SPECIALIZED WORKFORCE FOR INDONESIA'S TRANSITION (SWIFT) ROADMAP 2025 - 2060

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Prepared by:

Specialized Workforce for Indonesia's Future Transition (SWIFT) Roadmap 2025-2060

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List of Abbreviations

AI	Artificial Intelligence
AR/VR	Augmented Reality/Virtual Reality
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
CCS	Carbon Capture and Storage
CFPP	Coal-Fired Power Plant
CSO	Civil Society Organization
EE	Energy Efficiency
ETP	Energy Transition Partnership
GHG	Greenhouse Gases
GW	Gigawatts
ILO	International Labour Organization
IoT	Internet of Things
IRENA	International Renewable Energy Agency
JETP	Just Energy Transition Partnership

KEN	*Kebijakan Energi Nasional*/National Energy Plan
KKNI	*Kerangka Kualifikasi Nasional Indonesia*/Indonesian National Qualification Framework
LMIS	Labor Market Intelligence System
LTS-LCCR	Long-Term Strategy for Low Carbon and Climate Resilience
NDC	Nationally Determined Contributions
NGO	Non-Governmental Organization
NGSC	National Green Skills Council
NZE	Net Zero Emissions
OECD	Organisation for Economic Co-operation and Development
PLN	*Perusahaan Listrik Negara*/State Electricity Company
PV	Photovoltaics
RE	Renewable Energy
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 Supply Business Plan
SATGAS TEH	*Satuan Tugas Transisi Energi dan Ekonomi Hijau/*National Task Force on Energy Transition
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
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change

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.

The SWIFT National Roadmap has been developed based on the findings of a study on institutional roles and governance mechanisms responsible for workforce development within Indonesia's energy sector. With the existence of this SWIFT national roadmap, it is expected that the Indonesian government—particularly institutions tasked with human resource management—can better prepare the workforce to adapt to the energy transition. This roadmap includes implementation periods covering the short term (2025–2030), the medium term (2031–2045), and the long term (2046–2060), which can help identify recommended activities based on their urgency. Through an effective workforce roadmap, the country stands a better chance of realizing workforce development processes that support Indonesia's energy transition.

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.

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

Executive Summary

The Specialized Workforce for Indonesia's Future Transition (SWIFT) Roadmap 2025-2060 serves as guidance for relevant stakeholders from both the public and private spheres towards developing a specialized workforce that can support the country's energy transition, particularly in the renewable energy and energy efficiency sectors. It takes into consideration Indonesia's net-zero objective by 2060 and the activities it is looking to pursue as laid out in various strategy documents, including its most recent Nationally Determined Contributions (NDC) and National Electricity Plan 2025-2060 (*Rencana Umum Ketenagalistrikan Nasional, RUKN 2025-2060*).

With recommendations defined with a time frame during which they are envisioned to be implemented, the SWIFT Roadmap 2025-2060 aims to supply relevant stakeholders with clear actions to be pursued.

Strategic Framework for Workforce Development

The vision of this national roadmap is to realize inclusive workforce development and build a skilled workforce to power Indonesia's transition to clean energy.

The national roadmap is underpinned by six key pillars that encapsulate the activities needed to be realized to reach the vision for workforce development in Indonesia's transforming energy sector (Figure ES 1).

Figure ES 1. The six key pillars of the Specialized Workforce for Indonesia's Future Transition (SWIFT) Roadmap 2025-2060
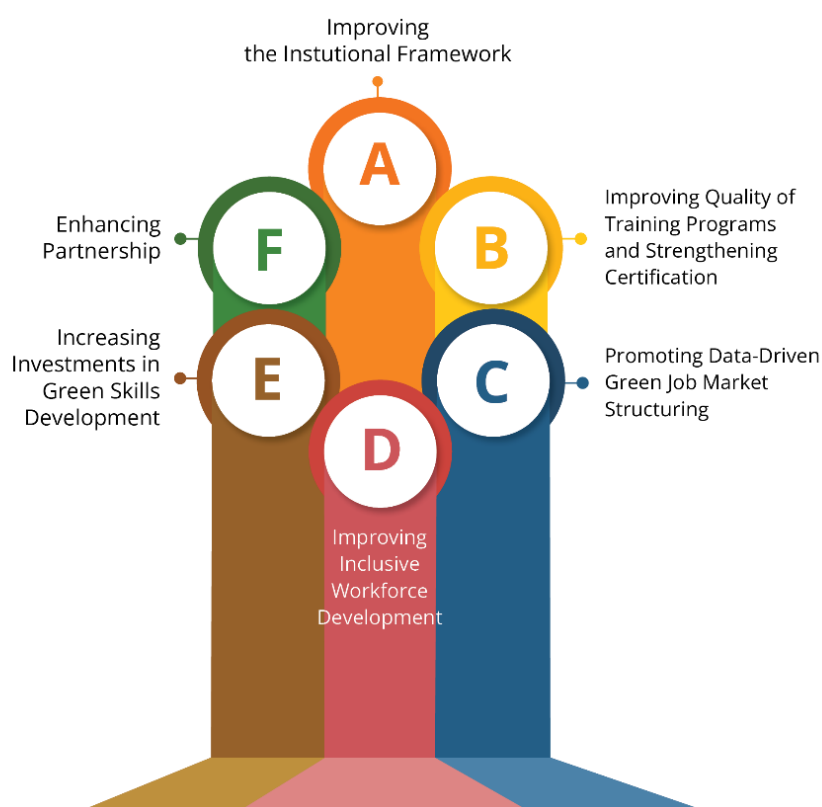
Workforce Projection

By 2060, around 1.26 million jobs are expected to be created in construction and installation (C&I) and operation and maintenance (O&M) activities in the power generation sector as part of the transformation outlined in the RUKN 2025-2060.

Table ES 1 provides a breakdown of job creation in three periods considered in the roadmap: short-term (2026-2030), medium-term (2031-2045), and long-term (2046-2060).

Table ES 1. Number of jobs created in C&I and O&M activities in the power generation sector in each period.

Period	Number of jobs
2026 – 2030	238,000
2031 – 2045	517,000
2046 - 2060	505,000

Job creation will not be uniform across the years, with some years experiencing more accelerated job creation than others. In general, between 2025 and 2050, job growth is expected to accelerate, reaching notable peaks between 2046 and 2050. The technologies where job creation is expected to be the greatest are solar, carbon

capture and storage (CCS) in coal-fired power plants (CFPPs), and hydro, contributing to more than half of the expected job growth by 2060.

Based on planned power generation capacity development in Indonesia's sub-national regions as outlined in the RUKN 2025-2060, projections for workforce demand at the sub-national level were also made (Table ES 2).

Table ES 2. Number of jobs created in C&I and O&M activities in the power generation sector in each sub-national region in Indonesia.

Region	Number of jobs created
Sumatra	234,000
Java and Bali	410,000
Kalimantan	208,000
Sulawesi	106,000
Maluku, Papua, and Nusa Tenggara	301,000

Job losses are expected to be minimal. Based on the RUKN 2025-2060, the phasedown of fossil fuel-fired power plants will be limited. Plans for retrofitting (mainly through CCS technologies) and the use of alternative fuels ensure that these facilities are maintained, avoiding significant job losses (approximately 7,700 by 2060). Instead, retrofitting activities, i.e., the installation of CCS in both coal- and gas-fired power plants, will lead to job creation.

In energy efficiency, a total of 3.53 million jobs are expected to be created by 2060, based on estimated investment needs in energy efficiency.[1] By 2060, about 119,000 jobs are expected to be created annually. Table ES 3 provides a breakdown of job creation in the short-, medium-, and long-term.

Table ES 3. Number of jobs created in the energy efficiency sector in each period.

Period	Number of jobs
2026 – 2030	445,000
2031 – 2045	1,365,000
2046 - 2060	1,720,000

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

Policy Recommendations for Workforce Development

The transformation of Indonesia's workforce to support a just and sustainable energy transition requires a phased and adaptive approach. The roadmap outlines three implementation phases—short-term (2025–2030), medium-term (2031–2045), and long-term (2046–2060)—each with activities to respond to evolving labor market demands spurred by the country's energy transition.

Short-Term (2025–2030):

Focus on laying the institutional and regulatory foundation for green workforce development. Around 683,000 jobs are expected—238,000 in clean power and 445,000 in energy efficiency—driven by early coal retirement, EV growth, and renewable deployment. Key actions include formalizing a coordinating body, launching a national labor market information system (LMIS), updating training standards, and piloting inclusive programs in transition regions.

Medium-Term (2031–2045):

This phase scales training systems and embeds green workforce planning into national and regional development strategies. With power capacity projected to reach 306 GW, job creation will total 1.88 million—517,000 in clean power and 1.37 million in energy efficiency. Priorities include decentralizing training infrastructure, institutionalizing lifelong learning systems, expanding LMIS use, and introducing equity-based skilling incentives.

Long-Term (2046–2060):

Indonesia aims to become a regional leader in green industrial skills and innovation. By 2060, with 443 GW of power capacity and a net-zero target, an additional 2.2 million jobs will be needed. The focus will shift to embedding green workforce mandates into national law, integrating advanced digital tools into training, and aligning workforce development with global climate and industrial goals.

1   Introduction

1. As the global community grapples with the urgent need to transition away from fossil fuels to sustainable energy sources, Indonesia stands at a pivotal juncture in its energy landscape. With its abundant natural resources, strategic geographic position, and a growing commitment to international climate agreements, Indonesia has the potential to become a leader in the renewable energy (RE) sector while also pursuing actions to improve energy efficiency (EE). However, this transition requires not only the adoption of new technologies but also the development of a robust and specialized workforce ecosystem that can effectively support this shift. To be successful, this transition must also be inclusive, addressing structural barriers that have historically limited women's participation in technical and leadership roles across the energy sector.

2. Implementing this vision will deliver transformative outcomes, including clear institutional leadership, streamlined governance, and improved coordination in green workforce planning. A highly skilled workforce, whose skills are aligned with industry needs and who are equipped with hands-on experience, will emerge, powering Indonesia's emerging sectors towards economic stability. At the same time, a highly skilled workforce has more opportunities to obtain decent employment in these emerging sectors, allowing more of the country's population to access the benefits of an energy transition. A gender-responsive workforce approach will ensure that women are not only beneficiaries of this transition but also active contributors and leaders within it.

3. The Specialized Workforce for Indonesia's Future Transition (SWIFT) Roadmap 2025-2060 serves as guidance for relevant stakeholders from both the public and private spheres towards developing a specialized workforce that can support the country's energy transition, particularly in the renewable energy and energy efficiency sectors. It takes into consideration Indonesia's net-zero objective and the activities it is looking to pursue as laid out in various strategy documents, including its Enhanced Nationally Determined Contributions (NDC) and National Electricity Plan 2025-2060 (*Rencana Umum Ketenagalistrikan Nasional,* RUKN 2025-2060*)*.

4. In addition to ensuring that Indonesia's workforce has the special skills for the country's transforming energy sector, this roadmap also aims to equip MEMR with guidance for ensuring that workforce development is inclusive. It is crucial for Indonesia's overall energy transition to leave no one behind, which includes making the benefits of the transition such as decent employment accessible to everyone. Thus, efforts should be made to increase the participation of groups that have often been underrepresented in the workforce, such as women. In this regard, the

roadmap also emphasizes the need to increase regional access to education and training, considering emerging energy sector activities throughout the country.

5. With recommendations defined with a time frame during which they are envisioned to be implemented, the SWIFT Roadmap 2025-2060 aims to supply relevant stakeholders with clear actions to be pursued. By embedding gender inclusion across all pillars of the roadmap, Indonesia can unlock the full potential of its human capital while advancing a just and equitable energy transition.

2 Strategic Framework for Workforce Development

2.1 Vision and Long-Term Objectives

6. The vision of this national roadmap is to realize inclusive workforce development and build a skilled workforce to power Indonesia's transition to clean energy.

2.2 Key Pillars

7. The national roadmap is underpinned by six key pillars that encapsulate the activities needed to be realized to reach the vision for workforce development in Indonesia's transforming energy sector (Figure 1). These key pillars were initially identified based on the findings of the *Review of Institutional Roles and Governance Mechanisms* and have since been further developed and refined by the project team to reflect additional analysis and stakeholder inputs.

Figure 1. The six key pillars of the national roadmap
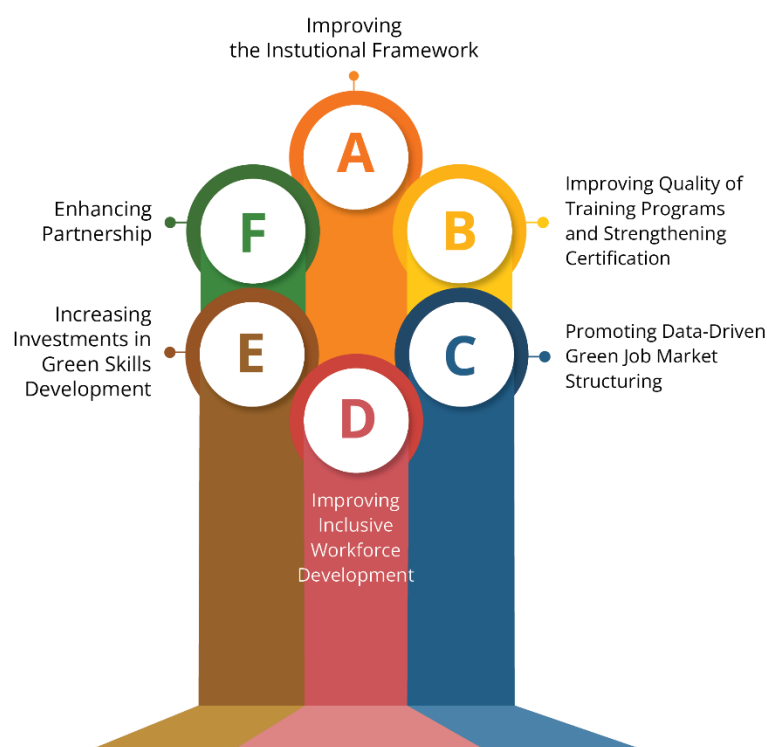
8. Placed in the center of the diagram, "Improving the Institutional Framework" is envisioned to be a critical pillar in Indonesia's efforts to advance workforce development in the energy sector. With a robust institutional framework and governance mechanism in place, activities in the surrounding five pillars, which involve the implementation of a range of policies, can lead to a more enduring transformation of Indonesia's workforce development landscape and, eventually, its transition to clean energy.

9. The six pillars are:

   a. **Improving the Institutional Framework.** The success of policy recommendations for specialized workforce development will rely on a framework of institutions with distinct but related roles and responsibilities. The coordination of these institutions can avoid inefficiencies, redundancy, and policy misalignment, leading to a more effective and enduring process for workforce development.

   b. **Improving Quality of Training Programs and Strengthening Certification.** This pillar ensures that Indonesia's workforce is equipped with globally competitive, industry-relevant skills through modernized training and robust certification. By aligning education with labor market needs and leveraging international partnerships, Indonesia can build a future-ready workforce for its energy transition.

   c. **Promoting Data-Driven Green Job Market Structuring.** This pillar lays the groundwork for a future-ready, adaptive labor force by anchoring workforce development in robust, real-time, and granular labor market intelligence. Through the establishment and institutionalization of a dynamic labor market information system (LMIS), Indonesia will be able to anticipate skill demands, reduce labor market mismatches, and foster inclusive and efficient human capital deployment across its vast archipelago. This system will not only guide national policy and education planning but also empower workers and employers to make informed decisions.

   d. **Promoting Inclusive Workforce Development.** Inclusive workforce development aims to increase access to groups that have not previously had substantial access to training programs and therefore relevant employment opportunities. This considers underrepresented groups such as women, as well as communities in more remote regions that historically have not been offered opportunities for education in training in the energy sector.

   e. **Increasing Investments in Green Skills Development.** The success of workforce development in the energy sector will need substantial, reliable, and inclusive investment in human capital. This pillar aims to build the financial infrastructure for Indonesia's just energy transition, emphasizing the importance of mobilizing both public and private finance for workforce development.

   f. **Enhancing Partnerships.** Strategic partnerships can serve as catalysts for the success of workforce development in the energy sector. With collaborations between government bodies, industry, academia, and international

organizations, Indonesia's workforce development strategy is market-driven, globally competitive, and scalable.

10. Recommendations provided in this roadmap will be framed around these six pillars.

2.3 Overall Timeline for Workforce Development

11. The transformation of Indonesia's workforce to support a just and sustainable energy transition requires a phased and adaptive approach. The roadmap outlines three implementation phases—short-term (2025–2030), medium-term (2031–2045), and long-term (2046–2060)—each with activities to respond to evolving labor market demands spurred by the country's energy transition.

12. This phased timeline is designed to:

- Build foundational institutions and systems early;

- Scale capacity and inclusivity during the growth phase of clean energy deployment;

- Institutionalize sustainability and global competitiveness in the long term

2.3.1 Short-Term (2025–2030)

13. This phase focuses on establishing the institutional, regulatory, and operational groundwork for Indonesia's workforce transformation. It aligns with the RUPTL 2021–2030, which targets over 50% of new capacity additions from renewable sources—an addition of around 18 GW of RE capacity by 2030, contributing to a total of 160 GW installed power capacity.

14. Job creation during this period is substantial, with an estimated 238,000 jobs in clean power (construction, installation, and O&M) and 445,000 jobs in energy efficiency, driven by early coal retirement, co-firing pilots, EV market development, and large-scale deployment of solar, hydro, and geothermal.

15. This stage is especially critical for preparing regions transitioning away from coal, ensuring early workforce reskilling and strengthening training systems. The period de-risks long-term investments and creates institutional readiness for the massive RE and EE expansion in the following phase.

16. **Key Priorities:**

- Formalize the central coordinating body for green workforce development and establish an inter-ministerial task force.

- Launch the national LMIS and begin integrating labor and education data systems.

5

- Update SKKNI standards for sectors not only in power generation but also in other energy sub-sectors, such as transmission and distribution.

- Modernize vocational training centers (BLKs, polytechnics) in high-priority transition provinces.

- Develop inclusive pilot programs targeting women, youth, and coal-transition regions.

- Initiate regional consultations and integrate workforce planning into local development strategies.

- Launch industry partnerships to align curricula with emerging labor needs.

2.3.2 Medium-Term (2031–2045)

17. This phase focuses on scaling up clean energy deployment and embedding workforce development into national and subnational plans. With Indonesia's power generation capacity projected to reach 306 GW by 2045, labor demand will rise sharply—517,000 new jobs in clean power and 1.37 million in energy efficiency are expected. Priorities include decentralizing training systems, aligning skills development with long-term planning (RPJMN, RPJPN), and expanding digital and inclusive learning pathways.

18. **Key Priorities:**

- Scale training programs and infrastructure across all provinces; ensure regional workforce planning units are fully operational.

- Institutionalize green skills and lifelong learning systems (e.g., modular certifications, stackable credentials).

- Fully integrate LMIS into national workforce and energy planning; use for forecasting, public funding allocation, and evidence-based policy design.

- Embed green workforce mandates into RPJMN, RPJMD, and RPJPN.

- Deepen inclusion efforts with a focus on gender parity, coal transition regions, and youth employment.

- Expand international partnerships for joint R&D, curriculum innovation, and recognition of certification.

- Launch national incentive schemes linking skilling outcomes to labor market absorption, performance, and equity metrics.

19. This period will define the resilience and fairness of Indonesia's energy transition and determine whether the green economy creates inclusive and sustainable job growth at scale.

2.3.3 Long-Term (2046–2060)

20. The long-term phase positions Indonesia's workforce system as a globally competitive, climate-resilient, and inclusive engine of green industrial transformation. By 2060, with a projected 443 GW of installed power capacity and net-zero emissions as the national target, the workforce must be equipped to operate advanced clean energy systems, produce exportable green technologies, and compete in global value chains.

21. Workforce projections estimate 505,000 new jobs in power generation construction, installation, and O&M, alongside 1,720,000 new jobs in energy efficiency sectors during this period, reflecting large-scale deployment and system maturity.

22. This period will focus on embedding the green workforce agenda into national law and ensuring that public investment, education, and employment systems continuously adapt to evolving technologies and climate objectives. Indonesia will aim to be a regional leader in renewable energy education, green industrial training, and innovation in workforce policy.

23. **Key Priorities:**

    - Fully institutionalize the coordinating body and legal mandates for green workforce development under national legislation.

