet certification standards required by the labor market.
Ministry of Primary and Secondary Education	The Directorate General of Vocational Education integrates certification requirements into SMK programs, ensuring students obtain both academic qualifications and industry-recognized certifications.	Enhances employability of vocational school graduates by embedding certification pathways into education programs.
Ministry of Higher Education, Science, and Technology	The Directorate General of Higher Education promotes certification readiness by encouraging universities and polytechnics to integrate certification pathways into academic training.	Ensures that graduates from higher education institutions are equipped with industry-relevant certifications for energy transition jobs.
Regional Governments	Regional Energy Offices and Regional Manpower Offices facilitate certification adoption by supporting accredited training centers and identifying local skill gaps.	Ensures equitable access to certified training programs across regions, addressing local labor market demands.

Source: Authors' elaboration.

Promote International Partnerships

218. Furthermore, Indonesia should promote international partnerships to adopt best practices in developing competency standards and certification frameworks. BNSP plays a central role in these efforts, not only by acting as the primary liaison between international organizations-such as IRENA and ILO-and domestic stakeholders but also by leveraging existing successful collaborations. Ongoing engagements with these organizations have already facilitated knowledge exchange and alignment with global standards, contributing to improvements in SKKNI and certification frameworks. By further strengthening these partnerships, BNSP can enhance its capacity to forecast skill demands and integrate internationally recognized best practices, similar to the success of India's Skill Council for Green Jobs.

219. MEMR, through BPSDM ESDM and Ditjen EBTKE, can leverage international expertise to develop renewable energy-specific competency standards. BPSDM ESDM can lead technical collaborations to adapt global frameworks for Indonesia's unique energy transition needs, ensuring the relevance and applicability of certifications. Ditjen EBTKE can focus on integrating international best practices into the development of certifications for solar, wind, and geothermal energy sectors, ensuring alignment with the demands of both domestic and international renewable energy markets.

220. The Ministry of Industry also plays a significant role in promoting these partnerships. Through the Industrial Human Resources Development Agency and the Agency for Standardization and Industrial Services Policy, the Ministry of Industry can foster collaborations with global organizations to develop certifications tailored to green manufacturing and renewable energy technology production. These efforts will ensure that industrial workforce competencies meet international standards, supporting Indonesia's integration into global green supply chains.

221. Finally, academic institutions and universities can also play a supporting role by engaging in joint research projects with international partners, contributing to the development of innovative training methodologies and certification frameworks. These collaborations can help integrate global advancements into Indonesia's workforce development system, ensuring that graduates are equipped with the skills needed for the energy transition.

222. Table 29 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 29. Summary of recommended roles and responsibilities for different institutions for promoting international partnerships.

Institution	Roles and Responsibilities	Justification
BNSP	Acts as the primary liaison between international organizations (IRENA, ILO) and domestic stakeholders to integrate	Strengthens certification systems by aligning them with international benchmarks, improving workforce

	global best practices into SKKNI and certification frameworks.	competitiveness in the global energy transition market.
MEMR	BPSDM ESDM leads technical collaborations to adapt global competency frameworks for Indonesia's energy transition needs. Ditjen EBTKE integrates international best practices into renewable energy certifications (solar, wind, geothermal).	Ensures that workforce training programs meet both domestic and international renewable energy sector requirements, increasing global employability.
Ministry of Industry	The Industrial Human Resources Development Agency and the Agency for Standardization and Industrial Services Policy facilitate collaborations with global organizations to develop industry-specific certifications for green manufacturing and renewable energy technology.	Ensures that industrial workforce competencies align with global standards, enabling Indonesia's integration into international green supply chains.
Academic Institutions & Universities	Engage in joint research projects with international partners to develop innovative training methodologies and certification frameworks.	Supports the integration of international knowledge into Indonesia's workforce development system, ensuring graduates are equipped for the energy transition.

Source: Authors' elaboration.

Increasing regional access and capacity

223. Regional Manpower Offices and Regional Energy Offices face significant challenges in delivering region-specific training programs necessary to prepare the workforce for the energy transition. These institutions often lack the capacity, resources, and technical expertise to implement effective localized workforce initiatives. Additionally, BLKs and UPTDs in many regions, which are responsible for implementing training at the local level, often operate with limited resources and coordination, further exacerbating these disparities. This gap disproportionately affects underserved areas, limiting equitable access to quality training programs. Table 30 summarizes the recommendations to address this constraint.