    - Establish Indonesia as a regional hub for renewable energy education and certification through international Centers of Excellence.

    - Integrate AI, AR/VR, and IoT-enabled learning in technical and vocational education (TVET).

    - Maintain and evolve LMIS into a predictive, open-access intelligence platform for both domestic and global benchmarking.

    - Enshrine gender equity, regional balance, and inclusive employment as permanent criteria in education, labor, and infrastructure policy.

    - Link workforce development directly to Indonesia's broader green industrial strategy and international obligations under UNFCCC, JETP, and ASEAN frameworks.

24. By the end of this phase, Indonesia's green workforce should not only meet domestic energy and industrial needs but also drive innovation, export capacity, and regional leadership in sustainable development.

3   Indonesia's Energy Transition

25. Historically, Indonesia's energy mix has been largely reliant on fossil fuels. By 2023, only 13% of the mix was renewable energy,[2] increasing to only about 14% by 2024.[3] Similarly, the majority of installed capacity in the country's electricity generation system is generated through fossil fuels. On the other hand, renewable energy technologies are still largely neglected in the national energy infrastructure. Both the historical dependence on fossil resources and persistent structural, financial, or policy barriers that hinder development and integration of renewables in energy have contributed to this imbalance.

26. However, the energy transition in Indonesia is imminent. While Indonesia's energy industry remains reliant on established carbon-intensive energy systems, recent policies have communicated clear intentions by the government to pursue actions to transform the energy sector.

27. The Golden Indonesia 2045 Vision (*Visi Indonesia Emas 2045*), formulated in 2019 and sets the goal for the country to be a sovereign, advanced, fair and prosperous nation by 2045, includes a priority program centered around energy security. Among the policy directions outlined within this program are the development of new energy and the improvement of energy conservation regulations and institutions.[4] In support of this vision, the *Asta Cita* was formulated by President Prabowo Subianto to communicate eight national priorities, which includes the pursuit of energy independence.

28. Indonesia has also set its sights on pursuing pathways to net-zero emissions (NZE). In 2021, Indonesia released its Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR) 2050, which explores a pathway to achieving net-zero emissions by 2060 or sooner.[5] Indonesia's Second Nationally Determined Contributions (NDC), which is yet to be released, aims to align with the LTS-LCCR 2050. The Enhanced NDC, released in 2022, serves as a steppingstone towards the Second NDC. It has set a target of a 31.89% reduction in greenhouse (GHG) emissions compared to the business-as-usual scenario. With international financing support, Indonesia aims to further reduce GHG emissions by 43.20%.[6] Similarly, MEMR's roadmap for the energy

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[2] Government of Indonesia. Ministry of Energy and Mineral Resources. 2024. *Handbook of Energy and Economic Statistics of Indonesia*.

[3] Government of Indonesia. Ministry of Energy and Mineral Resources. 2024. *Panas Bumi jadi Andalan Capaian Bauran EBT Hingga Akhir 2024*. 17 December.

[4] Government of Indonesia. 2024. *Rancangan Akhir Rencana Pembangunan Jangka Panjang Nasional 2025-2045*.

[5] Government of Indonesia. 2021. *Long-Term Strategy for Low Carbon and Climate Resilience 2050*.

[6] Government of Indonesia. 2022. *Enhanced Nationally Determined Contribution*.

sector towards NZE by 2060[7] emphasizes 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.

29. Against this backdrop, several energy and electricity strategy documents have set concrete policy objectives for reducing the country's dependence on fossil fuels. Among these are targets for the higher penetration of *new and renewable energy* (NRE), which includes ammonia, hydrogen, nuclear, and waste heat ("new energy") and solar, wind, ocean, hydro, geothermal, and bioenergy ("renewable energy").[8] 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]

30. In terms of total capacity, the RUKN 2025-2060 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, most 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] The technologies considered in the RUKN 2025-2060 are summarized in Table 1:

Table 1. Technologies considered for power generation in the RUKN 2025-2060

NRE	Fossil fuel
Solar	Diesel
Ocean	Gas H2
Waste heat	Gas + CCS
Wind	Gas
Hydro	Ammonia
Nuclear	Coal + CCS + biomass cofiring
Geothermal	
Bioenergy	Coal
Storage	

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[7] IEA and Government of Indonesia. 2022. *An Energy Sector Roadmap to Net Zero Emissions in 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. 2025. *Rencana Umum Ketenagalistrikan Nasional*.

31. The formulation of recommendations in the SWIFT Roadmap 2025-2060 takes into consideration Indonesia's energy transition targets. Available data have informed the estimation of workforce needs in the renewable energy and energy efficiency sectors, providing more granular insights into the recommendations.

4 Workforce Development Policy Analysis

4.1 Policy and Regulatory Framework Analysis

32. A comprehensive understanding of the policy and regulatory landscape is essential to strengthen Indonesia's energy workforce development. This section explores the existing frameworks that govern labor, vocational education, and energy sector development, identifies critical gaps, and assesses the extent to which current policies support green job creation and workforce resilience.

4.1.1 Review of existing policies governing energy workforce development.

33. Indonesia has introduced a range of policies to support energy workforce development, including those targeting vocational education, labor market readiness, and renewable energy integration. Table 2 provides an overview of existing policies that govern energy workforce development, focusing on their effectiveness in addressing the current and future demands of the energy sector. It examines the alignment of these policies with national energy transition goals and their impact on skill development, inclusivity, and regional equity. The review highlights key strengths and areas for improvement to better support a sustainable and skilled energy workforce.

Table 2. List of relevant legal and policy framework.

No.	Policy document	Relevant arrangements for the green jobs workforce
1	Golden Indonesia 2045 Vision (*Visi Indonesia Emas 2045)*	One of Indonesia Vision 2045 aims to strengthen human resource competitiveness while reducing greenhouse gas emissions to achieve Net Zero emissions. Strategic priorities include fostering mid-to-high-skilled employment within productive sectors—particularly green, blue, and digital jobs—and accelerating demand-responsive vocational education and training through dual systems. Emphasis is also placed on re-skilling and up-skilling initiatives, soft skills integration, and the provision of reliable, accessible, and current labor market information.
2	Enhanced Nationally Determined Contribution (ENDC)	Indonesia acknowledges the critical role of a just workforce transition and the promotion of decent, high-quality employment in achieving an inclusive shift toward low-emission and climate-resilient development. Employment generation will align with the broader agenda of national prosperity. Key strategic efforts include: ● Addressing sectoral, regional, and urban challenges in adopting low-carbon pathways while safeguarding the rights and livelihoods of affected workers; ● Fostering sustainable, low-emission economic activities that support the creation of quality employment across regions;

No.	Policy document	Relevant arrangements for the green jobs workforce
		• Strengthening workforce capacity to ensure inclusive access to decent work, with particular attention to gender equity and intergenerational justice.
3	Long-Term Strategy for Low Carbon and Climate Resilience 2050	Central to this is a just transition framework that ensures decent work creation, addresses labor displacement, and upholds gender, intergenerational, and social justice. Key interventions are structured into two phases in line with the Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR), which supports Nationally Determined Contributions (NDC) implementation and future NDCs: Guides regional governments in integrating workforce development into regional energy planning. • Pre-2030 (2021–2030): Focuses on managing employment shifts in carbon-intensive sectors, strengthening vocational training and re-skilling programs, enhancing labor market information systems, and promoting green job creation across cities and regions. • Post-2030 (2031–2060): Emphasizes sustaining job quality, institutionalizing just transition principles into national policy, expanding green industries, and scaling up inclusive labor strategies.
4	National Long Term Development Plan 2025-2045 (*Rencana Pembangunan Jangka Panjang Nasional – RPJPN*)	Indonesia's energy transition strategy is phased and integrates gender inclusivity to ensure a just and equitable shift. The key strategies include just Energy Transition which focuses on mitigating socio-economic impacts by reskilling and upskilling workers, especially in coal-dependent regions, while creating new job pathways in clean energy for vulnerable groups, including women and youth. Phased Implementation: • Pre-2030 Phase (Short-Term): Lays foundations through energy audits, pilot projects, and gender-responsive vocational training. Regulatory frameworks are strengthened, and stakeholder engagement expanded. • 2030–2045 Phase (Medium- to Long-Term): Deploys low-emission technologies, retires fossil-fuel infrastructure, and scales green industries, institutionalizing women's participation through quotas, leadership training, and financial access.
5	National Medium Term Development Plan 2025-2029 (*Rencana Pembangunan Jangka Menengah Nasional – RPJMN)*	It emphasizes inclusive and quality education to support human capital and workforce readiness. Key activities include: • Accelerating access to 13 years of compulsory education (1 year preschool, 12 years basic–secondary; • Enhancing teaching quality through curriculum reform, teacher training, and digital pedagogy; • Strengthening educator management with competency-based development and performance incentives;

No.	Policy document	Relevant arrangements for the green jobs workforce
		• Improving education governance through transparency, accountability, and data-driven systems; • Promoting equitable access to quality tertiary education; • Development of STEAM (Science, Technology, Engineering, Arts, and Mathematics) curricula to align with future industry needs and foster creativity and innovation.
6	National Electricity General Plan (RUKN) 2025–2060	RUKN 2025–2060 emphasizes the importance of human resource readiness as part of the transformation of the power sector industry, including the impacts of digitalization and automation. The government highlights strategies such as link and match between vocational education and industry needs, strengthening competency standards through SKTTK aligned with the Indonesian National Qualification Framework (KKNI), and developing a certification information system to monitor and facilitate certified technical personnel across Indonesia.
7	Government Regulation No. 35/2021 (*PP No. 35/2021 tentang Perjanjian Kerja Waktu Tertentu, Alih Daya, Waktu Kerja, Waktu Istirahat, dan Pemutusan Hubungan Kerja*)	It outlines strategic labor protections aimed at improving workers' welfare, particularly for contract-based workers (PKWT). First, it mandates compensation rights for PKWT employees upon contract completion, calculated at one month's wage per year of service (Article 15). This addresses the previous absence of post-contract compensation. Second, it introduces flexibility and safeguards in working hours and rest periods to prevent labor exploitation (Articles 21–25). These provisions include maximum working hour limits and guaranteed rest rights.
8	Government Regulation No. 31/2006 on the National Job Training System (*PP No. 31/2006 tentang Sistem Pelatihan Kerja Nasional – Silatkernas*)	This regulation establishes a strategic framework to align workforce training with labor market demands (Article 2), aiming to enhance labor competency and adaptability amidst industrial transformation. It encourages private sector participation in organizing training programs and applies across all sectors, including green industry and energy transition. A key strategy involves adopting the Indonesian National Work Competency Standards (SKKNI) as the main reference for training design (Article 5), ensuring relevance and quality. Workers who complete training are eligible for nationally recognized competency certification.
9	Presidential Decree No. 68 of 2022 (*Revitalisasi Pendidikan dan Pelatihan Vokasi – TVET*)	This regulation outlines a strategic framework to enhance the quality of Indonesia's human resources (Article 2), emphasizing readiness to meet evolving industrial challenges, including those in the green energy and energy transition sectors. It fosters stronger alignment between education and industry through vocational education and training programs at secondary (*Sekolah Menengah Kejuruan*, *SMK*), polytechnic, and community academy levels, organized by both public and private institutions. Key revitalization strategies (Article 3) include industry-responsive curriculum adjustments, strengthening the capacity of educators and instructors, and expanding access to high-quality vocational programs.

No.	Policy document	Relevant arrangements for the green jobs workforce
10	National Occupation Map of Green Jobs within the framework of the Indonesian National Qualification Framework *(Peta Okupasi Nasional untuk Pekerjaan Hijau dalam Kerangka, KKNI)*	The *National Occupation Map of Green Jobs* within the KKNI framework outlines green jobs that support environmental sustainability and decent work. It integrates these roles into Indonesia's qualification system to guide curriculum development, certifications, and training. Focused on sectors like renewable energy, waste management, and sustainable agriculture, the map supports the government's goal of creating 15.3 million green jobs by 2045, preparing a skilled workforce for a sustainable economy.
11	Minister of Manpower Regulation Number 11 of 2013 (*Pedoman Implementasi Sistem Pelatihan Kerja Nasional di Daerah – Permenaker No. 11/2013*)	It provides guidelines for implementing the National Work Training System at the regional level. Its objective is to improve workforce competencies through structured and market-oriented training programs. Key strategies include: ● Integrated Planning – developing comprehensive training plans based on labor market needs; ● Stakeholder Collaboration – involving government, industry, training institutions, and communities to ensure relevance and quality; ● Standardization – applying the Indonesian National Work Competency Standards (SKKNI) in training programs; ● Monitoring and Evaluation – establishing mechanisms to assess training effectiveness and labor market absorption.
12	Minister of Manpower Decree No. 138/2019 (*Penetapan Standar Kompetensi Kerja Nasional Indonesia – SKKNI – di Bidang Energi Baru dan Terbarukan – Kepmenaker No. 138/2019*)	It establishes the Indonesian National Work Competency Standards (SKKNI) for the electricity, gas, steam/hot water, and air conditioning supply sectors, with a specific focus on the operation of new and renewable energy (NRE) power plants. The regulation aims to ensure a standardized framework for workforce competency in the energy transition sector. The SKKNI outlines qualifications for technical personnel involved in the operation of NRE facilities, encompassing solar, wind, hydro, bioenergy, and geothermal energy systems. It supports workforce readiness by aligning vocational training and certification processes with industry demands.

Source: Authors' elaboration.

4.1.2 Opportunities in labor market regulations, vocational education frameworks, and certification standards

34. Despite progress in policy formulation and contributions of different stakeholders outlined in the section, several regulatory and institutional gaps hinder effective energy workforce development. A previous study identified key opportunities for enhancing workforce development in Indonesia's energy sector.[11] The findings, which

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[11] Energy Transition Partnership. 2024. *Specialised Workforce for Indonesia's Future Transition in Energy (SWIFT): Review of institutional roles and governance mechanisms*.

are summarized in Table 3, were used in the development of recommendations captured in the national roadmap.

Table 3. Summary of opportunities for enhancing workforce development in Indonesia's energy sector.

Opportunity	Description
Improving institutional coordination	Cohesion among different institutional efforts can help optimize the effectiveness and impact of national development programs, including workforce development. Currently, ministries and agencies often operate in silos, guided by their individual mandates without sufficient coordination or integration, leading to overlapping programs and inconsistent policy implementation. Additionally, many relevant institutions have not been formally designated roles in supporting workforce development for the energy transition, underscoring the urgent need for a more cohesive, cross-sectoral governance structure.
Enhancing data systems for workforce planning	Proper workforce development planning in Indonesia depends heavily on reliable monitoring mechanisms and strong data systems to guide institutional strategies. However, the lack of accurate and comprehensive employment data impede evidence-based policymaking. Challenges include the use of outdated classification systems for National Labor Force Surveys (*Survei Angkatan Kerja Nasional, Sakernas)* and the Ministry of Manpower's lack of access to comprehensive, individual-level employment data, as there is no legal obligation for individuals or companies to report employment information to the ministry.
Improving the quality and capacity of training institutions	Despite increasing job opportunities in the energy sector, the current capacity of vocational and training institutions—particularly SMKs and BLKs—remains inadequate to meet the sector's growing demands. These institutions often fall short in preparing a workforce equipped with the technical and professional competencies required in the field. The alignment between vocational training programs and industry needs should be improved. Meanwhile, universities should be enabled with establishing flexible and specialized programs to meet energy transition demand.
Optimizing processes for the development of certification standards	While new SKKNI have been developed upon the request of stakeholders in relevant industries, this is often not accompanied by the establishment of an appropriate certification program. As a result, competency frameworks exist without accessible pathways for certification. Aligning SKKNI, KKNI, and workforce development programs with the energy transition agenda through a clear mechanism for coordination can help accelerate overall workforce development in the country.
Increasing regional access and capacity	The number of training centers in Indonesia is limited, with only 38 accredited by the MEMR Training Institution Accreditation Commission, posing challenges in ensuring the availability of training programs for renewable energy workforce development. Meeting the workforce demands of the energy transition will require the expansion and accreditation of more training centers.
Integrating inclusivity into long-term workforce planning	Gender disparities persist in Indonesia's energy sector, particularly in technical roles where women are underrepresented. Discriminatory practices in hiring processes, such as prioritizing male workers for technical positions, create barriers for women to enter and advance in the field. The energy transition should strive to capitalize on opportunities to empower women and address gender inequality, particularly in rural areas.

Source: Authors' elaboration.

5 Workforce Demand

35. Effective planning for workforce development requires an adequate understanding of the trajectory of the job market, including the types of jobs, how many, and where they are expected to be needed. Such information can inform policymaking in terms of the types of programs needed, the resources needed to develop them, and in which regions of the country they should be developed.

36. Among the different sub-sectors of Indonesia's energy sector, power generation is slated to undergo one of the most significant transformations. The uptake of NRE into the country's power generation mix until 2060 is expected to give way to the creation of jobs as infrastructure projects emerge and new NRE facilities are operated and maintained.

37. From the demand-side, efforts to lower energy demand by improving energy efficiency correspond to new activities that are expected to create jobs, e.g., the retrofit of existing buildings. As efforts ramp up, job creation is expected to rise concurrently.

38. This section provides a characterization of anticipated jobs in power generation, based on capacity projections provided in the RUKN 2025-2060,[12] as well as in energy efficiency, based on projected investments. These projections provide the year-on-year growth in the number of jobs up to 2060. For power generation, workforce demand for various technologies is also projected at the sub-national level. It should be noted that while power generation and energy efficiency have been selected for these workforce projections, mainly due to the availability of data, there are other sub-sectors within the energy sector, e.g., transmission and distribution, carbon auditing, and energy modeling, that should be considered for future projections to better inform planning activities.

39. Some limitations of the workforce projections should be noted. First, the figures generated for these projections are merely estimates. They are based on prevailing methodologies for calculating workforce needs for a given NRE technology. While workforce needs for certain technologies such as solar and wind have been greatly studied based on theoretical calculations and workforce compositions of actual entities operating in these industries, methodologies for more nascent technologies may not be as precise. Moreover, as industries and technologies evolve, the amount

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[12] The development of the SWIFT Roadmap 2025-2060 and the workforce projections were carried out prior to the release of the RUPTL (Electricity Supply Business Plan) 2025-2034. Data used for calculations of workforce demand in power generation were obtained solely from the RUKN 2025-2060, which was already publicly available at the time of the development of the roadmap. Estimates do not take into account any possible discrepancies between the two documents.

of human resources needed will likely change, necessitating new methodologies for calculating workforce projections.

40. In addition, coefficients used in workforce projections, e.g., employment factors specifying the number of jobs created for each MW of a certain technology added, were estimated in existing studies conducted in a country with a socio-economic context different from Indonesia's. Because labor productivity tends to vary depending on a country's GDP, using coefficients obtained in one country in another may lead to significant misestimations. Nevertheless, to the extent possible, adjustments were made in the calculations to consider the Indonesian context.

41. Lastly, as workforce projections in power generation are based on capacity projections for a given NRE technology as provided in RUKN 2025-2060, the actual deployment of NRE may vary in the time period of interest, thus leading to different workforce needs.

42. Nevertheless, while caution is offered in the consideration of the exact figures provided in the projections, the results of this exercise still aim to inform relevant decision-makers in Indonesia regarding the appropriate measures for workforce development. For example, calculations based on current methodologies and capacity projections indicate the likely boom in jobs in the construction and installation of solar PV facilities in Maluku, Papua, and Nusa Tenggara starting in 2041. Currently, relevant training programs in the region are scarce. While the exact number of jobs in construction and installation in the region by 2041 cannot be ascertained, current projections suggest the need for appropriate training in encompassed provinces for related activities.

43. Projections are also not meant to be static. As circumstances and information change, so should the projections. Despite current limitations, new information and data in the future can help increase the precision of future projection exercises. Methodologies for both mature and budding technologies can be updated. They can also be developed specifically for the Indonesian context. Capacity projections can also be updated with the release of subsequent RUKN and other relevant documents such as PLN's Electricity Supply Business Plan (*Rencana Usaha Penyediaan Tenaga Listrik, RUPTL*) to further refine workforce projections.

5.1.1 Methodology

44. The projection of workforce needs employed a top-down approach that calculated the number of jobs to be created based on plans and policies that have been communicated by the Government of Indonesia. For power generation, projections are based on planned capacity increase; for energy efficiency, on planned investments.

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45. These figures were then multiplied by employment factors obtained from past studies on job creation in NRE technologies and energy efficiency in other countries. For example, a study has determined an employment factor of 0.09 jobs in operation and maintenance for every MW of solar power installed.[13] In 2030, the RUKN 2025-2060 estimates an additional 1,150 MW of solar capacity is expected to go online,[14] which, when multiplied with the employment factor, yields approximately 100 jobs in operation and maintenance. The employment factors used in this study are provided in *Annex I. Employment factors*.

46. However, to better represent the economic and labor context in Indonesia, this figure should be adjusted using a regional productivity factor.

47. A regional productivity factor considers variations in labor productivity in different countries. Generally, there is an inverse relationship between labor costs and the number of workers needed to produce a unit of output, i.e., lower labor costs generally mean higher workforce needs. Since countries with lower GDP per capita tend to have reduced average labor costs, they are expected to employ more people for the same activity compared to countries with higher GDP. Thus, the application of a regional productivity factor is necessary when using employment factors obtained from countries with notable differences in economic contexts. Because the employment factors used for this study were largely derived from studies of countries that are member of the Organisation for Economic Co-operation and Development (OECD), a previous study calculated factors to adjust for job creation in non-OECD countries in different regions, including ASEAN. The regional productivity factors used in this study are provided in *Annex II. Regional productivity factors*.

48. Therefore, after adjusting for expected difference in labor productivity between Indonesia and OECD countries from which employment factors were derived, a total of about 180 jobs are expected in Indonesia for the operation and maintenance of solar PV facilities in 2030.

49. Figure 2 illustrates the methodology for calculating job creation in power generation.

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[13] Rutovitz, J. et al. 2025. Updated employment factors and occupational shares for the energy transition. *Renewable and Sustainable Energy Reviews*. 212. p. 115339.
[14] Government of Indonesia. Ministry of Energy and Mineral Resources. 2025. *Rencana Umum Ketenagalistrikan Nasional*.

Capacity growth per technology per year (MW)	✖	Employment factor (jobs/MW)	✖	Regional productivity factor	＝	Number of direct jobs created per phase per technology per year (number of jobs)
The RUKN 2025-2060 provides information on the planned increase in power capacity for every year between 2025-2060 for a range of NRE technologies.		Employment factors have been obtained for a range of energy technologies for two main phases of deployment: (1) construction and installation and (2) operation and maintenance.		A regional productivity factor adjusts for variations in labor productivity between Indonesia and OECD countries, for which employment factors were determined.		Planned power capacity increase are multiplied by the employment factors to calculate the number of direct jobs to be created for each technology, each phase of deployment, and each year.

50. Estimates for the yearly installed power capacity was obtained by extracting numerical data from figures provided in RUKN 2025-2060. Due to the inherent limitations of extracting data from data visualizations, values obtained may deviate from official capacity projections.

51. While the life cycle of NRE projects can encompass several phases, this study focuses solely on (1) construction and installation and (2) operation and maintenance, for which employment factors have been estimated in previous studies. Although employment factors have also been estimated for manufacturing, workforce projections in this sector were not made, since manufacturing is outside the scope of the energy sector. Employment factors in decommissioning of installations related to certain technologies have also been calculated, but these activities are likely to take place beyond the temporal scope of the study.

52. Since installed power capacity was also provided for Indonesia's sub-national regions: (1) Sumatra, (2) Java and Bali, (3) Kalimantan, (4) Sulawesi, and (5) Maluku, Papua, and Nusa Tenggara, workforce projections were also estimated at the sub-national region.

53. Some components of the data visualizations of yearly installed power capacity projections in RUKN 2025-2060 were too small to be distinguishable visually, e.g., those related to diesel. Neither the capacity nor workforce projections were estimated for these technologies.

54. Outside of NRE, RUKN 2025-2060 also provides plans for the transformation of fossil fuel-fired installations. There is an anticipated increase nationally in coal- and gas-fired power until around 2030. Employment factors related to the construction and installation and operation and maintenance of these fossil fuel facilities are available and were used for workforce projections. In the medium- to long-term, retrofits for carbon capture and storage and fuel switch are expected for both types of facilities. For CFPPs, fuel switch to ammonia or biomass co-firing is anticipated, while gas-fired power plants target green hydrogen.

55. Workforce projections in fossil fuel-fired power plants were primarily conducted in relation to retrofitting activities, i.e., the construction and installation of CCS.

56. In the case of fuel switch, the number of workers was assumed to be the same as before the switch, i.e., no jobs are assumed to be created or eliminated.

57. Total gas-fired power plant capacity is expected to experience another increase in the second half of 2050s due to the construction of new power plants that use green hydrogen. Employment factors for the construction and installation and operation and maintenance of regular gas-fired power plants were used for these workforce projections.

58. Workforce projections for energy efficiency activities were conducted using a similar method involving employment factors. In this case, employment factors were developed by previous studies based on a country's planned investments in energy efficiency. Figure 3 illustrates this methodology.

Figure 3. General methodology for the calculation of workforce projections in energy efficiency.

Annual investments in energy efficiency per year *(million USD)*	✖	**Employment factor** *(jobs/million USD)*	✖	**Regional productivity factor**	=	**Number of direct jobs created in energy efficiency per year** *(number of jobs)*
An energy sector roadmap by MEMR presents investment needs in energy efficiency towards net-zero by 2060.		Employment factors have been obtained for different energy efficiency sub-sectors: industrial, residential, and commercial. Since estimates of investment needs in Indonesia did not distinguish between different sub-sectors, an average was taken.		A regional productivity factor adjusts for variations in labor productivity between Indonesia and OECD countries, for which employment factors were determined.		Annual investment needs in energy efficiency are multiplied by the employment factor to calculate the number of direct jobs to be created annually.

59. Estimates for investments in energy efficiency in Indonesia were obtained from the report, *An Energy Sector Roadmap to Net Zero Emissions in Indonesia,* developed by MEMR in collaboration with the International Energy Agency.[15]

60. No estimates of workforce demand were made at the sub-national level for energy efficiency, since no data has been found for planned investments below the national level.

5.1.2 Workforce Projection and Milestones (YoY Growth up to 2060)

5.1.2.1 Power generation

61. This section provides the projected year-on-year growth in the workforce for power generation. Projections are provided from a regional perspective and from a technological perspective.

5.1.2.1.1 Regional

62. This section provides projections from a regional perspective, providing estimates nationally and in five geographic regions in Indonesia: (1) Java and Bali; (2) Sumatra; (3) Kalimantan; (4) Sulawesi; and (5) Maluku, Papua, and Nusa Tenggara.

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[15] MEMR and IEA. 2022. *An Energy Sector Roadmap to Net Zero Emissions in Indonesia*.

63. For every region, a summary table is included, providing the top three technologies with the highest job creation, along with the total number of jobs expected to be created for each, and the percent of total job creation for the region.

5.1.2.1.1.1 National

Table 4. Summary of top three technologies for job creation at the national-level.

Technologies with highest job creation	Total number of jobs created between 2026-2060	Percent of total
Solar	284,000	23%
CCS (coal)	172,000	14%
Hydro	161,000	13%

64. By 2060, a total of 1.26 million jobs are expected to be created during the construction and installation and the operation and maintenance of the various technologies planned to be integrated into Indonesia's power generation system, as outlined in the RUKN. Table 5 provides a breakdown of job creation in three periods considered in the roadmap: short-term (2026-2030), medium-term (2031-2045), and long-term (2046-2060).

Table 5. Number of jobs created in C&I and O&M activities in the power generation sector in each period.

Period	Number of jobs
2026 – 2030	238,000
2031 – 2045	517,000
2046 – 2060	505,000

65. Figure 4 illustrates the expected job creation per sector from 2025 to 2060.

Figure 4. Job creation (national) per sector per year
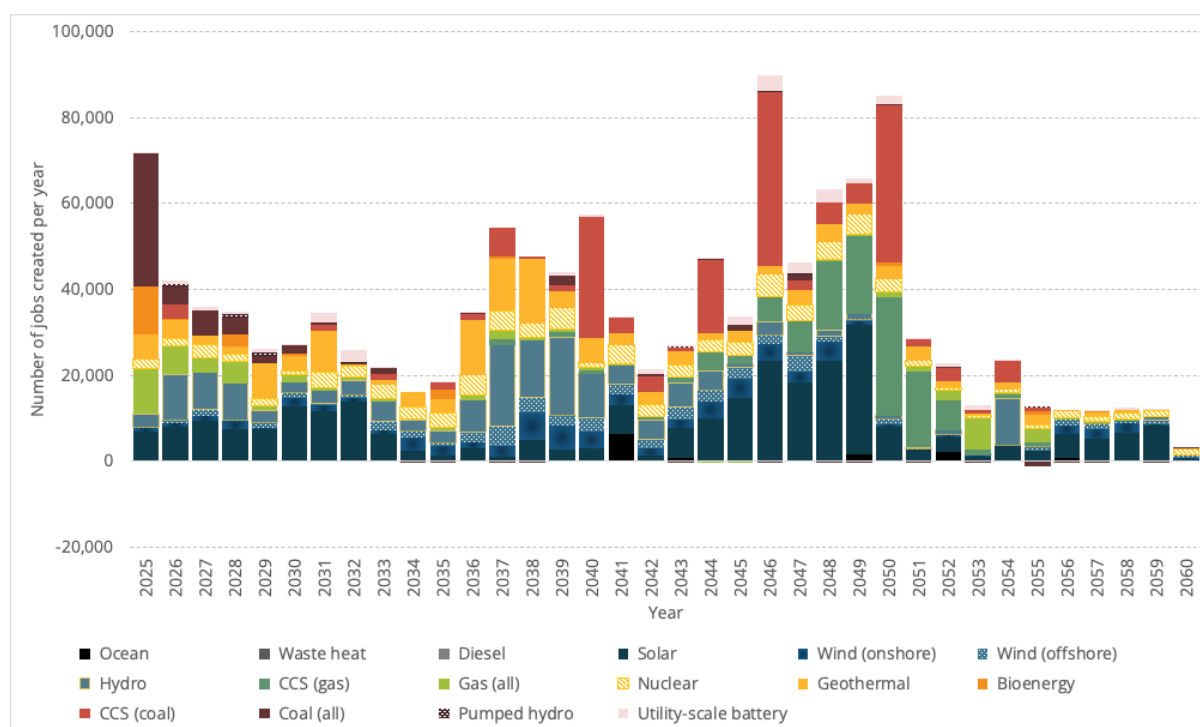
66. The year during which jobs are assumed to be created depends on whether the job is in operation and maintenance or in construction and installation. For jobs in operation and maintenance, the creation of jobs is assumed to be during the year the additional capacity is deployed for a given technology. Meanwhile, for jobs in construction and installation, the creation of jobs is assumed to be *x* number of years before the facility goes online, where *x* is the average number of years it takes to construct the technology.

67. The number of jobs expected to be created every year is expected to vary widely. Between 2025 and 2060, the highest number of jobs created is expected to occur around 2046 and 2050, largely due to the creation of construction and installation jobs for carbon capture and storage that are slated to go online in 2051 for existing coal-fired power plants. From 2054 on, job creation is expected to be moderate, as capacity increase begins to slow down and fewer construction projects emerge. Those that do appear are mostly in solar. It should be noted that, since there is no information about planned capacity increase beyond 2060, estimates towards 2060 do not capture any potential job creation from the commencement of construction projects for facilities expected to go online after 2060.

68. Some job losses are also expected up to 2060, estimated to equal approximately 7,700 in the operation and maintenance of coal and gas industries. Job losses in these two sectors are expected to be minimal, as the phasedown of fossil fuel facilities is not expected to be significant. As stipulated in the RUKN, plans for fossil fuel facilities

center around retrofitting for the installation of CCS technology and the utilization of other fuel sources (green hydrogen for gas power plants; ammonia and biomass for coal power plants). Thus, operation and maintenance needs for these facilities are not expected to decline significantly. In addition, yearly job creation is expected to offset job losses. It should be noted that calculated job losses do not include those lost at the conclusion of construction and installation jobs.

69. As mentioned, a significant amount of job creation is expected to come from the construction and installation of new facilities. Indeed, construction and installation will be the largest contributor to job creation, as can be seen in Figure 5, which shows the distribution of job creation per year between construction and installation and operation and maintenance. Activities related to construction and installation are more labor-intensive than those in operation and maintenance, leading to more significant job creation per MW of technology installed.

Figure 5. Cumulative job creation (national) per sector per year
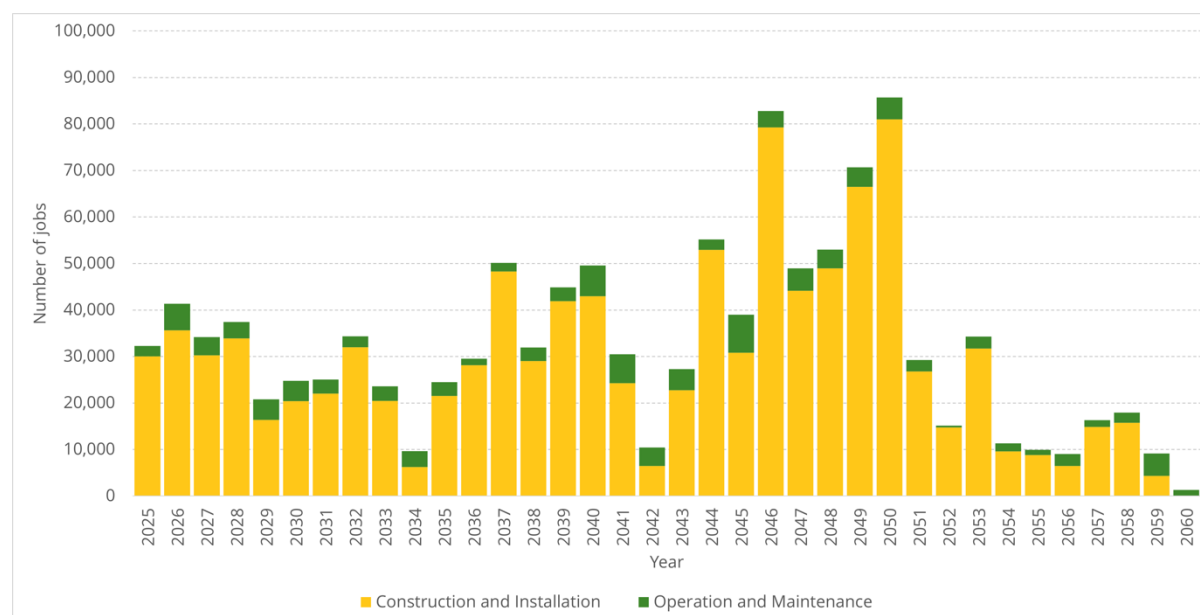
Source: Authors' elaboration

70. Figure 6 shows the cumulative net job creation per sector from 2025 to 2060.

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Figure 6. Cumulative job creation (national) per sector per year
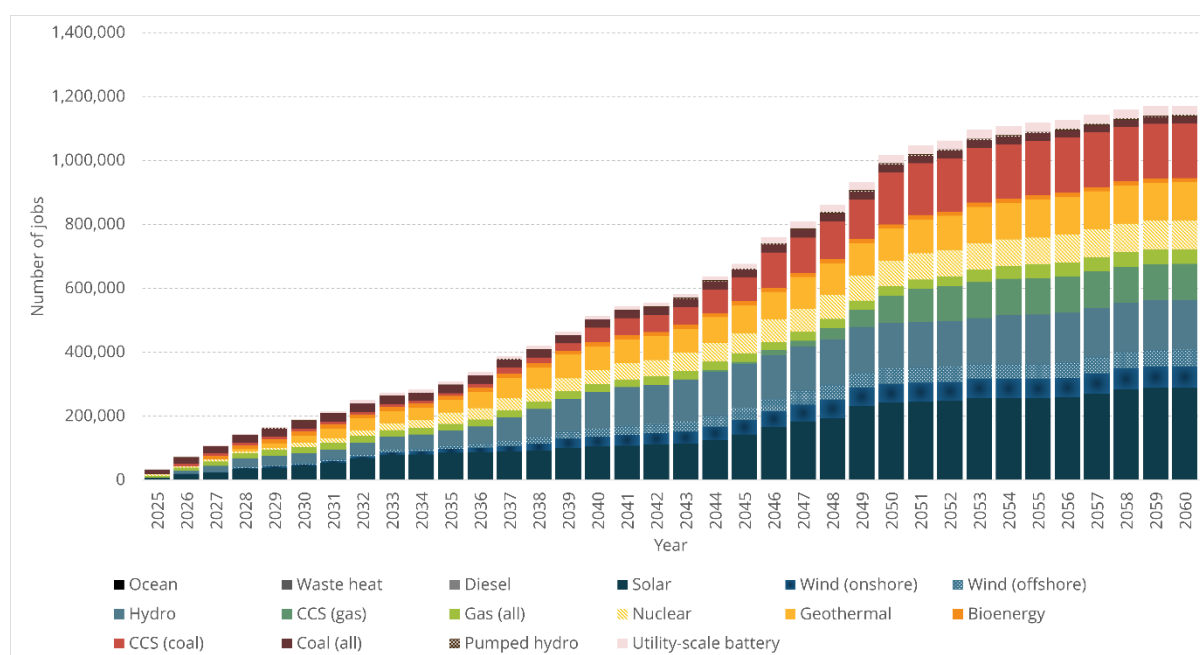
5.1.2.1.1.2 Java and Bali

Table 6. Summary of top three technologies for job creation in Java and Bali.

Technologies with highest job creation	Total number of jobs created between 2026-2060	Percent of total
CCS (coal)	88,000	21%
CCS (gas)	70,000	17%
Geothermal	49,000	12%

71. Figure 7 shows job growth per year for each power generation technology in the Java and Bali region from 2026 to 2060. A total of 410,000 jobs are expected to be created, with the installation of CCS in coal and gas making up about 38% of all jobs created. A significant portion of this is expected between 2048 and 2051 as CCS ramps up in the following years. Towards 2060, job creation stalls as new no capacity is expected to be added in the region starting in 2056.

Figure 7. Job creation per technology per year in the Java and Bali region
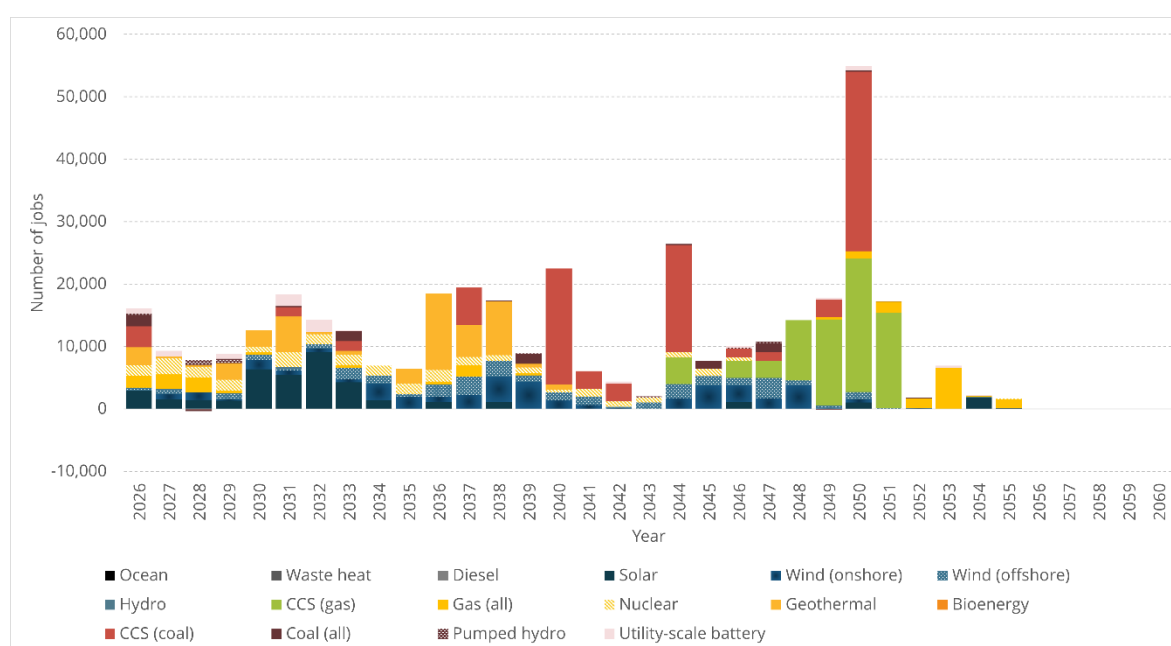
5.1.2.1.1.3 Sumatra

Table 7. Summary of top three technologies for job creation in Sumatra.