Table 30. Recommendations to increase regional access and capacity.

Recommendation	Description
Strengthen Regional Training Centers	Providing targeted funding and technical support to expand renewable energy programs, focus on equipping centers with modern equipment and tools, to enable hands-on learning.
Empower Local Institutions	Capacity-building initiatives, including technical training and operational support, are necessary to enhance their ability to deliver tailored programs that reflect regional labor market demands.

Source: Authors' elaboration.

Strengthen Regional Training Centers

224. Strengthen regional training centers can be facilitated by providing targeted funding and technical support to expand NRE programs. Regional governments should take the

lead role in driving this initiative, supported by key national institutions and stakeholders. By focusing on regional disparities and tailoring programs to local workforce needs, this approach can ensure that underserved and remote areas are not left behind in the energy transition.

225. Regional governments, particularly through Regional Energy Offices and Regional Manpower Offices, are best positioned to take the lead in identifying specific regional workforce demands, prioritizing skill development in areas with high renewable energy potential. Regional Energy Offices can assess local energy projects and infrastructure needs to guide the development of specialized training programs, ensuring alignment with renewable energy technologies such as solar, hydro, and geothermal energy. Regional Manpower Offices can analyze local labor market trends to determine workforce gaps and provide targeted recommendations for program development. Regional governments can also oversee the allocation of resources to training centers, such as BLKs and UPTDs, ensuring that funding is effectively utilized to upgrade facilities and acquire NRE equipment.

226. MEMR can play a supporting role by providing technical expertise and policy alignment. BPSDM ESDM can collaborate with regional governments to offer training modules and curricula tailored to the specific needs of each region, while Ditjen EBTKE can ensure that these programs are consistent with national renewable energy policies. MEMR can also provide technical support to Regional Energy Offices to strengthen their capacity for implementing and managing renewable energy training programs.

227. The Ministry of Manpower, through the Directorate General of Vocational Training and Productivity Development, can work closely with regional governments to ensure that BLKs and other training institutions under their supervision meet national accreditation standards. The Manpower Planning and Development Agency can assist by sharing labor market data to inform regional training strategies and by supporting the accreditation process for regional training centers. The Ministry of Manpower's collaboration with regional governments can also help ensure the effective delivery of certification programs aligned with SKKNI.

228. The Ministry of Industry can support regional governments by facilitating partnerships with local industries through the Industrial Human Resources Development Agency and the Agency for Standardization and Industrial Services Policy. These partnerships can ensure that training programs reflect the specific needs of green manufacturing and renewable energy technology industries operating in each region. The Ministry of Industry can also provide technical expertise to help regional training centers adopt industry-relevant standards and practices.

229. Table 31 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 31. Summary of recommended roles and responsibilities for different institutions for strengthening regional training centers.

Institution	Roles and Responsibilities	Justification
Regional Governments (Regional Energy Offices & Regional Manpower Offices)	Lead in identifying regional workforce demands, assessing local renewable energy potential, and overseeing the allocation of resources to training centers (BLKs, UPTDs). Ensure training programs align with local energy projects (solar, hydro, geothermal).	Regional governments are best positioned to tailor workforce development initiatives to local labor market conditions and ensure effective resource allocation for NRE training.
MEMR	BPSDM ESDM collaborates with regional governments to develop training modules tailored to local needs. Ditjen EBTKE ensures alignment with national renewable energy policies. Provides technical support to strengthen the capacity of Regional Energy Offices.	Ensures technical accuracy in workforce training, aligning regional programs with national energy transition goals.
Ministry of Manpower	The Directorate General of Vocational Training and Productivity Development works with regional governments to ensure that BLKs and UPTDs meet national accreditation standards. The Manpower Planning and Development Agency shares labor market data to inform training strategies and supports certification programs aligned with SKKNI.	Enhances standardization and quality control of regional training centers, ensuring certified workforce readiness for NRE sectors.
Ministry of Industry	The Industrial Human Resources Development Agency and the Agency for Standardization and Industrial Services Policy facilitate industry partnerships to align training programs with green manufacturing and NRE technology needs. Provides technical support for regional training centers to adopt industry-relevant standards.	Ensures that regional workforce training reflects real industry demands, increasing employability in green energy and manufacturing sectors.