Technologies with highest job creation	Total number of jobs created between 2026-2060	Percent of total
Geothermal	53,000	23%
Nuclear	40,000	17%
Solar	34,000	15%

72. Figure 8 shows job growth per year for each power generation technology in the Sumatra region from 2026 to 2060. A total of 234,000 jobs are expected to be created, with the largest potential in geothermal, encompassing 23% of all jobs created. Significant job creation in the region is expected between 2026 to 2029 to meet the concurrent acceleration in capacity increase, primarily in hydro and geothermal. After slowing down between 2032 and 2035, job creation is expected to be moderately sustained until 2050, punctuated by some years with low job creation. In the period between 2032 and 2035 when job creation slows down, the creation of jobs in nuclear begins to ramp up.

Figure 8. Job creation per technology per year in the Sumatra region

Figure 8. Job creation per technology per year in the Sumatra region
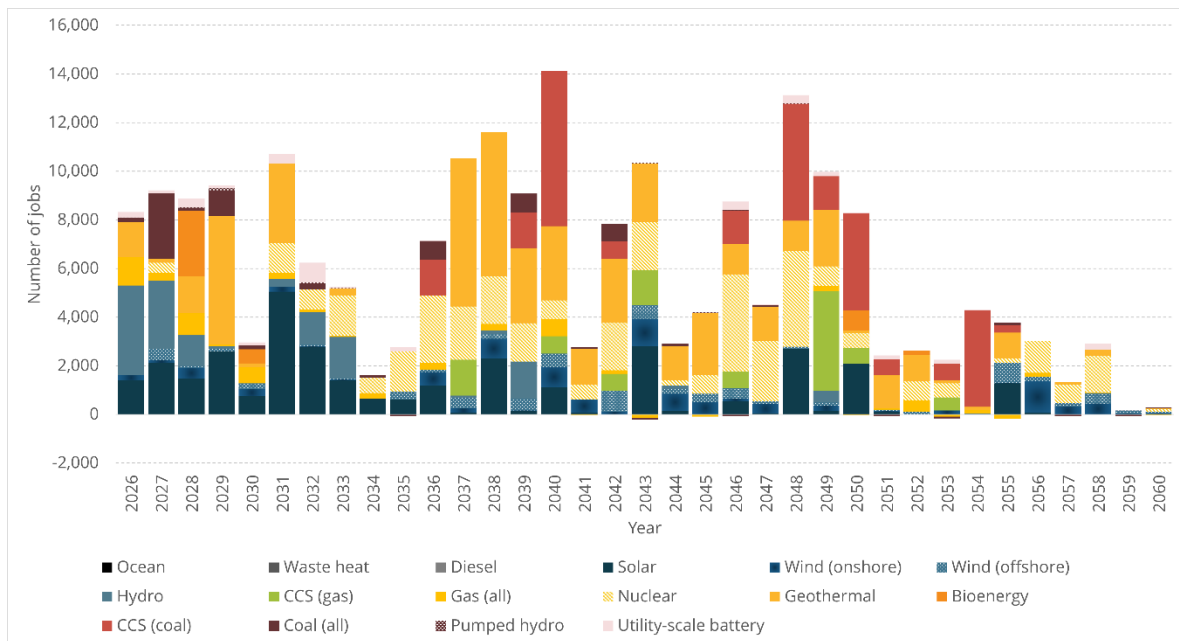
5.1.2.1.1.4 Kalimantan

Table 8. Summary of top three technologies for job creation in Kalimantan.

Technologies with highest job creation	Total number of jobs created between 2026-2060	Percent of total
Hydro	124,000	60%
Solar	21,000	10%
Nuclear	18,000	9%

73. Figure 9 shows job growth per year for each power generation technology in the Kalimantan region from 2026 to 2060. A total of 208,000 jobs are expected to be created, with the largest potential in hydro, encompassing 60% of all jobs created. Although jobs in hydro are expected to appear starting in 2026, a significant portion is expected to appear between 2036 and 2040, largely in construction and installation. Solar, nuclear, and CCS in gas power plants are also expected to experience job creation towards 2060.

Figure 9. Job creation per technology per year in the Kalimantan region
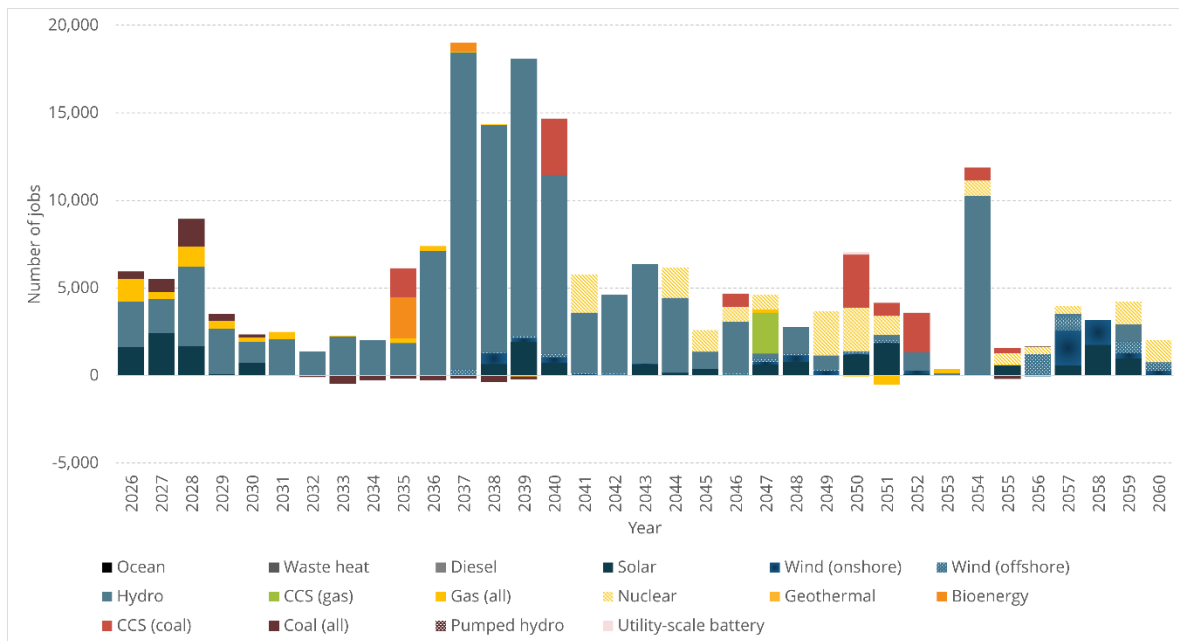
5.1.2.1.1.5 Sulawesi

Table 9. Summary of top three technologies for job creation in Sulawesi.

Technologies with highest job creation	Total number of jobs created between 2026-2060	Percent of total
CCS (coal)	21,000	19%
Geothermal	18,000	17%
Solar	16,000	15%

74. Figure 10 shows job growth per year for each power generation technology in the Sulawesi region from 2026 to 2060. A total of 106,000 jobs are expected to be created, with the largest potential in CCS (coal), contributing to 19% of job creation in the region, a large portion of which occurs around 2046.

Figure 10. Job creation per technology per year in the Sulawesi region

Figure 10. Job creation per technology per year in the Sulawesi region
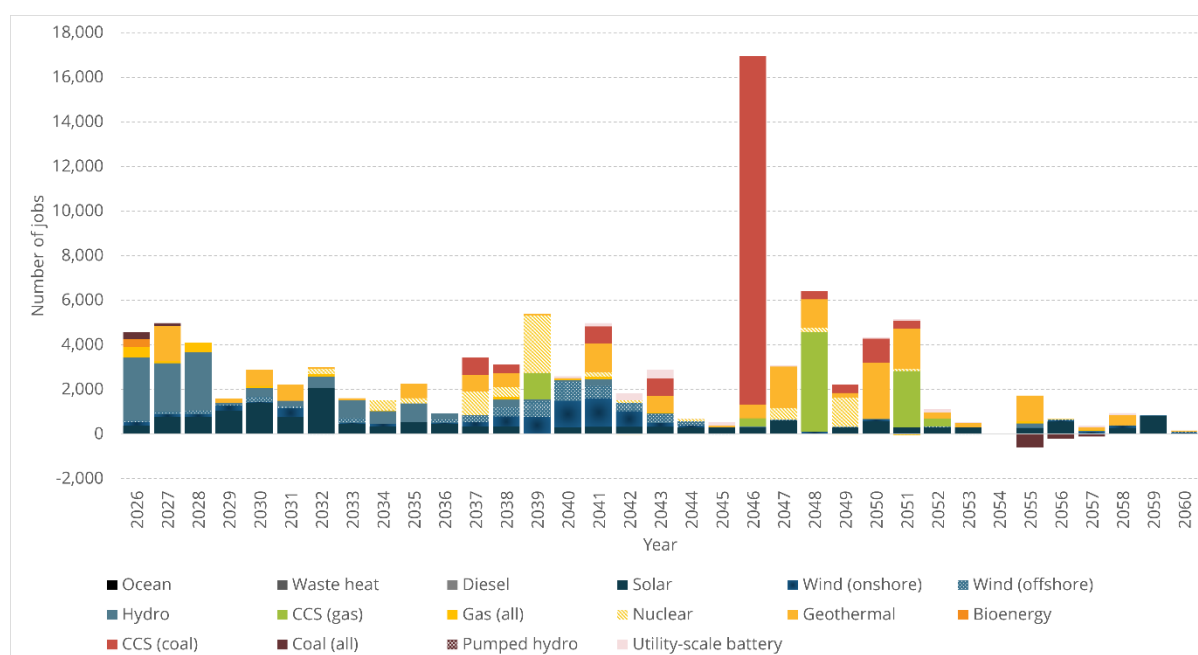
5.1.2.1.1.6 Maluku, Papua, and Nusa Tenggara

Table 10. Summary of top three technologies for job creation in Maluku, Papua, and Nusa Tenggara.

Technologies with highest job creation	Total number of jobs created between 2026-2060	Percent of total
Solar	169,000	56%
CCS (coal)	23,000	8%
CCS (gas)	23,000	8%

75. Figure 11 shows job growth per year for each power generation technology in the Maluku, Papua, and Nusa Tenggara region from 2026 to 2060. A total of 301,000 jobs are expected to be created, with the largest potential in solar, making up more than half of the jobs created. A great deal of these jobs in solar are expected to appear between 2045 and 2049. CCS is also expected to lead to significant job creation in the region. However, extended periods of slow growth in installed capacity leads to similar extended periods of slow job creation in the region.

5.1.2.1.2 By technology

76. This section discusses the growth in the most prominent NRE technology in Indonesia, disaggregated by region.

77. For every technology, a summary table is included, providing the total number of jobs to be created and the region in which job creation is expected to be greatest.

5.1.2.1.2.1 Solar

Table 11. Summary of job creation in solar.

Total number of jobs to be created	284,000
Region with largest job creation	Maluku, Papua, and Nusa Tenggara

78. From 2025 to 2059, the job market for solar energy in Indonesia is depicted in Figure 12. Solar energy generates more jobs over a relatively long period of time, with significant increases between 2044 and 2049. From 2041 onwards, Maluku, Papua, and Nusa Tenggara are the primary contributors with almost 30,000 jobs expected in 2049.

Figure 12. Job creation in solar per region per year.
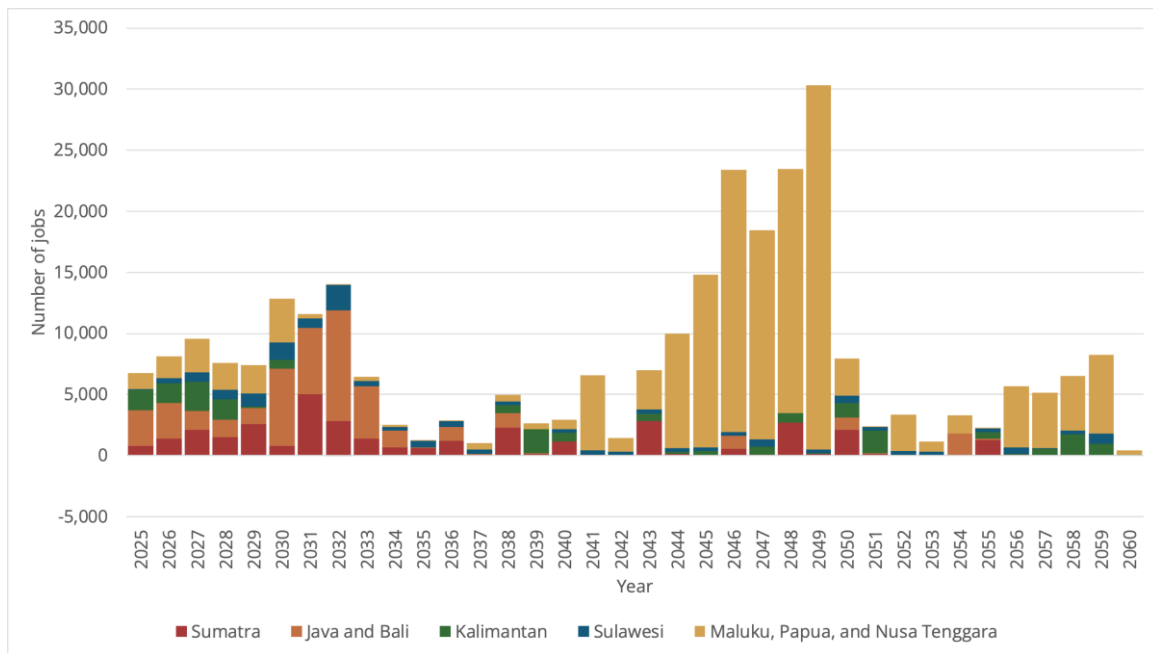
5.1.2.1.2.2 Offshore wind

Table 12. Summary of job creation in offshore wind.

Total number of jobs to be created	54,000
Region with largest job creation	Java and Bali

79. Figure 13 shows projected job growth in offshore wind across Indonesia between 2025 and 2060, with a high point in 2037, when 4,500 jobs are added. Throughout this period, Java and Bali will see the most job creation in offshore wind.

Figure 13. Job creation in offshore wind per region per year.
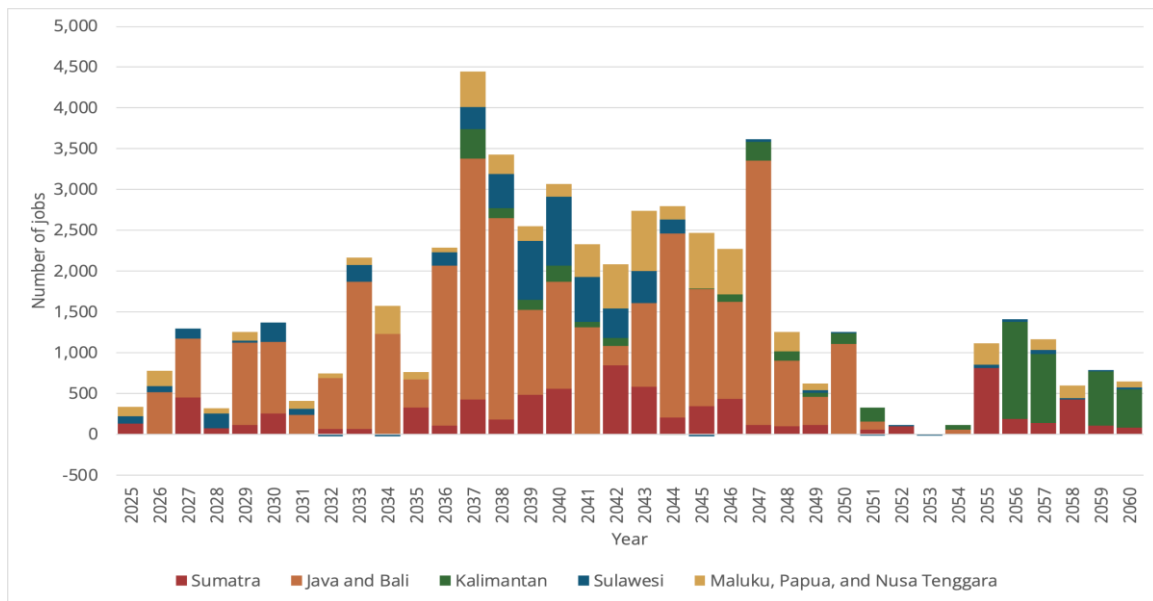
5.1.2.1.2.3 Onshore wind

Table 13. Summary of job creation in onshore wind.

Total number of jobs to be created	69,000
Region with largest job creation	Java and Bali

80. Figure 14 shows the projected employment for onshore wind farms in Indonesia between 2025 and 2060. The number of jobs increases rapidly in 2038, reaching a maximum of more than 6,000, due to an anticipated surge in project construction and installation activities. While a large portion of job creation in the country is anticipated in Java and Bali at first, between the late 2030s and early 2040s, more jobs begin to appear in other regions.

Figure 14. Job creation in onshore wind per region per year.
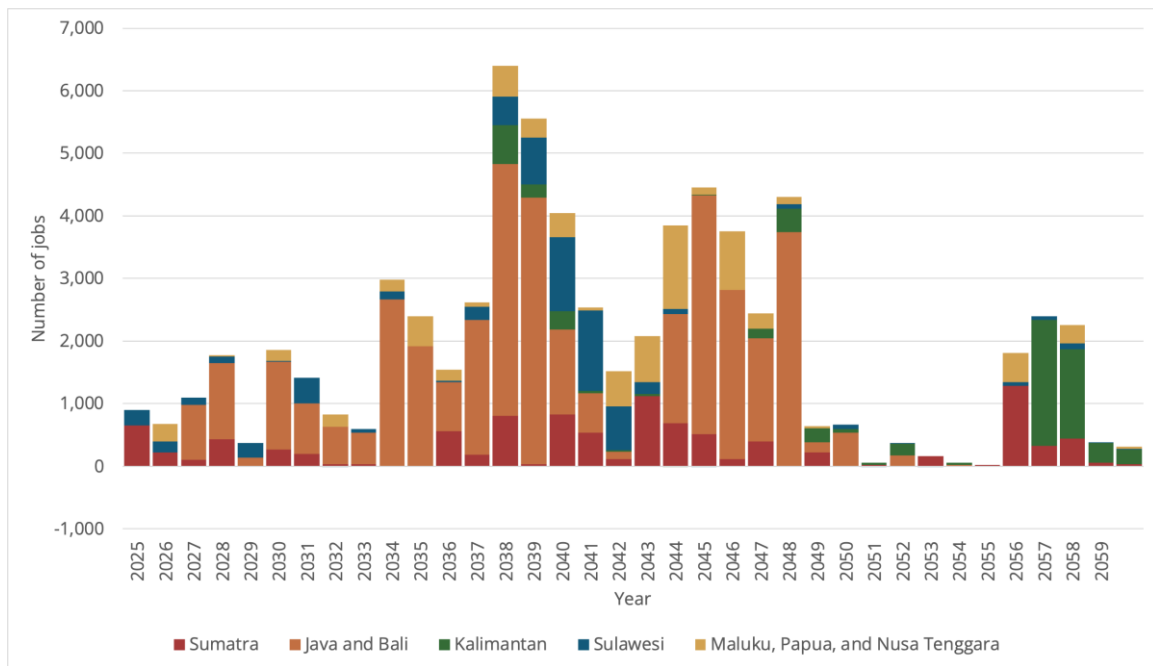
5.1.2.1.2.4 Hydro

Table 14. Summary of job creation in hydro.

Total number of jobs to be created	162,000
Region with largest job creation	Kalimantan

81. From 2036 to 2043, a significant increase in job creation in hydro is expected in Kalimantan (Figure 15). After 2042, job creation starts to decline as capacity increase slows. Kalimantan may be the catalyst for a second phase of hydropower development, as indicated by an increase in numbers in 2054.