Source: Authors' elaboration.

Empower Local Institutions

230. Additionally, efforts should focus on empowering local institutions, including Regional Manpower Offices, Regional Energy Offices, and Regional Technical Implementation Units, to implement localized workforce programs effectively. Building on existing initiatives—such as vocational schools specializing in renewable energy technology supported by Switzerland's State Secretariat for Economic Affairs (SECO) and other partners—can provide a strong foundation for regional capacity-building. To empower local institutions, the inclusion of the Ministry of Home Affairs is critical in ensuring effective coordination and governance at the regional level.

231. The Ministry of Home Affairs, through its Directorate General of Regional Development, should ensure that regional governments integrate workforce development initiatives into their development plans. Drawing from successful programs, the Ministry can provide guidelines and policy frameworks that mandate the inclusion of energy

transition-related training and capacity-building programs in regional development strategies. By aligning regional plans with national priorities, the Ministry of Home Affairs can ensure that local governments prioritize the development of NRE competencies and workforce readiness as part of their overall development agenda. Furthermore, the Ministry of Home Affairs can facilitate budget allocations to support Regional Manpower Offices and Regional Energy Offices, enabling them to expand existing programs and scale up localized workforce initiatives effectively.

232. Regional Manpower Offices and Regional Energy Offices are critical to translating these mandates into action. Regional Manpower Offices can focus on assessing regional labor market needs, identifying skills gaps, and designing programs that prepare the local workforce for renewable energy jobs. Regional Energy Offices can leverage existing programs to create targeted training programs for sectors such as solar, wind, and geothermal energy. Regional Technical Implementation Units can operationalize these programs at the community level, delivering practical, hands-on training that equips local workers with industry-relevant skills.

233. MEMR can support local initiatives by providing technical expertise and policy alignment. Through BPSDM ESDM, MEMR can develop standardized training materials and share knowledge on renewable energy technologies with regional institutions. Ditjen EBTKE can further ensure that local programs align with national energy transition policies and standards, enhancing their relevance and impact.

234. The Ministry of Manpower, through the Manpower Planning and Development Agency, can supply labor market data to help regions identify high-priority sectors for workforce development. The Directorate General of Vocational Training and Productivity Development can work with Regional Manpower Offices to ensure that regional training centers, such as BLKs, meet accreditation standards and deliver programs aligned with SKKNI for NRE jobs.

235. The Ministry of Industry can collaborate with regional governments through the Industrial Human Resources Development Agency and the Agency for Standardization and Industrial Services Policy. By fostering partnerships with local industries and leveraging expertise from existing training initiatives, such as renewable energy-focused vocational schools, the Ministry can align training programs with the demands of green manufacturing and renewable energy technology production. The Ministry of Industry's expertise ensures that local training efforts remain consistent with industry needs and standards.

236. The Ministry of Home Affairs, in collaboration with MEMR, the Ministry of Manpower, and regional governments, can facilitate partnerships with international organizations like ILO and IRENA. These collaborations can bring global expertise and resources to support local workforce initiatives, strengthening and scaling up existing programs. By integrating successful models like SECO-supported vocational schools into broader

international knowledge-sharing platforms, Indonesia can ensure that regional training programs remain informed by global best practices and innovative methodologies.

237. Table 32 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 32. Summary of recommended roles and responsibilities for different institutions for empowering local institutions.