Figure 15. Job creation in hydro per region per year.
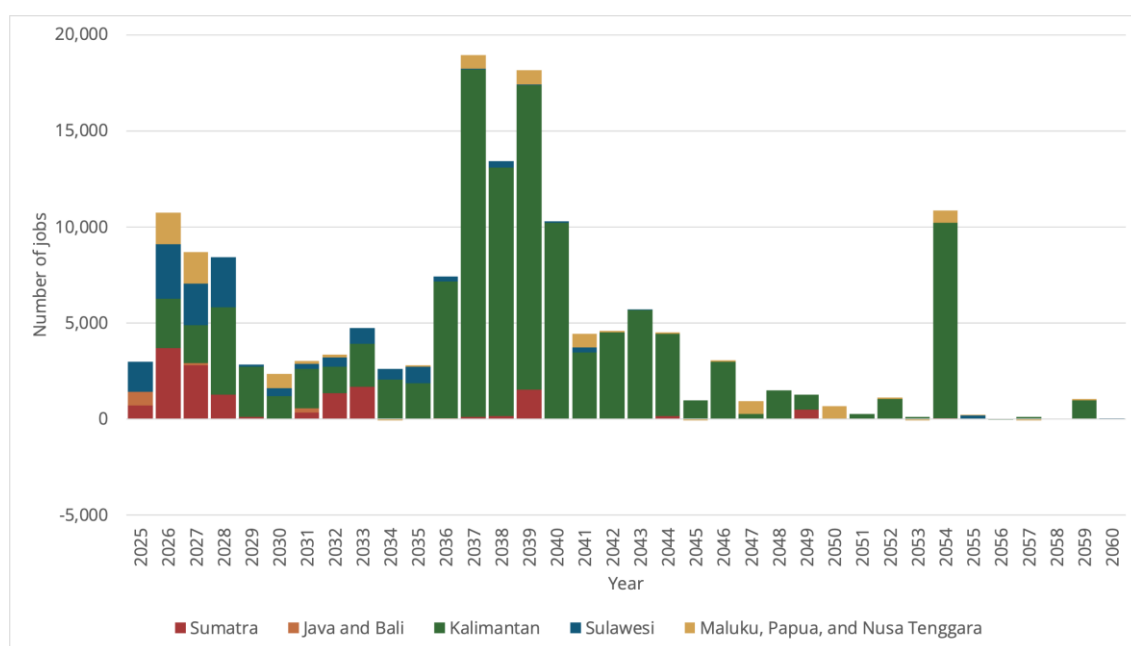
5.1.2.1.2.5 Geothermal

Table 15. Summary of job creation in geothermal.

Total number of jobs to be created	130,000
Region with largest job creation	Sumatera; Java and Bali

82. Job creation in the geothermal industry witnesses highs between 2029 and 2031 and again in 2036-2038. Job creation is dominated by Sumatra and Java-Bali, with some expected in Sulawesi to a lesser extent. No job creation is expected in Kalimantan. After peaking around 2038, job creation is expected to be moderate until 2060.

Figure 16. Job creation in geothermal per region per year.
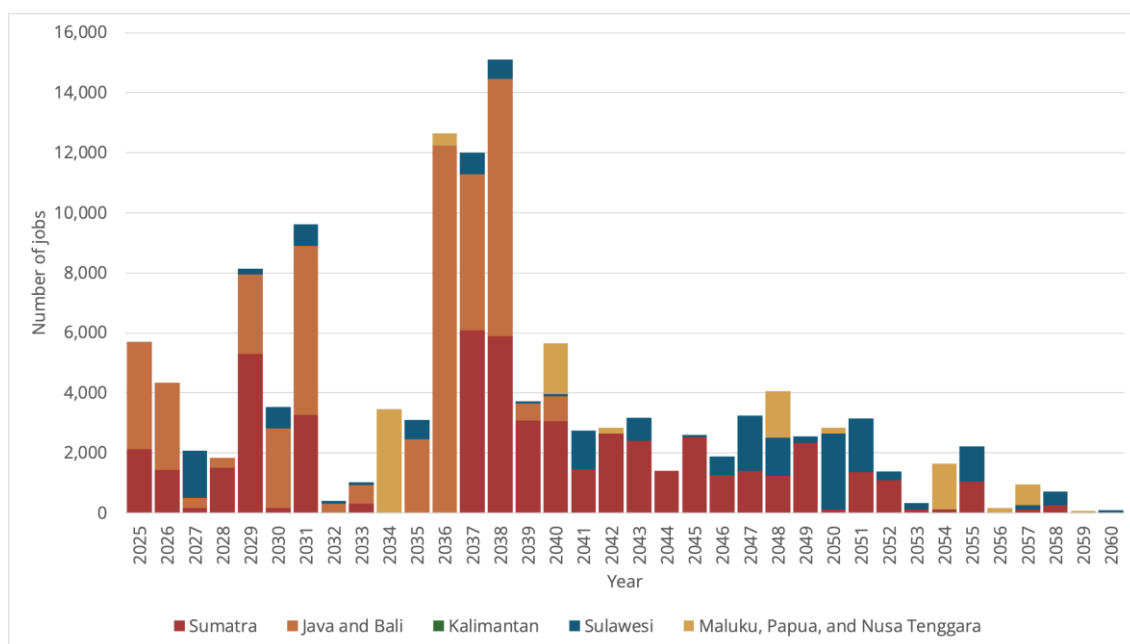
5.1.2.1.2.6 Nuclear

Table 16. Summary of job creation in nuclear.

Total number of jobs to be created	94,000
Region with largest job creation	Sumatra

83. Job creation in nuclear will experience a generally increasing trend until 2039, primarily in Java-Bali and Sumatra, as well as in Sulawesi to a lesser extent. Starting in 2041, job creation in nuclear in Kalimantan begins. After 2050, job creation slows down.[16]

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[16] It should be noted that workforce projections up to 2034 do not take into account an additional 250 MW of nuclear capacity communicated in the RUPTL 2025 – 2034, slated to go online in Kalimantan in 2033.

Figure 17. Job creation in nuclear per region per year.
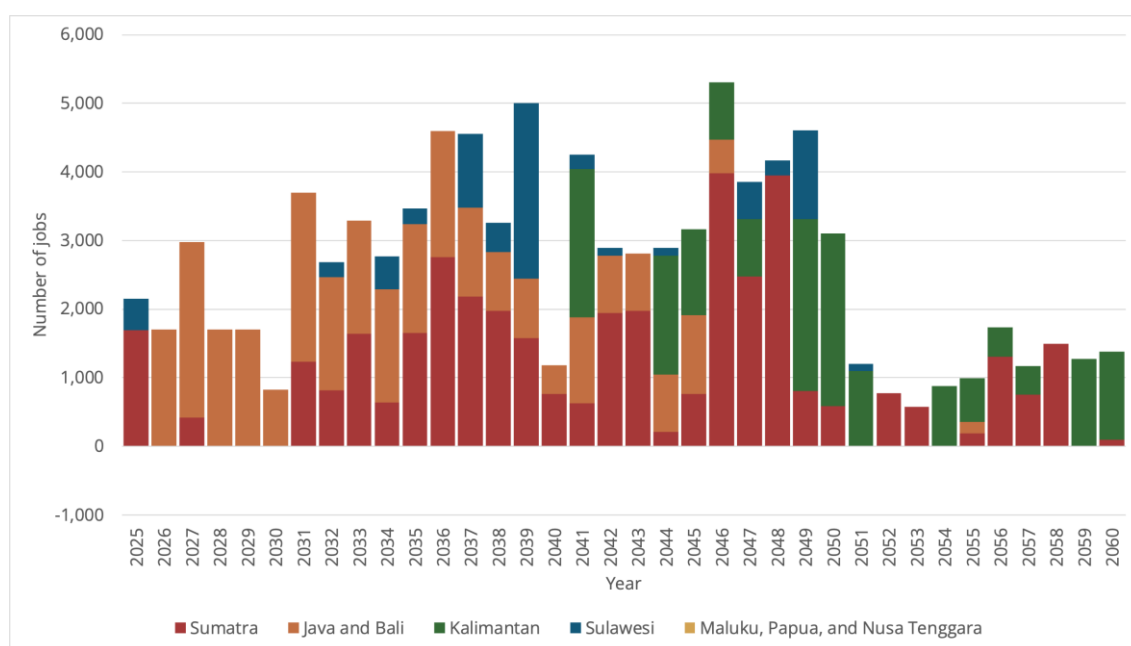
5.1.2.1.2.7 Carbon capture and storage

84. Carbon capture and storage are expected for both gas- and coal-fired power plants.

85. For CCS in gas power plants, job creation is expected to start around 2037, reaching a peak in 2050. The greatest potential for job creation is expected in Java and Bali, particularly between 2048 and 2051.

Table 17. Summary of job creation in CCS (gas).

Total number of jobs to be created	114,000
Region with largest job creation	Java and Bali

Figure 18. Job creation in carbon capture and storage (gas) per region per year.
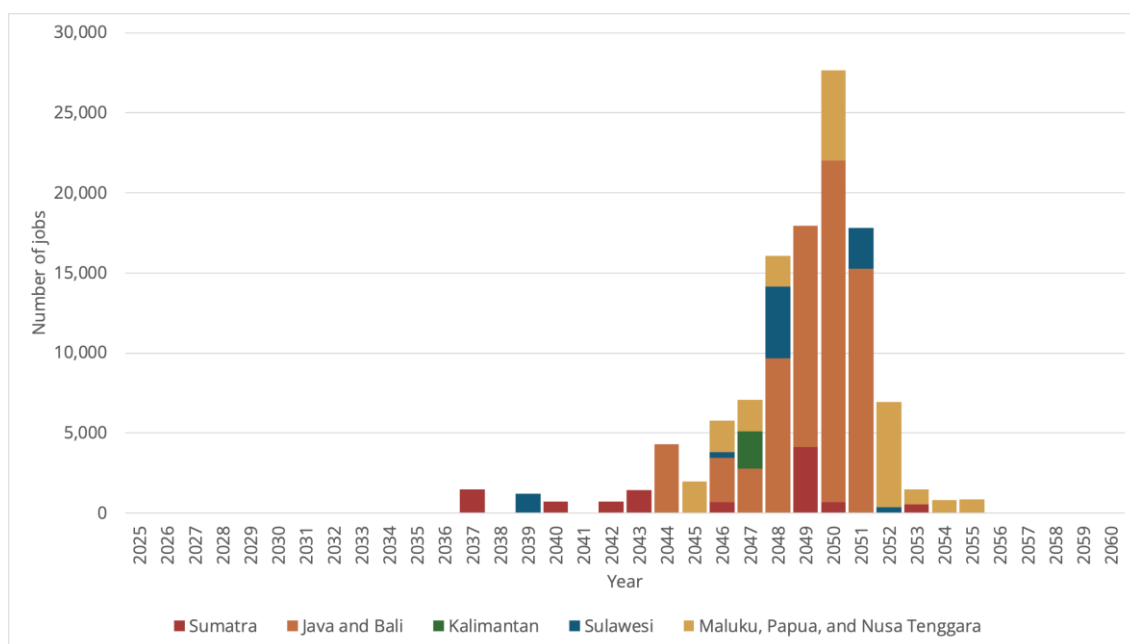
86. Meanwhile, job creation related to CCS in CFPPs is expected to contribute to 172,000 jobs by 2060, with more than half expected in Java and Bali. The most significant increase in 2046 is the employment of more than 40,000 people, with Java and Bali once again leading the way, and a notable surge in Sulawesi and Maluku, Papua, and Nusa Tenggara.

Table 18. Summary of job creation in CCS (coal).

Total number of jobs to be created	172,000
Region with largest job creation	Java and Bali

Figure 19. Job creation in carbon capture and storage (coal) per region per year.
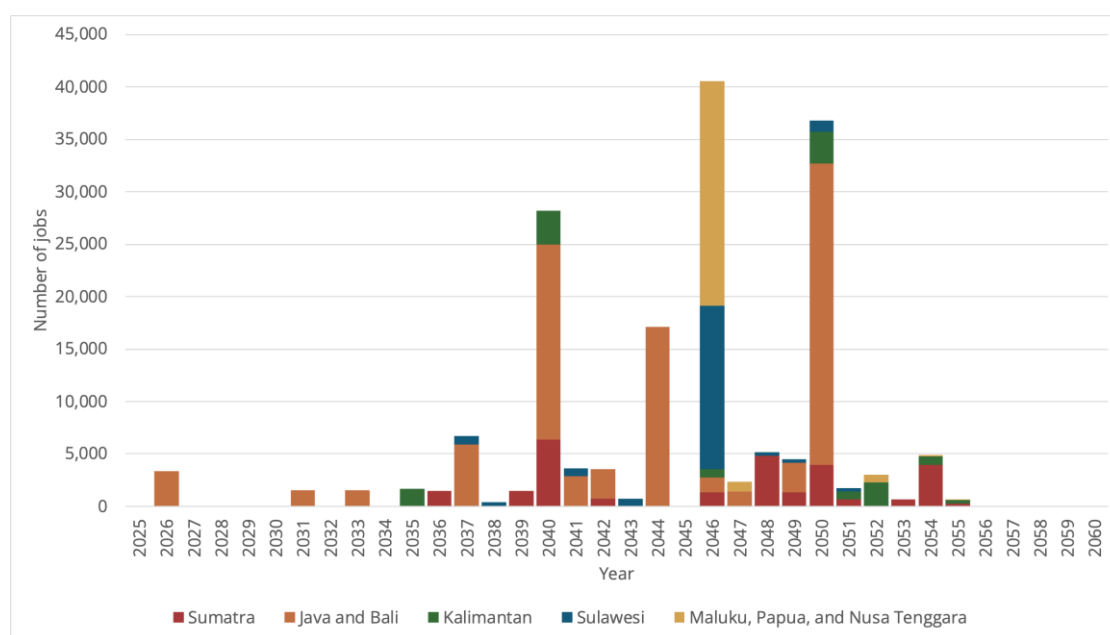
5.1.2.1.2.8 Storage

87. For storage, two technologies were studied: pumped hydro and utility-scale batteries.

88. Pumped hydro is envisioned only for the Java and Bali and Sumatra regions, with more than three-quarters of job creation expected to occur in Java and Bali, particularly between 2026 and 2029 (Figure 20). Subsequent development in the in the late 2030s and throughout the 2040s contribute to further job creation.

Table 19. Summary of job creation in pumped hydro.

Total number of jobs to be created	3,000
Region with largest job creation	Java and Bali

38

89. Job creation in utility-scale batteries, which are expected to be deployed throughout Indonesia, will see an initial boom in Java and Bali (and to a lesser extent in Sumatra) between 2025 and 2032 (Figure 21). Later deployment in other regions sees job creation in eastern Indonesia, particularly in Maluku-Papua-Nusa Tenggara, which will capture more than half of total job creation in utility-scale batteries until 2060.

Table 20. Summary of job creation in utility-scale batteries.

Total number of jobs to be created	29,000
Region with largest job creation	Maluku, Papua, and Nusa Tenggara

Figure 21. Job creation in utility-scale batteries per region per year
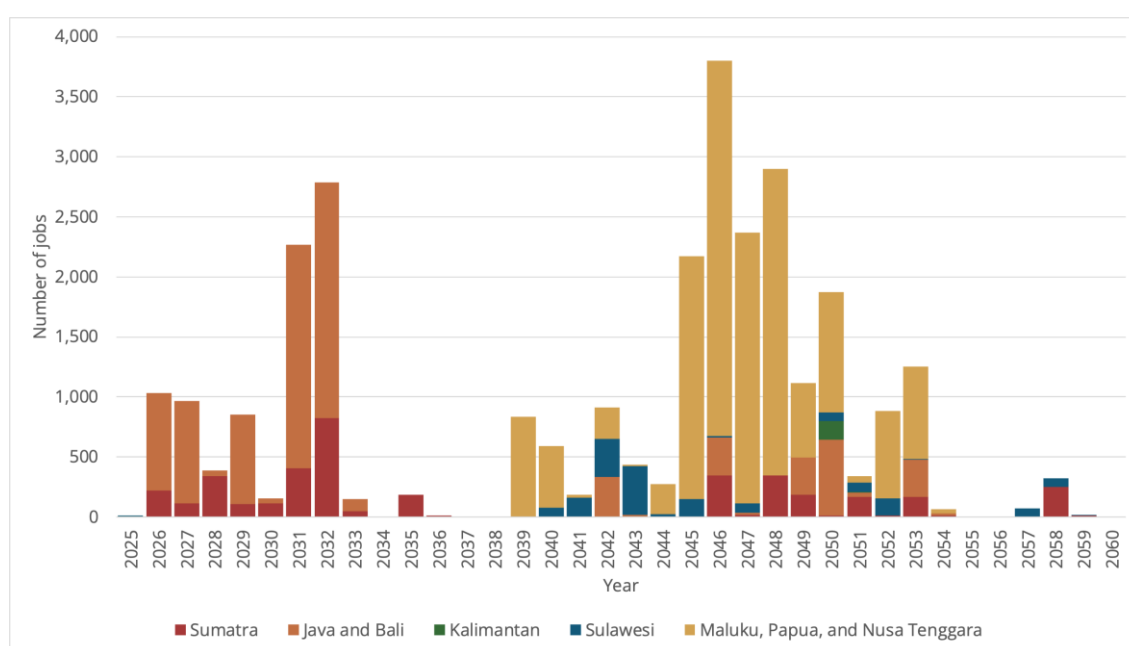
5.1.2.2 Energy Efficiency

90. By 2060, a total of 3.53 million jobs are expected to be created in energy efficiency (industrial, residential, and commercial), based on estimated investment needs in energy efficiency provided in MEMR's Net-Zero Emissions Roadmap.[17]

91. In this scenario, which is aligned with achieving NZE by 2060, annual investments required between 2026-2030 total about USD 10.1 billion, leading to the annual creation of 75,000 direct jobs. Investments in energy efficiency in the NZE scenario are assumed to follow a step-wise increase every 5 years starting in 2031 with intermediary dips to account for increase in labor productivity. By 2060, about 119,000 jobs are expected to be created annually.

92. Table 21 provides a breakdown of job creation in energy efficiency in the short-, medium-, and long-term.

Table 21. Number of jobs created in the energy efficiency sector in each period.

Period	Number of jobs
2026 – 2030	445,000
2031 – 2045	1,365,000
2046 – 2060	1,720,000

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

93. Figure 22 illustrates the expected annual job creation in energy efficiency from 2025 to 2060.

Figure 22. Job creation in energy efficiency per year in the NZE by 2060 scenario.
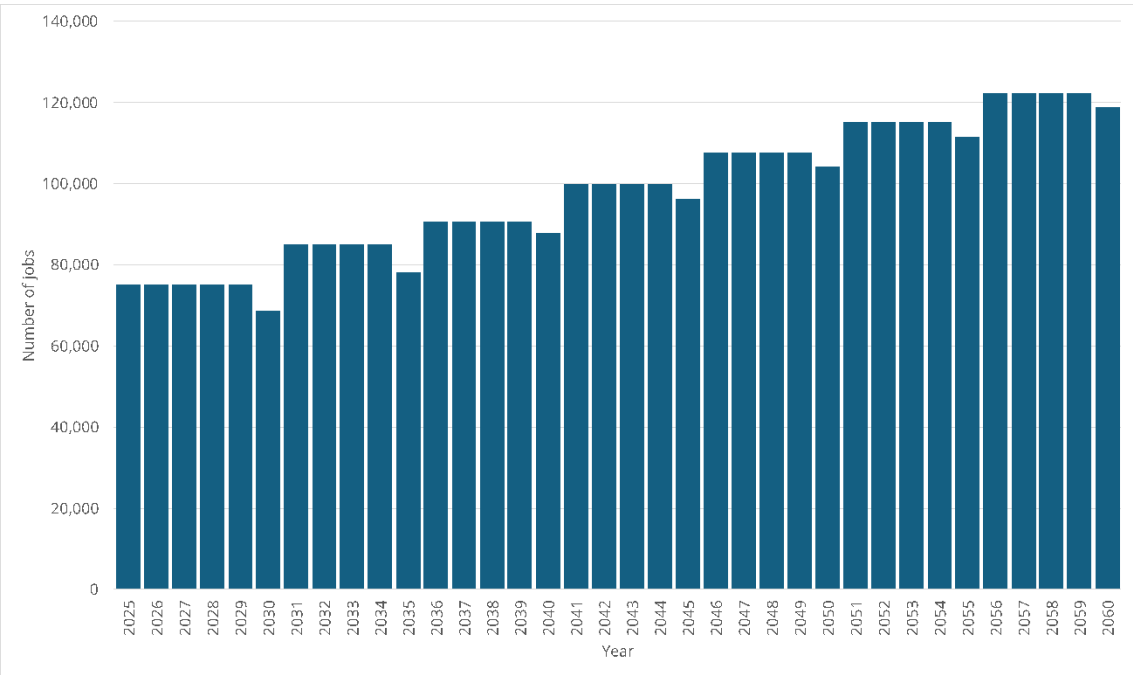
94. No estimates of workforce demand were made at the sub-national level for energy efficiency, since no data has been found for planned investments below the national level.