Institution	Roles and Responsibilities	Justification
Ministry of Home Affairs	Integrates workforce initiatives into regional development plans, allocates funding, and facilitates international partnerships.	Strengthens governance, ensures alignment with national priorities, and secures sustainable funding.
Regional Governments (Regional Energy & Manpower Offices)	Leads local workforce planning, identifies skill gaps, and develops regional NRE training programs.	Tailors workforce development to local energy projects and labor market needs.
MEMR (BPSDM ESDM & Ditjen EBTKE)	Provides technical guidance, standardizes training materials, and ensures alignment with NRE policies.	Enhances regional workforce capacity through expertise and standardized curricula.
Ministry of Manpower	Supplies labor market data, accredits BLKs, and aligns vocational training with SKKNI for NRE jobs.	Supports data-driven workforce planning and ensures national certification standards.
Ministry of Industry	Aligns regional training with industry needs, facilitates local partnerships, and supports green manufacturing workforce.	Ensures practical, industry-relevant training for NRE technology and green industries.
Regional Technical Implementation Units (UPTDs)	Implements hands-on training and collaborates with industries and vocational schools.	Provides accessible, community-based training aligned with regional demands.
International Organizations (ILO, IRENA, SECO, etc.)	Provides technical expertise, funding, and best practices for scaling regional workforce initiatives.	Enhances global competitiveness and adapts international models for local use.

Source: Authors' elaboration.

Integrating inclusivity into long-term workforce planning

238. Another challenge in Indonesia's workforce development strategies for the energy transition is the insufficient integration of equity considerations. While long-term plans often emphasize the development of technical expertise, they frequently overlook critical dimensions such as gender equality, regional access, social inclusion, and support for people with disabilities. Additionally, current workforce policies lack robust mechanisms to ensure equitable representation across demographics, leaving significant gaps in inclusivity and access to opportunities. Table 33 summarizes the recommendations to address this constraint.

Table 33. Recommendations to integrate inclusivity into long-term workforce planning.

Recommendation	Description
Integrate Equity into Workforce Roadmaps	Embedding gender equality, regional access, social inclusion, and support for people with disabilities as core components of workforce planning.
Adopt Lifelong Learning Models	Modular and flexible training pathways play a vital role by allowing learners to progress through training programs in smaller, manageable units or modules. This will accommodate diverse needs, enabling learners to balance education with other commitments, such as work or family responsibilities.

Source: Authors' elaboration.

Integrate Equity into Workforce Roadmaps

239. Integrating equity into workforce roadmaps involves embedding gender equality, regional access, social inclusion, and support for people with disabilities as core components of workforce planning. By developing monitoring and evaluation frameworks to assess the socio-economic impacts of workforce programs, disparities can be addressed, and inclusivity can be promoted, resulting in more equitable outcomes. The Ministry of Women Empowerment and Child Protection is central to ensuring that gender equality is embedded in workforce policies. This ministry can provide guidance on creating gender-sensitive training programs and policies that address barriers faced by women in entering and succeeding in renewable energy jobs. The ministry can also collaborate with other institutions to design monitoring frameworks that track the participation and progression of women in workforce programs. Additionally, the Ministry of Women Empowerment and Child Protection can work with local governments to implement initiatives that support women in underserved and rural areas.

240. The Ministry of Social Affairs can lead efforts to ensure workforce programs are inclusive of people with disabilities and marginalized communities. Through targeted interventions, the Ministry of Social Affairs can support the development of accessible training centers and provide resources for trainers to accommodate diverse learning needs. The ministry can also help design socio-economic monitoring frameworks to evaluate how workforce programs impact vulnerable groups and ensure that their needs are met. Collaboration with local governments and NGOs can further amplify the reach of these initiatives.

241. Local governments, through Regional Manpower Offices and Regional Energy Offices, play a crucial role in ensuring that workforce initiatives address regional disparities. These institutions can identify specific needs in their communities, such as skill gaps or accessibility issues, and tailor programs to meet these challenges. Regional governments can also collaborate with local NGOs and training centers to implement inclusive workforce policies that reflect the unique socio-economic conditions of their

regions. By prioritizing regional access, local governments ensure that underserved and remote areas are included in workforce development initiatives.

242. NGOs can act as intermediaries to ensure that workforce programs are inclusive and equitable. They can advocate for the inclusion of gender equality, social inclusion, and disability rights in workforce policies, as well as provide direct support for program implementation. NGOs can also contribute to monitoring and evaluation efforts by collecting on-the-ground data on the socio-economic impacts of workforce programs, offering valuable insights for policymakers.

243. Table 34 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 34. Summary of recommended roles and responsibilities for different institutions for integrating equity into workforce roadmaps.