6 Policy Recommendations for Workforce Development

95. Indonesia's commitment to achieving net-zero emissions by 2060 marks a national transformation of unprecedented scale—one that will fundamentally reshape not just the country's energy system, but also its economy and labor market. At the heart of this roadmap is the principle that job creation and workforce transformation must be planned in lockstep with clean energy deployment.

96. What sets this roadmap apart is its grounding in detailed workforce projections across key energy technologies. These projections directly shape the roadmap's timelines and policy recommendations. This roadmap aligns with that long-term vision, recognizing that a just and inclusive energy transition depends on the country's ability to equip its workforce with the skills, protections, and opportunities needed to thrive in a low-carbon future.

97. Over the coming decades, the goal is to build a resilient, inclusive, and future-ready labor market that can support and sustain the transition to net zero. This includes ensuring that by 2060, the workforce is fully realigned with green and climate-resilient sectors, with up to 4.4 million green jobs created, and no region or worker left behind.

98. By 2030, Indonesia aims to lay the institutional and systemic foundations for a just energy workforce transition. This includes establishing a central coordinating body for workforce planning—anchored in the National Task Force on Energy Transition and Green Economy's (*Satuan Tugas Transisi Energi dan Ekonomi Hijau*, *SATGAS TEH*)'s Human Resources Capacity Development Group—to ensure alignment with national transition priorities. The country will also upgrade TVET infrastructure and trainer capacity, launch digital learning and certification platforms, and begin mobilizing green skills financing. Training investments will be linked to energy transition projects and implementation tracked through SATGAS TEH's oversight mechanisms. Efforts will also focus on expanding inclusive training access, particularly in fossil fuel-intensive and underserved regions.

99. By 2045, Indonesia will scale and integrate the green workforce ecosystem nationwide with developing a national Labor Market Information System (LMIS). At this stage, green skills will be mainstreamed across TVET and higher education, and predictive labor market analytics will be routinely used to adapt training supply to emerging demand. Industry-driven apprenticeships and retraining programs will reach maturity, and women, youth, and informal workers will be systematically included in workforce development strategies. Performance-based financing and regional partnerships will drive innovation and deepen private sector participation.

100. By 2060, Indonesia will have realized a resilient, inclusive, and future-ready workforce fully aligned with its net-zero pathway. Labor institutions will be adaptive and data-driven, green employment opportunities will be equitably distributed across regions and social groups, and Indonesia will emerge as a regional leader in green talent development and workforce innovation.

6.1 PILLAR A. Improving the Institutional Framework

101. Pillar A stands at the center of National Roadmap for a Specialized Workforce to Support Indonesia's Energy Transition. This pillar is the key enabler without which the success of the other five pillars cannot be fully realized. As workforce development for the energy transition spans multiple sectors - energy, education, labor, and industry - effective cross-ministerial coordination becomes indispensable. However, further cohesion among different institutions in Indonesia is recommended, given that ministries such as MEMR, the Ministry of Manpower, and the Ministry of Industry conduct parallel training programs without a unified strategy, shared goals, or aligned mandates.

102. A well-coordinated governance framework is critical to ensuring that workforce development aligns with Indonesia's energy transition objectives. Coordinating responsibilities across ministries and institutions could lead to the alignment of policies, as well as higher efficiency and effectiveness of workforce planning.

103. In the short term, the priority is to build the institutional architecture and foundational partnerships required for long-term success in green workforce development. This involves establishing formal leadership and coordination structures—with SATGAS TEH's Human Resources Capacity Development Group serving as the central platform—initiating regional engagement processes, and beginning the alignment of policies across labor, education, and energy sectors. Anchoring coordination within SATGAS TEH ensures coherence with national energy transition governance and facilitates cross-ministerial alignment. These measures set the stage for a more coherent, inclusive, and effective workforce development strategy that can evolve with Indonesia's energy transition goals.

104. During the medium term, the focus shifts to scaling and institutionalizing the early-phase reforms. The emphasis is on embedding collaborative governance models into standard government operations, expanding coordination platforms across all provinces, formalizing legal mandates for green skills development, and developing robust systems for monitoring and evaluation. These efforts support sustained, inclusive workforce development aligned with Indonesia's long-term energy transition goals.

105. By institutionalizing coordination bodies, multilevel governance structures, and legal mandates, Indonesia can secure a future-ready workforce system that supports inclusive, low-carbon economic growth for generations to come.

6.1.1 Establish and Institutionalize a Central Coordinating Body

106. In the short-term, the priority is to build the institutional architecture and foundational partnerships required for long-term success in green workforce development. This involves establishing formal leadership and coordination structures, initiating regional engagement processes, and beginning the alignment of policies across labor, education, and energy sectors. These measures set the stage for a more coherent, inclusive, and effective workforce development strategy that can evolve with Indonesia's energy transition goals.

Timeline	Action
Short-term (2025–2030)	- Designate the Energy and Mineral Resources Human Resources Development Agency (*Badan Pengembangan Sumber Daya Manusia Energi dan Sumber Daya Mineral*, *BPSDM ESDM*) as coordinating body; - Coordinate all green workforce initiatives through the National Task Force on Energy Transition's Human Resources Capacity Development Group; - Obtain legislative mandate; - Embed governance model into national development plans and ministerial budgets (e.g., RPJMN); - Ensure autonomy, funding, and parliamentary reporting

6.1.1.1 Short-Term (2025–2030)

107. **Designate BPSDM ESDM as the Central Coordinating Body.** The Energy and Mineral Resources Human Resources Development Agency (*Badan Pengembangan Sumber Daya Manusia Energi dan Sumber Daya Mineral*, *BPSDM ESDM*) should be formally mandated to oversee workforce planning, ensuring coherence between energy transition targets and labor market needs.[18] Formal leadership is critical to unify efforts and align training programs with national energy goals. BPSDM ESDM has strong technical expertise and an existing role in workforce development. While BPSDM ESDM by itself lacks the authority to issue policies or regulations, it can leverage its technical expertise and operational experience and coordinate with other MEMR directorates, such as Directorate General of New, Renewable Energy and Energy Conservation or the Directorate General of Electricity, which do have the power to issue regulatory documents.

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[18] Energy Transition Partnership. 2024. *Specialised Workforce for Indonesia's Future Transition in Energy (SWIFT): Review of institutional roles and governance mechanisms*.

108. **Obtain endorsement of the Central Coordinating Body from the House of Representatives**. The House of Representatives plays a key role in securing political legitimacy and policy continuity. With their endorsement, the mandate of a body like BPSDM ESDM becomes stronger, not just based on ministerial discretion but also backed by legislative support. This is important to keep workforce development efforts running even through political transitions. In addition, since the House of Representatives is also responsible for approving the national budget, obtaining their support helps ensure more consistent and reliable funding for relevant programs.

109. **Coordinate all green workforce development initiatives through SATGAS TEH's Human Resources Capacity Development Working Group.** The multi-institutional National Task Force on Energy Transition (*Satuan Tugas Transisi Energi dan Ekonomi Hijau*, *SATGAS TEH*) was created in 2025 with the responsibility of overseeing activities accelerating Indonesia's energy transition, including developing strategic programs, setting targets, and defining performance indicators. Efforts related to workforce development in the energy sector should be undertaken by the Human Resources Capacity Development Group, one of the task force's working groups. The involvement of different institutions in the task force under the supervision of its Steering Committee and Supervisory Unit can ensure strategic coherence and financing alignment (JETP, SWIFT, RPJMN). Workforce data, forecasting, training budgets, and implementation progress should be regularly reviewed through the task force's mechanisms.

110. **Fully implement a collaborative governance framework linking workforce planning with national goals.** This alignment ensures that workforce investments are directly supporting Indonesia's decarbonization and industrial diversification targets.

111. **Embed coordination mechanisms within ministry budgets and planning documents.** Formalizing inter-ministerial task forces and regional platforms within the planning and budgeting processes ensures that collaborative governance is not ad-hoc but a sustained effort.

112. **Ensure the central coordinating body's mandate and programs are embedded within national development planning frameworks (e.g., RPJMN).** This formal alignment strengthens legitimacy, supports resource mobilization, and ensures long-term policy coherence.

113. **Ensure it has enduring authority, budgetary autonomy, and reporting responsibilities to the national legislature.** To function effectively over the long term, the coordinating body must have independent decision-making power, secure multi-year funding, and institutional accountability. Reporting to the House of

Representatives enhances transparency and oversight, while budgetary autonomy allows for continuity even during political transitions or administrative reshuffles.

6.1.2 Strengthen sub-national engagement

Timeline	Action
Short-term (2025–2030)	- Conduct regional consultations and assign focal points in provincial governments to ensure subnational alignment; - Initiate regional pilot programs aligned with national workforce plans; - Engage provincial and local city/regency-level governments in workforce planning
Medium-term (2031–2045)	- Scale regional coordination platforms to all provinces, ensuring tailored workforce planning at the local level; - Establish permanent platforms for regional, national, and international coordination.

6.1.2.1 Short-Term (2025–2030)

114. **Conduct consultations and assign focal points in provincial governments to ensure sub-national alignment.** Provincial governments often manage or coordinate TVET institutions, local labor offices, and industrial clusters. Without their active participation, national initiatives risk poor implementation or misalignment with actual labor demands. Establishing local focal points and integrating them into the central planning process will enhance coordination, local ownership, and the ability to deliver context-sensitive workforce solutions.

115. **Initiate regional pilot programs aligned with national workforce plans.** Successful pilots can later inform broader implementation, creating a feedback loop between national strategy and local needs.

116. **Engage provincial and city/regency-level governments in workforce planning to ensure that regional energy transition needs are met.** Engaging provincial and local governments from the outset allows for the integration of region-specific labor data, educational capacity, and industry feedback into national planning. Their involvement helps identify skill gaps that are specific to local industries and communities, ensuring that training programs are not only aligned with national targets but are also locally relevant and inclusive.

6.1.2.2 Medium-term (2031–2045)

117. **Scale regional coordination platforms to all provinces, ensuring tailored workforce planning at the local level to ensure a nationally cohesive yet locally relevant approach to workforce development.** Indonesia's vast geographic and

economic diversity means that each region has unique energy transition pathways, workforce capacities, and labor market dynamics. For example, provinces with a heavy reliance on coal may require more intensive reskilling efforts, while regions with renewable energy potential (e.g., geothermal, hydro, solar) will need specialized training for local project deployment.

118. **Establish permanent platforms for regional, national, and international coordination.** Regional coordination bodies should be embedded within provincial governments, with structured feedback loops to national ministries. National platforms can serve as clearinghouses for best practices and policy alignment. On the international front, Indonesia should engage in formal cooperation with other transitioning economies, ASEAN forums, and development partners to share skills frameworks, joint certifications, and innovation models.

6.1.3 Initiate policy harmonization

Timeline	Action
Short-term (2025–2030)	- Audit mandates; - Labor and education law amendments to include green skills - Develop cross-sectoral alignment across RUEN, RPJMN, RIPIN; - Introduce legal instruments for green apprenticeships and industry certification standards - Pass Green Workforce or Just Transition Law; - Ensure long-term budget commitments through fiscal planning tools

6.1.3.1 Short-Term (2025–2030)

119. **Review overlapping mandates and start aligning labor, education, and energy policies with workforce development objectives.** This includes evaluating whether current labor and education laws accommodate the emerging needs of the green economy, such as green skills, apprenticeships, and industry-aligned training frameworks.

120. **Amend national labor and education legislation to formally include green workforce development mandates,** explicitly incorporating provisions that promote green skills development, sustainable practices, and environmental stewardship within the workforce.

121. **Establish a cross-sectoral policy harmonization framework** to align green workforce development with national energy, education, industry, and regional development strategies.

122. Building on earlier legislative reforms, this phase should focus on aligning and integrating national policies, sectoral roadmaps (e.g., RUEN, RIPIN, RPJMN), and subnational development plans to ensure coherence across ministries and agencies.

123. Introduce legal instruments to institutionalize green apprenticeships and industry certification standards ensuring consistency, quality, and recognition of green skills across sectors.

124. **Enshrine workforce coordination and green jobs policy into a standalone national law or as a key chapter within broader climate legislation.** A comprehensive "Green Workforce and Just Transition Act" or a dedicated chapter within Indonesia's climate law would clearly define the scope, institutional roles, and rights of stakeholders (e.g., workers, training providers, industries). It would also mandate inter-ministerial cooperation and formalize pathways for worker reskilling and placement.

125. **Ensure long-term budget commitments through fiscal planning tools.** Legal mandates must be matched by guaranteed resources. By embedding budgetary commitments into fiscal frameworks such as the Medium-Term Expenditure Framework or climate finance strategies, Indonesia can ensure that green workforce development is not deprioritized in future budget cycles. Dedicated budget lines for training programs, regional platforms, and certification schemes would enhance resilience and sustainability

6.1.4 Enhance monitoring and evaluation (M&E)

Timeline	Action
Short-term (2025–2030)	- Define baseline indicators; - Pilot with MEMR and green industries; - Build M&E capacity; - Institutionalize M&E into Renstra and RPJMN; use KPIs for budgeting and revisions; - Implement 5-year review cycles synchronized with RPJMN; adapt to labor and tech changes

1.1.1.1   Short-Term (2025–2030)

126. **Lay the Institutional and Technical Foundations for M&E** by definition of baseline indicators, targets, and data sources for key green workforce metrics (training outcomes, employment placement, sectoral demand), piloting data collection with selected ministries (e.g., MEMR, Ministry of Manpower) or with selected green industries (e.g., solar PV, biomass) to test data collection, reporting, and evaluation tools, and linking with existing systems like Sakip and LMIS.

127. **Capacity-building programs** for M&E units in relevant ministries and regional governments to ensure institutional readiness.

128. **Formalize and scale the M&E framework**, integrating it into ministries' Renstra and RPJMN cycles. Use performance indicators to inform budgeting and policy revisions across sectors.

129. **M&E framework should be embedded within the strategic planning cycles (Renstra)** of key ministries—such as the Ministry of Energy and Mineral Resources, Ministry of Manpower, Ministry of Education, Ministry of Industry, and Bappenas. The M&E system should generate performance indicators at the directorate and directorate-general levels, ensuring alignment with Key Performance Indicators (KPIs) used in Sakip (Performance Accountability System of Government Institutions) and support ministerial budget justifications in the RKP (Annual Government Work Plan) process.

130. Specific indicators could include:

    - Quality and accreditation status of green training programs
    - Graduate absorption rates into green and transition sectors
    - Regional equity in program access and delivery
    - Alignment of trained skills with labor market demand

131. To ensure institutional buy-in, M&E metrics should inform budget negotiations (via K/L budget ceilings) and feed into national evaluations conducted by Bappenas under the RPJMN monitoring framework.

132. Institutionalize cyclical workforce planning and M&E updates through mechanisms synchronized with the RPJMN five-year cycles. Every five years, green workforce strategies and their KPIs should be reviewed and updated based on:

    - Labor market shifts
    - Technological changes
    - Emerging regional and global decarbonization trends

133. These policy cycles will promote predictability, responsiveness, and cross-sectoral coordination in adapting workforce development to the evolving demands of Indonesia's just energy transition.

6.2 PILLAR B. Improving Quality of Training Programs and Strengthening Certification

134. Pillar B is crucial for ensuring that Indonesia's workforce is well-equipped to meet the demands of the energy transition, particularly in renewable energy sectors. To ensure that training programs meet industry demands and international standards, Indonesia must enhance technical and vocational education, modernize training

infrastructure, and strengthen certification frameworks. This pillar focuses on aligning training with labor market needs—including sector-specific workforce projections—upgrading facilities and ensuring workers transitioning from fossil fuel sectors have access to high-quality reskilling and upskilling opportunities.

135. Indonesia should focus on establishing the foundational systems that underpin a responsive, modern, and internationally aligned training and certification ecosystem. This includes aligning national certifications with global benchmarks, updating SKKNI to meet labor market needs, launching digital platforms to expand training access, and upgrading facilities and instructor capacity to deliver hands-on, high-quality instruction across the country.

136. By the mid-term, the focus should shift toward scaling up training systems to reach wider and more diverse groups, while integrating more advanced technologies and emerging topics. This includes deepening modular certification systems for continuous learning, updating SKKNI for new technologies like hydrogen and AI and sectoral needs, and further developing digital and physical infrastructure to expand geographic and demographic reach.

137. In the long term, Indonesia should establish itself as a global hub for renewable energy training and certification. This involves integrating AI and automation into certification processes, using AR/VR for advanced learning experiences, and creating sustainable, high-tech training centers. Indonesia's trainers should be positioned as global thought leaders, contributing to international research, innovation, and policy development.

6.2.1 Strengthening certification frameworks

Timeline	Action
Short-Term (2025–2030)	- Align national certification with international benchmarks through partnerships with global certification bodies (e.g., IRENA, GIZ, IEA). - Develop SKKNI-tailored to priority energy sectors both in power generation (as guided by workforce demand projections) and in other energy sub-sectors.
Medium-Term (2031–2045)	- Continuously update SKKNI to capture skills in emerging technologies. - Fully integrate AI, IoT, and automation into certification processes (AI-based assessments, predictive labor analytics, and blockchain-based certification tracking).

6.2.1.1 Short-Term (2025–2030)

138. **Align certification with international benchmarks**. The National Professional Certification Agency should collaborate with international organizations to integrate

global best practices into Indonesia's certification system to ensure Indonesian certifications are recognized internationally, boosting workforce mobility and FDI.

139. **Develop SKKNI for priority sectors.** Developing the SKKNI for priority sectors will directly address the gaps in skills required to meet sector-specific needs, ensuring a responsive workforce for emerging industries. These should consider needs in the workforce not only in power generation based on projections per sector/technology but also in other energy sub-sectors, such as transmission and distribution. Skills related to activities in smart grids, battery storage, and digital solutions for energy systems are among those that should be considered in the development of new SKKNI.

6.2.1.2 Medium-Term (2031–2045)

140. **Update SKKNI for emerging technologies and sectors.** Integrate new and emerging renewable energy technologies and sectoral needs into the SKKNI to ensure it remains responsive to the evolving energy landscape. As technologies such as green hydrogen gain prominence in Indonesia's energy transition, updating the SKKNI to cover these areas ensures that the workforce is prepared to meet the needs of these new sectors. This will support Indonesia's efforts in becoming a global leader in renewable energy innovation.

141. **Fully Integrate AI, IoT, and Automation in Certification Processes:** Incorporate AI-based assessments, predictive analytics for skill forecasting, and automated certification tracking systems to maintain global competitiveness in certification standards. As AI, IoT, and automation continue to reshape industries worldwide, integrating these technologies into the certification process will ensure that Indonesia remains competitive and responsive to global workforce demands.

6.2.2 Launching Digital learning and certification platforms

Timeline	Action
Short-Term (2025–2030)	● Launch a centralized, government-endorsed digital training portal with sector-specific courses (solar, EV, EE, etc.), e-certification, and micro-credentials. ● Ensure mobile-optimized and low-bandwidth access to expand reach in rural and remote areas.
Medium-Term (2031–2045)	● Integrate AI-driven personalized learning paths, gamification, and virtual peer learning into the portal. ● Establish partnerships with local and international universities and private sector to continuously update content. ● Incorporate immersive AR/VR learning tools to simulate real-world training scenarios (e.g., offshore wind maintenance).

	● Create a globally networked platform enabling shared access to international content, credentials, and best practices.

6.2.2.1 Short-Term (2025–2030)

142. **Launch an online training and certification portal.** A centralized digital platform should offer:

    a. Energy-related courses (solar, wind, energy efficiency, electric vehicles, etc.)

    b. Virtual workshops and certification programs

    c. Industry-recognized micro-credentials

143. **Promote e-learning accessibility.** Develop **mobile-friendly and low-bandwidth** solutions to ensure training is accessible in remote regions. This ensures inclusivity, especially in rural and remote communities, enabling wider access to renewable energy training**.**

144. **Address digital access barriers in underserved areas.** To ensure no community is left behind, targeted strategies should be adopted to overcome digital divides. These include:

    – **Device access initiatives** (e.g., community digital kiosks, government-subsidized tablet distribution for learners in priority provinces)

    – **Offline-enabled course modules** that can be downloaded and accessed without continuous internet connectivity

    – **Multilingual content offerings**, especially in Bahasa Indonesia and local dialects, to improve usability among diverse linguistic groups

    – **Digital literacy support**, including basic IT skills training for first-time users of e-learning platforms.