Institution	Roles and Responsibilities	Justification
Ministry of Women Empowerment and Child Protection	Ensures gender equality in workforce policies, develops gender-sensitive training programs, and tracks women's participation in renewable energy jobs.	Addresses gender disparities and ensures equitable access to workforce opportunities.
Ministry of Social Affairs	Supports inclusion of people with disabilities and marginalized communities, ensures accessibility in training centers, and develops socio-economic monitoring frameworks.	Enhances workforce inclusivity by removing barriers for underrepresented groups.
Local Governments (Regional Manpower Offices, Regional Energy Offices)	Identifies regional workforce disparities, implements inclusive policies, and collaborates with NGOs and training providers to expand accessibility.	Ensures localized solutions to address workforce inequalities and regional disparities.
NGOs	Advocates for gender equality, social inclusion, and disability rights in workforce programs, provides implementation support, and contributes to monitoring and evaluation.	Strengthens workforce inclusivity through grassroots advocacy and targeted interventions.

Source: Authors' elaboration.

Adopt Lifelong Learning Models

244. Additionally, adopting lifelong learning models is crucial to creating an adaptable workforce that meets the dynamic demands of the energy transition. Such models, inspired by Singapore's SkillsFuture Initiative, ensure continuous upskilling opportunities while accommodating various commitments and barriers faced by underrepresented groups. The Ministry of Primary and Secondary Education and the Ministry of Higher Education, Science, and Technology are pivotal in embedding lifelong learning principles into education systems. The Directorate General of Vocational Education under the Ministry of Primary and Secondary Education can redesign SMK curricula to include modular training pathways that enable students to gain renewable energy-specific competencies incrementally. These modules can be integrated with certification systems, allowing learners to return for further education as their career

paths evolve. Meanwhile, the Directorate General of Higher Education under the Ministry of Higher Education, Science and Technology can encourage universities and polytechnics to adopt flexible learning models, such as online courses, hybrid programs, and micro-credentials, aligned with industry needs. By partnering with training institutions and industries, these ministries can ensure that lifelong learning pathways remain relevant and accessible.

245. The Ministry of Manpower plays a crucial role in promoting lifelong learning through its BLKs and workforce development programs. The Directorate General of Vocational Training and Productivity Development can oversee the incorporation of modular training pathways into BLK programs, ensuring that training modules align with SKKNI and industry requirements. Flexible delivery formats, such as evening classes or online programs, can be implemented to accommodate working adults and those with family responsibilities. The Manpower Planning and Development Agency can conduct labor market analyses to identify emerging skills demands and inform the development of targeted lifelong learning programs. These programs should prioritize inclusivity by addressing barriers faced by women, rural communities, economically disadvantaged individuals, and people with disabilities.

246. The Ministry of Social Affairs ensures that lifelong learning initiatives are inclusive of individuals with disabilities and economically disadvantaged groups. The Ministry of Social Affairs can provide guidance on designing accessible training facilities, adaptive technologies, and tailored curricula to accommodate diverse learner needs. Additionally, the Ministry of Social Affairs can support the development of targeted outreach programs to engage underrepresented groups, ensuring their equitable participation in lifelong learning pathways.

247. Regional Manpower Offices, Regional Energy Offices, and Regional Technical Implementation Units are instrumental in implementing lifelong learning models at the regional level. Regional governments can adapt modular training pathways to reflect local workforce needs, prioritizing renewable energy sectors with significant potential, such as solar, wind, and geothermal energy. By collaborating with national ministries and local industries, these institutions can ensure that lifelong learning programs are both accessible and aligned with regional labor market demands.

248. Table 35 summarizes specific roles and responsibilities for different institutions for this recommendation.

Table 35. Summary of recommended roles and responsibilities for different institutions for adopting lifelong learning models.

Institution	Roles and Responsibilities	Justification
Ministry of Primary and Secondary Education	Embeds lifelong learning principles into SMK curricula through modular training pathways and certification integration.	Enables students to gain renewable energy-specific competencies progressively.

Ministry of Higher Education, Science, and Technology	Encourages universities and polytechnics to adopt flexible learning models, such as online courses, hybrid programs, and micro-credentials.	Ensures accessibility and continuous upskilling opportunities for students and professionals.
Ministry of Manpower	Oversees modular training pathways in BLKs, aligns programs with SKKNI, and ensures flexible learning options for working adults and disadvantaged groups.	Supports workforce adaptability to evolving energy transition demands.
Ministry of Social Affairs	Develops inclusive training policies, supports accessible learning facilities, and provides outreach programs for marginalized communities.	Ensures equitable participation of individuals with disabilities and economically disadvantaged groups.
Regional Manpower Offices, Regional Energy Offices, and Regional Technical Implementation Units	Implements modular training at the regional level, tailoring programs to local workforce needs in renewable energy sectors.	Ensures workforce training is relevant to regional labor market demands and energy potential.

Source: Authors' elaboration.

Conclusion

249. Indonesia's energy transition offers significant opportunities for workforce transformation but also presents substantial challenges that require urgent attention. Key issues include critical gaps in institutional coordination, underdeveloped workforce data systems, and varying training quality. These challenges are further exacerbated by fragmented efforts across ministries, local governments, and industry stakeholders. Moreover, limited technical expertise, reactive frameworks like SKKNI, and inadequate consideration of equity and regional disparities hinder Indonesia's ability to meet the demands of a green economy effectively.

250. Survey findings reveal that stakeholders prioritize technical expertise (35%) and strong industry networks (35%) as the most critical criteria for reliable training centers, while factors such as training infrastructure (10%) and market-driven programs (20%) play secondary roles. Notably, inclusivity and accessibility were deprioritized, underscoring the need for greater emphasis on equitable workforce development. Additionally, quality assessments of training centers indicate that In-House Corporate Training Centers and Internal Ministry Training Centers received the highest ratings at 3.1 (on a scale of 1–5), reflecting moderate satisfaction but also the need for systemic improvements across all types of training centers. These findings emphasize the importance of enhancing specialization, fostering public-private partnerships, and addressing regional disparities.

251. To address these challenges, a robust and integrated approach is essential. Strengthening institutional collaboration, establishing centralized data systems, and implementing targeted capacity-building initiatives are foundational steps. The creation of a central coordinating body, such as Bappenas or MEMR, is pivotal for harmonizing efforts, aligning policies, and ensuring cross-sectoral coordination. This body would serve as a hub for strategic oversight, enabling ministries, local governments, and industries to align workforce initiatives with national energy transition goals while avoiding duplication of efforts.

252. Additionally, developing an Integrated Labor Market Information System (LMIS) tailored to energy transition needs is critical for informed workforce planning. This system would consolidate labor market data, identify emerging skills needs, and guide curriculum updates and training programs. Ministries like the Ministry of Manpower, MEMR, and the Ministry of Industry can take the lead, with regional governments and private industries contributing localized and sector-specific insights. By integrating data-driven strategies, Indonesia can ensure that workforce initiatives remain responsive to evolving market demands.

253. Strengthening vocational and training centers, such as BLKs, Regional Technical Implementation Units, and SMKs, is another key priority. Investments in modern infrastructure, renewable energy equipment, and instructor training will enhance the capacity of these institutions to deliver high-quality, industry-relevant programs.

Institutions like BPSDM ESDM, the Ministry of Industry's Industrial Human Resources Development Agency, and the Ministry of Primary and Secondary Education's Directorate General of Vocational Education are critical in aligning training with market needs and regional labor demands. These efforts must be complemented by enhanced certification standards, with BNSP playing a central role in aligning competency frameworks with global benchmarks to ensure international competitiveness.