145. These mitigation strategies are critical for maximizing reach and equity in green skills training programs.

6.2.2.2 Medium-Term (2031–2045)

146. **Enhance the digital portal with advanced features**. Expand the online portal to include advanced features like AI-based personalized learning paths, gamified modules, and collaborative learning opportunities, offering more interactive and immersive experiences. As digital technology evolves, incorporating AI, gamification, and personalized learning paths will enhance the learning experience, making it more engaging and effective. These advancements are key to keeping Indonesia's

workforce adaptable in an increasingly digital world, while ensuring ongoing access to updated content.

147. **Ensure ongoing support for areas with low Internet connectivity** by maintaining lightweight, offline-accessible versions of the platform even as more advanced features are developed. These parallel solutions help bridge digital inequities during the transition period.

148. **Develop partnerships for expanding e-learning content**. Establish partnerships with renewable energy companies, universities, and international organizations to continually refresh and expand the content available on the platform

149. **Implement augmented reality (AR) and virtual reality (VR) for advanced training.** Integrate AR and VR technologies into the e-learning platform to offer immersive, hands-on training experiences in complex renewable energy systems like offshore wind farms or energy storage plants. Augmented and virtual reality will allow for immersive, hands-on training experiences, particularly for complex and high-risk areas like wind farms and large-scale solar installations.

150. **Expand global collaboration for learning.** Expand digital platforms into a global network by collaborating with top universities, companies, and training institutions worldwide, enabling access to cutting-edge renewable energy programs. A global collaboration platform will foster international cooperation, enriching Indonesia's educational ecosystem and providing broader access to world-class training programs.

6.2.3 Upgrading training infrastructure and instructor capacity

Timeline	Action
Short-Term (2025–2030)	- Renovate and equip existing training centers (e.g., BLKs, PPSDM EBTKE) with renewable energy labs (solar PV, battery systems, smart grids). - Establish regional renewable energy training hubs in partnership with universities and private sector, tailored to local resource profiles.
2031–2045 (Medium-Term)	- Expand and modernize training centers, introducing simulation labs, digital twin systems, and mobile training units for underserved areas. - Develop advanced training modules on AI, automation, and smart systems. - Establish national and regional networks for continuous trainer development and knowledge exchange. - Introduce advanced certification pathways for trainers in emerging technologies.

2046–2060 (Long-Term)	• Construct sustainable, energy-positive training centers powered by renewables. • Establish international Centers of Excellence in key technologies (hydrogen, AI-grid systems, bioenergy), with global R&D and training mandates.

6.2.3.1 Short-Term (2025–2030)

151. **Renovate and equip BLKs & PPSDM EBTKE facilities**. Invest in state-of-the-art labs for solar PV installation, battery storage, smart grids, and other renewable energy technologies. Upgrading the infrastructure at vocational training centers ensures students gain hands-on experience with cutting-edge technologies, preparing them for the job market.

152. **Establish regional training hubs**. These regional hubs provide tailored training for spec renewable energy resources, addressing localized workforce needs. Partner with universities and private companies to create specialized training centers in key renewable energy zones (e.g., solar in East Nusa Tenggara, geothermal in North Sumatra).

6.2.3.2 Medium-Term (2031–2045)

153. **Expand training facilities and regional hubs and modernize infrastructure**. Continue expanding the number of vocational training centers (BLKs and PPSDM EBTKE), ensuring they are well-equipped with the latest renewable energy technologies, such as solar, wind, and energy storage. With advanced technologies becoming integral to the energy transition, offering specialized modules will ensure that Indonesia's workforce is not only large but highly skilled in these new areas.

    a. Priority Upgrades for BLKs & Polytechnics:

        i. Solar/Wind Simulation Labs – Mimic real-world conditions for hands-on practice.

        ii. Digital Twins – Virtual replicas of power plants for troubleshooting training.

    b. Mobile Training Units for remote areas (e.g., Papua, Maluku).

154. **Introduce advanced renewable energy training modules**. Develop training programs focused on advanced technologies, such as AI applications in renewable energy, and the integration of automation in energy systems.

155. **Expanding the number of centers will ensure equitable access to high-quality training in renewable energy across the country**. Strengthen national and international networks for trainer development by establishing continuous learning platforms and networks for instructors to exchange knowledge and best practices.

156. **Advanced certification programs for trainers.** Update/develop specialized certifications in advanced renewable energy technologies, ensuring trainers have cutting-edge knowledge to impart to their students.

6.2.3.3 Long-term (2046–2060)

157. **Develop smart, green energy-driven training centers**. Build fully sustainable, green energy-powered training centers that use renewable energy sources such as solar, wind, and geothermal, serving as both training grounds and demonstrations of best practices in energy efficiency. Training centers that are powered by renewable energy will not only serve as demonstration projects but will also expose trainees to energy-efficient building designs and sustainable energy solutions.

158. **Establish international Centers of Excellence**. Create specialized centers of excellence dedicated to high-demand renewable energy technologies such as AI-driven smart grids, hydrogen energy systems, and future biofuel innovations. Establishing centers of excellence will make Indonesia a global leader in the research and development of cutting-edge renewable energy technologies, strengthening its position in the global energy transition.

6.2.4 Enhancing trainer competencies

Timeline	Action
2025-2030 (Short-term)	Strengthen and mobilize the current trainer workforce, including upskilling, deployment and industry collaboration.
2031–2045 (Medium-Term)	• Launch international instructor exchange programs with countries leading in energy transition (e.g., Germany, Australia, Singapore). • Institutionalize industry-embedded training programs to ensure trainers remain connected with technological and industrial trends.
2046–2060 (Long-Term)	• Develop a global trainer exchange and collaborative research program, enabling Indonesian instructors to contribute to global innovation. • Position Indonesia's trainers as globally recognized leaders through active participation in international publications, standard-setting, and policy discourse.

6.2.4.1 Short-term:

159. **Strengthen and mobilize the current trainer workforce.** To meet the urgent demands of the energy transition until 2030, Indonesia must act immediately to assess and enhance the capacity of its existing training personnel. This includes conducting a nationwide skills and trainer gap assessment, fast-tracking upskilling programs, and mobilizing qualified instructors to support priority energy transition

projects. Public and private training centers—particularly in regions dependent on fossil fuels—must be supported to deliver high-quality, context-specific green skills training from the outset. Early efforts should also include technical assistance, national trainer certification upgrades, and partnerships with domestic industry to embed real-time practices into classroom instruction.

6.2.4.2 Medium-Term (2031–2045)

160. **International instructor exchange programs**. Trainers play a key role in shaping the skills of the future workforce. By participating in international exchange programs, Indonesian trainers can learn best practices, gain exposure to new teaching methodologies, and stay up-to-date with the latest industry innovations. Collaboration with international experts will bring global perspectives on renewable energy training, which will enrich local training programs and ensure that they meet international standards. These programs will also help build lasting relationships and networks with international training organizations, which can provide long-term support for Indonesia's training efforts. Exchange programs with leading international organizations and institutions (e.g., Germany's GIZ, Australia's VET system, Singapore's ITE, etc.) should be established to provide Indonesian trainers with exposure to the latest renewable energy technologies and teaching methodologies.

161. **Organizing industry-embedded training**. Instructors must stay connected with the real-world applications of renewable energy technologies. By participating in industry embedded training, they will gain first-hand experience of working in the renewable energy sector, thus keeping their knowledge current and practical. This hands-on experience is crucial for ensuring that trainers are able to deliver high-quality, relevant training to students that reflects the challenges and opportunities in the industry. The integration of industry practice into instructor training enhances the credibility and quality of the training programs delivered to students. Trainers should be required to undergo periodic upskilling through apprenticeships with renewable energy companies, ensuring they are familiar with the latest industry practices and technologies.

6.2.4.3 Long-term (2046-2060)

162. **Create a global trainer exchange and research program**. Develop a program for global exchange of instructors, allowing Indonesian trainers to participate in international research projects and collaborate on groundbreaking renewable energy solutions. Through the global exchange and research program, Indonesian trainers can stay at the forefront of global renewable energy innovations, enabling them to bring back cutting-edge knowledge to local training programs.

163. **Achieve global recognition for Indonesia's trainers**. Position Indonesia's trainers as global thought leaders by ensuring that they are contributing to international publications, research, and policy developments in renewable energy. The recognition of Indonesian trainers as global leaders in renewable energy education will solidify Indonesia's role as a key player in the global transition to sustainable energy.

6.3 PILLAR C. Promoting Data-Driven Green Job Market Structuring

164. **Effective workforce planning for Indonesia's energy transition requires robust, real-time labor market intelligence.** Pillar C focuses on establishing a comprehensive Labor Market Information System (LMIS) that enables real-time workforce intelligence to align human capital development with Indonesia's green energy transition. This data-driven approach ensures that policies and investments in human capital development are targeted, efficient, and responsive to the evolving renewable energy sector.

165. It is critical that all labor market data collected through the LMIS is disaggregated by gender to enable targeted monitoring of progress, identify systemic gender disparities, and inform responsive policy development. Gender-disaggregated metrics should include enrollment in training programs, job placement rates, and career progression across energy sectors.

166. **In the short term, the focus is on building the foundational infrastructure for a national LMIS.** This includes launching the system, defining key features, integrating cross-sectoral data sources, and establishing mechanisms for reliable, real-time data collection. These efforts will allow Indonesia to identify current and emerging skills gaps in the green sector and prepare for the workforce demands of the energy transition.

167. **In the medium term**, Indonesia should operationalize the LMIS as a central decision-support tool to align education, training, and certification systems with evolving labor market demands—particularly within the green economy. By enabling the early identification of current and emerging green skills gaps, the LMIS will help anticipate workforce needs driven by the energy transition. Indonesia should embed the LMIS into routine government planning processes, ensure sustainable financing, and link it to national policy instruments to maintain competitiveness in the global green job market.

168. LMIS-generated insights should inform curriculum development, certification reform, and targeted policy incentives. This will allow both government and industry stakeholders to adapt rapidly to labor market shifts, address workforce bottlenecks, and accelerate the creation of a future-ready green workforce.

6.3.1 Developing a Labor Market Information System (LMIS)

Timeframe	Actions
Short-Term (2025–2030)	● Establish the foundation of the LMIS with BPSDM ESDM & Ministry of Manpower coordination ● Establish a centralized database for green job demand forecasting, incorporating geospatial labor mapping, integrating inputs from industry, academia, and government
Medium-Term (2031-2045)	● Use LMIS data to update curricula and roll out micro-credentials ● Fast-track certification through the National Professional Certification Agency (*Badan Nasional Sertifikasi Profesi, BNSP*) based on labor analytics ● Implement MEMR-led workforce incentives for critical RE skills ● Develop digital "Skills Passport" and regional heatmaps ● Enact Presidential Regulation on LMIS governance ● Train local labor offices in LMIS use- Develop sustainable LMIS funding models ● Integrate with international LMIS platforms (ASEAN, IRENA)

6.3.1.1 Short-Term (2025–2030)

169. **Establish the foundation of the LMIS.** Launch the national LMIS under the leadership of the Ministry of Manpower and BPSDM ESDM, in collaboration with MEMR (for energy sector demand data), BPS (for labor force and economic data), Ministry of Higher Education, Science and Technology (for education and training supply data), Central Statistics Agency (BPS), and industry associations (e.g., Indonesian Solar Energy Association/ISEA, Indonesian Geothermal Association/API) (for private-sector insights).

170. Key features of the LMIS:

   a. Real-time labor market analytics (job vacancies, skills gaps, wage trends)

   b. Green jobs taxonomy aligned with international standards (ILO, IRENA, etc.)

   c. Geospatial mapping of renewable energy projects and workforce needs

   d. Integration with vocational training databases (BLK, polytechnics, universities)

171. **Establish a centralized database for green job demand forecasting**, incorporating geospatial labor mapping, integrating inputs from industry, academia, and government aligned with international standards. This will be essential for green job demand forecasting and policy scenario planning, especially as Indonesia implements major national strategies such as the Just Energy Transition Partnership (JETP) and National Energy Policy (KEN).

6.3.1.2 Medium-Term (2031–2045)

172. **Develop dynamic curriculum and micro-credentialing.** Use LMIS to adapt TVET and polytechnic programs in real time; roll out micro-credentials in niche RE skills to keep training relevant and reduce graduate underemployment. LMIS data should feed directly into updating vocational and technical curricula. Institutions can issue micro-credentials in high-demand specialties (e.g., offshore wind maintenance, grid digitization) to allow workers to upskill efficiently and stay relevant.

173. The LMIS should directly support **job-matching and employment facilitation**. This includes:

    – **Organizing national and subnational green job fairs** to connect training graduates with employers in renewable energy, energy efficiency, and related industries.

    – **Establishing a centralized green jobs online platform** linked to LMIS data to post vacancies, internships, apprenticeships, and training opportunities.

    – **Forging partnerships with industry associations** (e.g., MKI, ISEA) to facilitate **real-time vacancy data sharing and demand forecasting**.

    – **Developing employer-labor matching tools and regional heatmaps** to visualize job clusters and skill shortages, enabling better workforce placement and mobility planning.

174. These efforts will reduce labor market frictions, accelerate school-to-work transitions, and improve alignment between training outputs and actual hiring trends in the green economy.

175. **Streamline skills certification process.** The National Professional Certification Agency (*Badan Nasional Sertifikasi Profesi*, *BNSP)* uses LMIS data to fast-track certifications in critical roles and update SKKNI standards. Skills Certification Streamlining will help in accelerating worker readiness for fast-growing RE sub-sectors.

176. **Implement targeted workforce incentives.** MEMR provides training subsidies for undersupplied skills; Ministry of Manpower matches workers across islands. Incentivizes learning where the payoff is highest and bridges geographic workforce gaps.

177. **Create national skills inventory and heatmaps.** Launch digital "Skills Passport" system and publish green job heatmaps by region. Enhances visibility and matching for job seekers and employers alike.

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178. **Obtain legal and regulatory backing**. Enact a Presidential Regulation mandating cross-ministerial LMIS data-sharing and updates. Embeds LMIS in government routine and ensures long-term inter-agency cooperation.

179. **Provide regional capacity building**. Train district and provincial labor offices in data collection, visualization, and LMIS utilization. Decentralized capacity supports local implementation and contextual relevance.

180. **Establish long-term funding models**. Establish a skills development fee on large RE projects; formalize donor partnerships. Ensures sustainable financing and builds resilience against public budget shifts.

181. **Integrate globally**. Connect Indonesia's LMIS with international platforms for talent mobility and benchmarking (e.g., ASEAN, IRENA). Prepares Indonesia to compete in and contribute to the international green labor market

6.3.2 Data collection and validation mechanisms

Timeframe	Actions
Short-Term (2025-2030)	- Mandatory employer reporting (PLN, Pertamina, RE developers) - Conduct biannual labor market surveys focused on green jobs - Develop 5-year predictive labor model (JETP, KEN, regional disparities - Collect gender-disaggregated data across all metrics
Medium-Term (2031-2045)	Establish structured industry working groups and create feedback loops to validate LMIS outputs with real-world needs

6.3.2.1 Short-Term (2025–2030)

182. **Instate mandatory industry reporting**. To ensure timely, relevant data from frontline actors in the green economy, large energy employers (e.g., PLN, Pertamina, private RE developers) should be required to report skills demand and hiring trends.

183. **Conduct periodic labor market surveys**: Conduct biannual green jobs assessments to track emerging occupations, e.g., solar technicians, battery storage specialists. Biannual surveys on green job occupations, such as solar PV installers, battery technicians, or hydrogen engineers, will capture emerging trends and identify nascent skills in real time.

184. **Carry out skills forecasting modeling**. To allow the government to anticipate training needs, minimize skills mismatches, and optimize workforce placement across provinces, a 5-year predictive model for renewable energy jobs should be developed, accounting for:

   a. National energy transition targets (JETP, KEN);

b. Regional disparities in energy infrastructure development;

c. Technological disruptions (e.g., smart grids, hydrogen economy).

185. Ensure all data collected through the LMIS is gender-disaggregated across training enrollment, graduation, job placement, income levels, and career progression. Establish mandatory reporting requirements and integrate with national labor statistics systems (e.g., Sakernas) to monitor gender gaps and guide corrective policy.

6.3.2.2 Medium-Term (2031–2045)

186. **Industry working groups and feedback loops.** Skills Certification Streamlining. Embedding structured industry participation ensures that the LMIS evolves alongside market dynamics and remains grounded in real-world labor trends.

6.4 PILLAR D. Promoting Inclusive Workforce Development

187. To support Indonesia's equitable and efficient energy transition, workforce development must be localized, inclusive, and accountable.

188. Regional disparities in infrastructure, education, and labor readiness require a decentralized approach that empowers provinces and communities to shape their green workforce strategies. This pillar emphasizes the importance of region-specific solutions that align local energy profiles with targeted training and employment efforts—especially for those at risk of exclusion.

189. In addition, it is important that marginalized groups who have had little access to decent employment opportunities be provided new opportunities for workforce development. Efforts should be made to ensure that groups such as women who are underrepresented in the energy sector are given pathways for acquiring the appropriate skills to participate meaningfully in the energy sector workforce.

190. In the short term, the primary focus is on creating the foundation for decentralized workforce development. This includes setting up the structures needed to assess regional labor market needs, modernizing training infrastructure, and ensuring that local communities directly benefit from renewable energy projects. By implementing these measures, we can ensure that training opportunities are not only accessible but also tailored to the specific needs of each region, leading to more sustainable job creation.

191. In the medium-term, the focus shifts to enhancing inclusivity and ensuring that the green energy workforce reflects the diversity of Indonesia's population. By prioritizing the inclusion of underrepresented groups—such as women, youth, rural communities, and persons with disabilities—we can ensure that the benefits of the green energy transition are equitably shared. This phase will introduce targeted

workforce inclusivity programs to remove socio-economic, cultural, and logistical barriers, ensuring no one is left behind.

192. To ensure impact, inclusive workforce development strategies must be tied to measurable indicators such as: proportion of female trainees completing technical energy programs; percentage of women placed in RE sector employment; and number of leadership roles occupied by women within TVET and green industry projects.

193. In the long term, the focus is on institutionalizing the mechanisms required to ensure sustainability and accountability of the workforce development efforts. This phase emphasizes building frameworks for continuous improvement, data transparency, and ensuring that marginalized groups continue to have access to opportunities. It also includes creating mechanisms for local communities to take ownership of their workforce development needs, ensuring that energy transition goals are embedded within local governance and development.

6.4.1 Expanding Regional Training Opportunities

Timeframe	Actions
Short-Term (2025-2030)	- Promote decentralized workforce planning via regional labor assessments and forecasting - Integrate workforce development into RPJMD plans via Ministry of Home Affairs - Modernize BLKs and polytechnics in priority regions with mobile training units, industry labs, and simulation centers - Mandate local apprenticeship and job quotas for energy projects

6.4.1.1 Short-term (2025–2030)

194. **Promote decentralized workforce planning.** Decentralized, localized workforce planning ensures that each region's unique energy profile is addressed, optimizing training and employment opportunities. Regional Energy and Manpower Offices should **conduct local labor assessments**, identify renewable energy job demand, and forecast regional skill needs in collaboration with PLN, IPPs, and SOEs.

195. **Integrate workforce development in regional plans.** Embedding workforce development into regional development plans ensures a more holistic approach to sustainable local growth and job creation. The Ministry of Home Affairs should integrate workforce development into the Regional Medium Term Development Plan (RPJMD) and allocate matching grants for provinces to establish RE training hubs.

196. **Strengthen local training centers.** Strengthening local training centers increases accessibility to quality education, particularly for remote or underserved

communities. BLKs & polytechnics in priority regions should be modernized with mobile training units, industry-linked labs, and mini-grid simulation centers.

197. **Mandate local apprenticeship and employment for energy projects.** Require energy projects to reserve a certain percent of technical roles for locally trained workers, ensuring that local communities directly benefit from regional energy projects and receive hands-on experience.