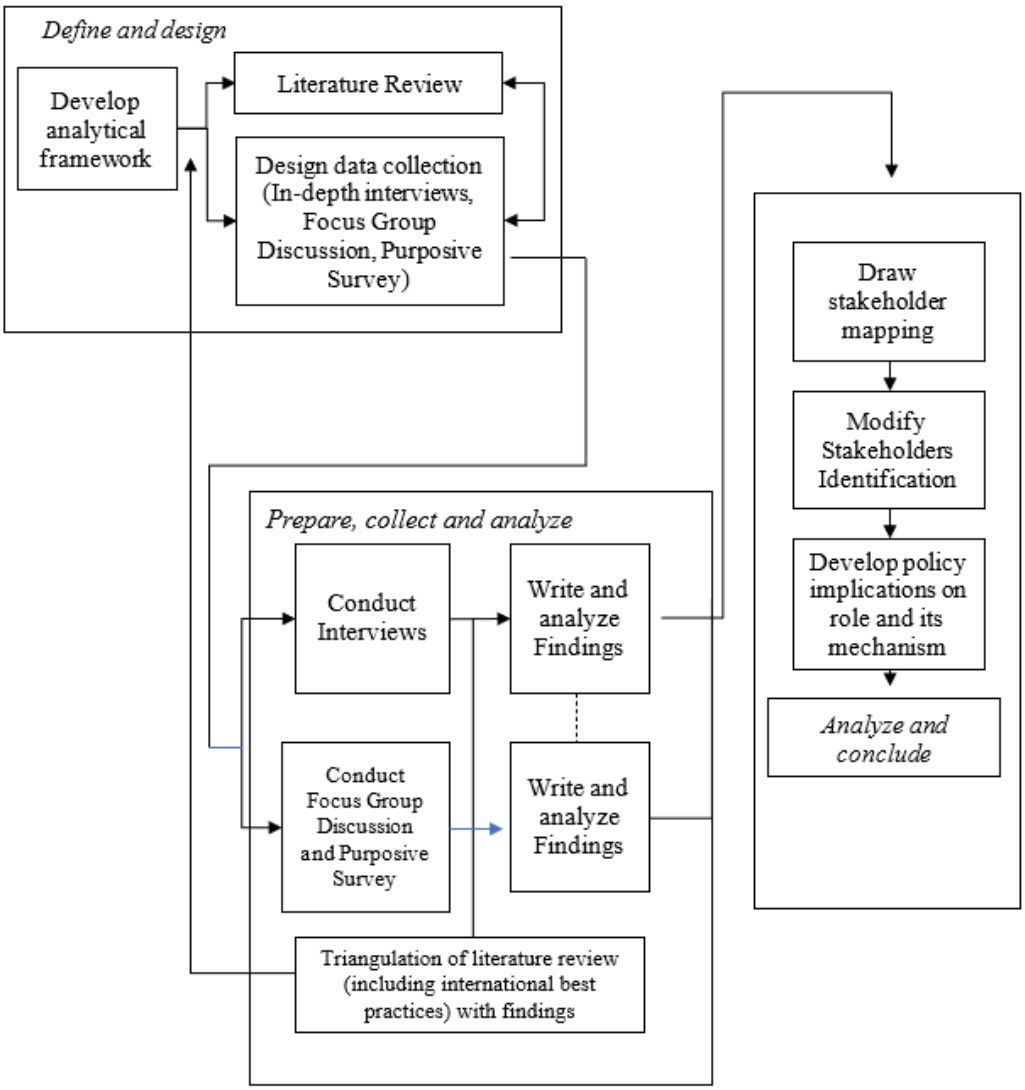
254. Regional governments, through Regional Manpower Offices, Regional Energy Offices, and Regional Technical Implementation Units, are uniquely positioned to address local workforce needs. They can prioritize renewable energy sectors with significant regional potential, such as solar, wind, and geothermal energy. The Ministry of Home Affairs can facilitate integration of workforce initiatives into regional development plans, ensuring alignment with national energy transition priorities. This localized approach will help bridge regional disparities and expand access to training in underserved areas.

255. Inclusivity must be embedded in workforce strategies to ensure equitable access to opportunities. The Ministry Of Women Empowerment and Child Protection, the Ministry of Social Affairs, and regional governments can champion initiatives that prioritize gender equality, support for people with disabilities, and access for underserved communities. Modular and flexible learning pathways, supported by the Ministry of Primary and Secondary Education; the Ministry of Higher Education, Science, and Technology; and the Ministry of Manpower, can provide continuous upskilling opportunities while accommodating diverse learner needs.

256. By implementing these measures and drawing on international best practices, Indonesia can develop a resilient, skilled workforce and establish itself as a leader in the global transition to renewable energy. The integration of equity, inclusivity, and regional considerations into workforce strategies will not only address current challenges but also ensure long-term sustainability and socio-economic benefits. A coordinated, data-driven, and inclusive approach is key to unlocking the full potential of Indonesia's workforce in supporting the energy transition.

Appendix I. Methodology Design

Figure A1. 1. Design of study methodology.



Source: Authors' elaboration.

Appendix II. List of Stakeholders and Interviewees

Table A2. 1. List of Stakeholders and Interviewees.

Stakeholder Clusters	Institution	Interviewees
Independent Body	National Professional Certification Agency (*Badan Nasional Sertifikasi Profesi*, BNSP)	1. Vice of Chairman on Energy Sectors 2. Government Officer
Ministries	Center for Human Resource Development in Electricity, New and Renewable Energy, and Energy Conservation, Ministry of Energy and Mineral Resources (Pusat Pengembangan Sumber Daya Manusia Ketenagalistrikan, Energi Baru, Terbarukan, dan Konservasi Energi, Kementerian Energi dan Sumber Daya Mineral)	1. Head of Center, Echelon II 2. Head of Unit, Government officer (female)
	Green Industry Center (Pusat Industri Hijau), Ministry of Industry (Kementerian Perindustrian)	1. Head of Unit, Government officer (female) 2. Government officer (female) 3. Government officer (female) 4. Government officer
	Director of Employment (Direktur Ketenagakerjaan), National Development Planning Agency (Badan Perencanaan Pembangunan Nasional)	1. Director, Echelon II (female) 2. Government officer (female) 3. Government officer (female) 4. Government officer 5.
	Energy and Mineral Resources Human Resources Development Agency, Ministry of Energy and Mineral Resources (Badan Pengembangan Sumber Daya Manusia, Kementerian Energi dan Sumber Daya Mineral)	1. Senior Government Officer 2. Senior Government officer 3. Senior Government officer 4. Technical Government Officer 5. Technical Government Officer
	Manpower Planning and Development Agency, Ministry of Manpower (Badan Perencanaan dan Pengembangan Ketenagakerjaan, Kementerian Ketenagakerjaan)	1. Head of Unit, Government Officer 2. Government officer (female)

Source: Authors' elaboration.

Appendix III. List of Stakeholders and Participants for Focus Group Discussion

Table A3. 1. List of Stakeholders and Participants for Focus Group Discussion.

Stakeholder Clusters	Institution	Participants	Talking Points
Government	Center for Human Resource Development in Electricity, New and Renewable Energy, and Energy Conservation, Ministry of Energy and Mineral Resources	1. Head of Unit (female) 2. Government Officer (female)	1. Provide insights on existing policies, regulations, and frameworks related to the discussion topic 2. Government priorities and strategic plans.
Non-Governmental Organizations	Labour Union Coalition on Climate Change and Just Transition Issues	1. Head of Union (female) 2. Senior representative (female) 3. Senior representative	1. Advocate for workers' rights in the context of transitioning to renewable energy and low-carbon industries. 2. Represent labor perspectives in policy discussions on just transition strategies.
	Renewable Energy Starts Up	1. Director of Starts Up	1. Partner with labor unions to align workforce needs with skills training. 2. Serve as incubators for scalable, sustainable energy solutions. 3.
	Indonesia Renewable Energy Society	1. Head of Committee	1. Promote public understanding of renewable energy. 2. Highlight best practices and case studies from Indonesia and abroad.
Private Sectors	Indonesian Chamber of Commerce and Industry	1. Chairman of the Standing Committee on New and Renewable Energy 2. Senior Member of Indonesian Chamber of Commerce and Industry.	1. Identify workforce needs in renewable energy and green industries to align training programs with market demands. 2. Advocate for vocational training programs that equip workers with the skills required for emerging green jobs.

	Institution of Engineers Indonesia	1. Board Members of the Institution of Engineers Indonesia	1. Partner with universities to integrate renewable energy and sustainability topics into engineering curricula. 2. Partner with universities to integrate renewable energy and sustainability topics into engineering curricula.
Universities/ Schools	Swiss German University	1. Senior Lecturer (female) 2. Lecturer (female) 3. Lecturer (female)	1. Strengthen collaboration with universities, technical colleges, and vocational training centers to develop renewable energy curricula. 2. Propose initiatives to enhance workforce readiness, such as certifications, scholarships, and public-private partnerships. 3. Discuss barriers for meeting the requirements of workers in renewable energy sectors.
	SMK N 1 Jakarta	1. Teacher (female) 2. School Officer (female)	

Source: Authors' elaboration.