6.4.2 Enhancing Inclusivity in Workforce Development

Timeframe	Actions
Medium-Term (2031-2045)	- Establish gender targets: 30–50% female participation in green training by 2030 20% women instructors in TVET by 2035 - Reduce gender pay gap by 50% by 2045 - Deliver targeted programs for underrepresented groups - Scale up outreach, scholarships, and support systems

6.4.2.1 Medium-term (2031–2045)

198. **Develop measurable indicators to track gender outcomes in workforce development programs**. Targets may include:

    a. Minimum 30–50% female participation in all green skills training by 2035.

    b. At least 20% of instructors/trainers in energy-related TVET institutions are women by 2035.

    c. Gender pay gap in renewable energy sector reduced by 50% by 2045.

199. **Deliver targeted programs for underrepresented groups.** These groups often face structural or socio-economic barriers that require tailored solutions. Table 3 outlines illustrative interventions for key groups—including but not limited to women, youth, rural communities, persons with disabilities, and individuals with low economic resources.

Table 3. Targeted programs for underrepresented groups

Group	Interventions
Women	- WIRE Initiative: Scholarships, leadership training, gender quotas in RE projects. - Flexible training schedules and caregiving supports.
Youth (15–24)	- Green Youth Corps: Paid internships in solar/wind farms. - Vocational high school partnerships with RE companies.
Rural communities	- Community-based training (e.g., micro-hydro for village cooperatives). - Subsidized transport to regional training centers.

Persons with disabilities	● Adaptive training tools (e.g., Braille manuals). ● Job matching with inclusive employers.
Low-income Individuals	● Training fee waivers and living stipends. ● Partnerships with social assistance programs for outreach and support.

200. **Scaling up inclusive outreach, financial assistance, and wraparound services** ensures that vulnerable populations are not only aware of green skills training opportunities but are also able to **access and complete them successfully**. For Indonesia to meet its renewable energy targets while maintaining social equity, training pathways must be actively inclusive. Scholarships and living stipends remove cost barriers; tailored support systems like childcare, psychosocial counseling, and mentorship address the **non-financial constraints** that disproportionately affect marginalized groups. These mechanisms are essential to building a broad, skilled, and resilient workforce that can drive the green energy transition in every province— not just urban centers. Moreover, by expanding the talent pool, these efforts help close labor gaps in priority sectors like solar, geothermal, and grid modernization, making the transition faster, more inclusive, and nationally owned.

6.4.3 Ensure Accountability and Transparency in Inclusive Development

Period	Measures
Long-term (2046–2060)	● Integrate a social inclusion dashboard on the LMIS. ● Establish an Ombudsman for Energy Transition Labor Issues. ● Embed workforce development into local governance structures and investing in community-driven projects. ● Institutionalize gender-responsive education, training, and employment systems. ● Secure formal commitments to gender equity from energy sector stakeholders. ● Achieve gender parity across the energy workforce.

6.4.3.1 Long-term (2046–2060)

201. **Integrate a social inclusion dashboard on the LMIS.** Real-time tracking ensures transparency and helps identify gaps in inclusivity, ensuring that efforts are directed to the most vulnerable groups. A social inclusion dashboard should be integrated into the LMIS to track participation rates of marginalized groups in training programs and job placements.

202. **Integrate energy transition labor issues into the scope of the Ombudsman.** An ombudsman fosters accountability and provides a dedicated channel for workers to voice concerns, ensuring fair treatment during the transition. A mandate should be created clearly including labor issues related to the energy transition in the scope of the Ombudsman's responsibilities. This ensures that complaints related to

discrimination, exploitation, and other labor rights issues in the transition can be addressed.

203. **Promote regional empowerment and local ownership.** Empowering local communities to take charge of their own workforce development ensures sustained growth and greater buy-in for the energy transition. Long-term regional ownership over workforce development should be fostered by embedding energy transition goals into local governance structures and investing in community-driven projects.

204. **Fully institutionalize gender responsive education, training, and employment systems.** This measure emphasizes embedding gender sensitivity and responsiveness into every stage of the education-to-employment pipeline. It means that TVET programs must adopt curricula and learning environments that actively support women's participation, eliminate gender biases, and offer equal access to resources and opportunities. By institutionalizing these principles, Indonesia can ensure that women and other marginalized groups are not only included but empowered to thrive in the energy workforce. This aligns with broader Sustainable Development Goals (SDGs), particularly SDG 5 on gender equality and SDG 8 on decent work for all.

205. **Establish formal commitments from energy sector stakeholders to ensure equitable hiring practices, career development, and leadership opportunities for women.** Achieving meaningful gender inclusion requires the active participation of key players in the energy sector. This measure calls for formalized agreements or policy instruments (such as gender equity charters or inclusion frameworks) signed by government bodies, state-owned enterprises, and private companies. These commitments should include clear objectives for fair hiring, mentorship programs, promotion pathways, and leadership development for women. Justification for this measure lies in its potential to remove structural barriers to women's advancement, correct historical imbalances in representation, and foster a more innovative and resilient workforce.

206. **Achieve gender parity across all workforce categories within Indonesia's renewable energy sector, reinforcing gender inclusivity as a national economic priority.** Gender parity—meaning equal representation of men and women—in the renewable energy workforce is not just a social goal; it's an economic imperative. Diverse teams have been shown to outperform homogeneous ones in terms of creativity, productivity, and problem-solving. Achieving parity across all occupational levels—from technical roles to leadership—ensures that the energy transition reflects the full potential of the population. It also aligns with Indonesia's long-term development goals, demonstrating that inclusivity can drive innovation and national competitiveness in emerging global green markets.

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6.5 PILLAR E. Increasing Investments in Green Skills Development

207. **A thriving green economy needs more than just ambition; it requires substantial, reliable, and inclusive investment in human capital.** Pillar E focuses on building the financial infrastructure for Indonesia's just energy transition, emphasizing the importance of mobilizing both public and private finance. The aim is to create fiscal incentives that attract investment while aligning skills development with the specific regional and sectoral demands of Indonesia's energy transition. The strategies outlined in this pillar ensure that green skills development is not only sustainable but also flexible and responsive to the fast-paced changes in renewable energy technologies. This approach fosters an inclusive green economy where all Indonesians, including those from disadvantaged or underrepresented communities, can access the training and opportunities they need to thrive.

208. In the short term, the focus will be on creating a financial foundation for green skills development by establishing sustainable funding mechanisms and mobilizing both public and private sector resources. This phase will also focus on capacity-building through the development of training infrastructures, particularly in regions where the energy transition will have significant impacts. The goal is to create a flexible and inclusive funding structure that can support critical upskilling programs, modernize training facilities, and encourage private-sector involvement in green skills development.

209. In the medium term, the focus will shift towards scaling apprenticeships and enhancing outcome-based funding for TVET institutions. This phase will incentivize industry participation by requiring renewable energy companies to provide apprenticeship opportunities, and it will also link public funding for vocational education to job placement outcomes. These strategies aim to ensure that the workforce is not only trained but is also equipped with the skills and experience that meet labor market demands, thereby reducing the risk of underemployment and ensuring a steady supply of qualified workers in the green economy.

210. The long-term focus will be on embedding green skills financing and governance mechanisms into the broader institutional framework of Indonesia's energy and economic systems. This phase will ensure that the systems put in place in earlier phases remain sustainable, transparent, and accountable, creating a self-sustaining model for green skills development that will continue to evolve in line with new technologies and economic shifts.

6.5.1 Mobilize and Incentivize Green Skills Financing

Period	Measures
Short-term (2025–2030)	- Establish a National Green Workforce Development Fund. - Launch a blended finance facility to support TVET and retraining. - Introduce fiscal and tax incentives for workforce development. - Launch public-private training hubs - Development of Distributed Renewable Energy (DRE) demonstration centers

6.5.1.1 Short-Term (2025–2030)

211. **Establish a National Green Workforce Development Fund**. A dedicated Green Workforce Development Fund provides sustainable financing to green skills development initiatives. By blending public, private, and international funding, Indonesia can ensure that critical programs, such as upskilling fossil fuel workers, are fully financed. This approach diversifies funding sources and provides the flexibility needed to address the rapidly evolving needs of the renewable energy sector.

212. To further expand access to green skills development and promote self-employment, the Fund will also support partnerships with financial institutions, microfinance providers, and cooperatives. These partnerships aim to facilitate access to affordable capital for green micro-enterprises and startups, particularly in rural and underserved areas. Targeted financial products—such as concessional loans, green credit schemes, and startup incubator support—will help green entrepreneurs and skilled workers transition into self-employment or small business creation, increasing inclusivity and economic resilience within the green economy.

213. **Launch a blended finance facility to support TVET programs, retraining initiatives, and modern training infrastructure.** Funding sources include government allocations via APBN (e.g., from MEMR); international climate finance (e.g., GCF, JETP); and private sector contributions (mandatory 1–2% skills levy on large energy projects). Key focus areas for the Fund include the upskilling fossil fuel workers, especially in coal-dependent provinces (e.g., East Kalimantan) and the modernization of vocational labs in renewable energy (e.g., solar, wind, smart grids).

214. **Introduce fiscal and tax incentives**. Fiscal incentives make it easier for businesses to invest in workforce development. These incentives lower the financial barriers to industry participation, ensuring that companies—particularly in the private sector—are incentivized to contribute to the broader goals of upskilling the workforce in the green economy. These measures also encourage inclusivity by promoting the hiring of marginalized groups in green jobs. Provide targeted incentives to encourage private-sector participation and institutional upgrades. Incentives include a 20% tax deduction for companies training workers in RE skills; import duty waivers for TVETs

purchasing RE training equipment; and payroll subsidies for employers hiring women or persons with disabilities in green roles

215. **Launch public-private training hubs**. Develop regional "Skills Factories" co-funded by government and industry (e.g., GE/Siemens-supported technician schools in Sulawesi). It would support to increase regional access to hands-on training, reduces rural-urban skills gaps.

216. In addition, to support hands-on learning and demonstrate the practical applications of renewable technologies in real-world settings, the strategy includes the **development of Distributed Renewable Energy (DRE) demonstration centers.** These demo centers, particularly in rural and remote areas, will showcase applications such as solar-powered irrigation, cold storage, mini-grids, and clean cooking solutions. By linking training to tangible livelihood opportunities, these centers will enhance skills retention, increase awareness of DRE potential, and accelerate community-level adoption—contributing both to local economic development and the national energy transition.

6.5.2 Link Training Investments to Labor Market Outcomes

Period	Measures
Medium-term (2031–2045)	- Mandate industry-led apprenticeships with support for underrepresented group - Provide performance-based grants for TVETs - Strategize regional fund allocation

6.5.2.1 Medium-Term (2031–2045)

217. **Mandate industry-led apprenticeships**. Apprenticeships create a critical pipeline for skilled workers while enhancing job readiness. By ensuring that renewable energy developers participate in apprenticeship programs, this measure will provide hands-on, real-world training that improves workforce retention and quality. Support measures, including stipends and mentorship programs, will also be introduced to ensure that apprentices from underrepresented groups (e.g., women, rural youth) have the resources to succeed. Support measures include stipends and wrap-around services for underrepresented groups (e.g., women, rural youth) and mentorship programs to improve retention and completion rates. Companies such as PLN, Pertamina, and RE developers should be required to reserve a share of entry-level roles for apprentices.

218. **Provide performance-based grants for TVETs**. Link public funding to employment outcomes (e.g., 70% job placement threshold). Shifts focus from inputs (number of trainees) to impact (quality jobs created). Moving beyond a focus on the number of trainees, this performance-based approach ensures that vocational training

programs are aligned with actual labor market needs. By tying funding to measurable outcomes, the government incentivizes TVET institutions to focus on quality training and job placement, which improves the employability of graduates and addresses skills mismatches in the green economy.

219. **Strategize regional fund allocation**. Regional targeting ensures that training and workforce development resources are allocated where they are most needed. This helps balance the energy transition by focusing on regions like East Kalimantan (coal worker transitions) and North Sumatra (geothermal innovation). Tailoring funding to these transition hotspots ensures that workers in regions with higher energy-sector job displacement have access to reskilling opportunities that align with the growing renewable energy sector. Funding to regions should be prioritized based on labor transition needs and RE development potential. Examples include:

   a. East Kalimantan: Coal worker transition through reskilling and job guarantees

   b. East Nusa Tenggara: Solar micro-grid deployment with community-led trainer programs

   c. North Sumatra: Geothermal innovation with drilling simulators for advanced technicians.

6.5.3 Link green skills training to energy projects and planning through transparent, accountable governance.

Period	Measures
Long-term (2046–2060)	- Establish a Transfund governance framework - Tie workforce investments to project approvals - Promote long-term sustainability planning

6.5.3.1 Long-Term (2046–2060)

220. **Establish a Transfund governance framework**. To ensure that funds are used efficiently and equitably, an independent monitoring mechanism for the Green Workforce Development Fund should be established with real-time data enabling corrective action when necessary. Public dashboards enhance trust and allow stakeholders to track the success of training programs and employment outcomes, ensuring that investments are generating the intended impact. Components include:

   a. A monitoring committee to oversee disbursement and flag risks, e.g., corruption in infrastructure projects)

   b. Public dashboards showing real-time data on training investments vs. employment outcomes

221. **Tie workforce investments to project approvals**. Tying workforce development directly to energy project approvals ensures that energy companies take

responsibility for developing local talent. This guarantees that renewable energy projects contribute not just to energy production but also to local job creation, which amplifies the socio-economic benefits of energy transition projects. Renewable energy developers should be required to allocate a portion of project budgets to local workforce training as a condition for licensing. Skills development should be embedded into the energy project lifecycle, enhancing local impact and accountability.

222. **Promote long-term sustainability planning.** Integrate green skills financing into national education and economic planning (e.g., RPJMN, Long-Term Energy Strategy). Ensures enduring policy alignment and secure, predictable funding pipelines beyond donor cycles.

6.6 PILLAR F. Enhancing Partnerships

223. Strategic partnerships contribute to the success of a sustainable energy transition, particularly in workforce development. Pillar F emphasizes the importance of collaboration between government bodies, industry, academia, and international organizations. The goal is to ensure that Indonesia's workforce development strategy is market-driven, globally competitive, and scalable. By fostering these collaborations, Pillar F aims to create a flexible and dynamic workforce that can meet the evolving demands of the green economy. This approach aligns stakeholders across sectors, ensuring that green skills development is inclusive, efficient, and globally recognized, ultimately enhancing the competitiveness of Indonesia's workforce on the international stage.

224. In the short-term, the focus will be on laying the groundwork for robust partnerships by establishing public-private partnerships (PPPs) and creating the necessary policy frameworks.

225. In the medium term, the focus shifts towards strengthening the alignment between industry needs and training curricula, deepening global engagement and institutionalizing collaborative frameworks that ensure sustained quality and competitiveness in green workforce development.

226. Form strategic partnerships with local women's organizations and civil society Organizations (CSOs) to co-design training content, promote outreach in rural and marginalized areas, and ensure the inclusion of women's voices in policy consultations.

6.6.1 Build Strong Public–Private Collaboration Frameworks

Period	Measures
Short-term (2025–2030)	- Establish green skills public-private partnerships (PPPs); - Enact policy enablers for PPPs; - Prioritize partnerships with CSOs, women's organizations, and local advocacy groups.

6.6.1.1 Short-Term (2025–2030)

227. **Establish green skills public-private partnerships (PPPs).** Public-private partnerships accelerate workforce readiness by leveraging the expertise and capital of the private sector, which fills public capacity gaps. These partnerships ensure that training programs are aligned with industry needs, providing a more effective and responsive workforce development system. Through this model, industry partners play a direct role in shaping the skills of the workforce, ensuring that training is relevant to current and future market demands. Co-investment frameworks where government collaborates with RE developers (e.g., PLN, Sun Energy) should be

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formalized to fund training centers, apprenticeships, and upskilling programs. Partnership models include:

a. Skills development funds - Government and RE developers (e.g., PLN, Sun Energy)

b. Industry-adopted TVETs - Equipment and expertise donations (e.g., Siemens, Tesla)

c. Apprenticeship guarantees - Collaboration with IPPs to place a certain number of apprentices annually

228. **Enact policy enablers for PPPs**. Policy enablers reduce the entry barriers for private partners, encouraging sustained participation in skills development programs. Fiscal and regulatory incentives should be provided to boost participation, reducing entry barriers for private partners and incentivizing long-term participation in skills development. By offering fiscal incentives, the government makes it more attractive for companies to invest in workforce development, fostering a collaborative environment that benefits all stakeholders. Examples include a 10% tax reduction for companies sponsoring vocational training programs (BLKs) and fast-track permitting for training centers led by industry.

229. In addition to private sector and academic partners, the roadmap should p**rioritize formal partnerships with civil society organizations (CSOs)**, particularly women's organizations and local gender equity advocacy groups, to ensure inclusive outreach, community co-design of training programs, and sustained engagement of underrepresented populations.

6.6.2 Strengthening the alignment between industry needs and training curricula

Period	Measures
Medium-term (2031–2045)	• Establish sectoral forums for curriculum co-development; • Require ≥3-month industry internships in certification pathways; Develop competency-based certification frameworks; • Align SKKNI with job-specific needs; • Track industry satisfaction and graduate outcomes using KPIs.

6.6.2.1 Medium-Term (2031–2045)

230. **Launch sectoral working groups for curriculum co-development**. Within the framework of SATGAS TEH's Human Resources Capacity Development Group, establish sectoral forums co-chaired by MEMR and the Ministry of Manpower where energy companies and TVETs review and update curricula every six months. This

coordination ensures curriculum reform is aligned with Indonesia's energy transition goals and benefits from national-level policy coherence.

231. **Require mandatory industry internships.** Embed ≥3-month internships into certification pathways to provide hands-on experience with RE systems. Mandatory internships provide essential hands-on experience, enabling students to apply theoretical knowledge to real-world scenarios.

232. **Develop competency-based certification frameworks.** Align SKKNI standards with job-specific needs through BNSP-industry committees and introduce micro-credentials for emerging fields. These efforts should be coordinated under **SATGAS TEH's Human Resources Capacity Development Group** to ensure consistency with national energy transition priorities and labor market forecasts. Competency-based certifications allow workers to gain qualifications that are closely aligned with job-specific skills. By creating flexible certification pathways and offering micro-credentials, Indonesia's workforce can quickly adapt to emerging technologies and niche sectors, enhancing their employability in a rapidly evolving market.

233. **Track industry satisfaction and graduate outcomes explanation.** Use KPIs (e.g., ≥80% employer satisfaction, placement rates) to monitor the quality of graduates and guide funding decisions. Promotes accountability and continuous improvement across the training ecosystem. Tracking private sector satisfaction and graduate outcomes ensures continuous improvement in the quality of training programs. This feedback loop helps adjust curricula and training methods to better meet the needs of employers, improving the overall effectiveness of workforce development.

6.6.3 Deepen global engagement and ensure alignment with global standards

Period	Measures
Medium-term (2031–2045)	● Partner with international organizations to adopt international best practices and jointly develop green jobs taxonomies and certification systems; ● Implement knowledge exchange and train-the-trainer programs; ● Facilitate study tours to top RE training hubs; ● Establish the National Green Skills Council (NGSC).

6.6.3.1 Medium-Term (2031–2045)

234. **Partner with international organizations to adopt international best practices and jointly develop green jobs taxonomies and certification systems**. Aligning Indonesia's national standards with international and regional frameworks—especially within ASEAN—will improve the **portability and recognition of**

qualifications across borders, enhancing labor mobility and allowing Indonesian workers to tap into regional and global green job markets.

235. Collaborate with ASEAN TVET councils and regional quality assurance bodies to develop **mutual recognition arrangements (MRAs)** for green skills certifications. This regional harmonization will enable skilled Indonesian workers to fill labor gaps in neighboring countries while ensuring consistency in training quality across borders.

236. **Implement knowledge exchange and train-the-trainer programs**. Launch ASEAN-wide instructor exchanges and scholarship programs through the international networks (e.g., IRENA Academy). Knowledge exchange programs enhance the capacity of local trainers by exposing them to best practices and innovations from around the world. These cross-border initiatives strengthen institutional capacity, support innovation, and **foster regional peer learning ecosystems**.

237. **Facilitate study tours to top RE training hubs**. Expands local trainer capacity, transfers global expertise, and accelerates institutional learning. Study tours provide valuable opportunities for Indonesian educators to learn from international training hubs. By experiencing the best training practices and technologies firsthand, local trainers can implement these insights to improve their own training programs, strengthening the quality of Indonesia's workforce development ecosystem.

238. **Establish the National Green Skills Council (NGSC).** Form a permanent governance body co-chaired by MEMR and the Ministry of Manpower, including industry associations (e.g., MKI, ISEA), BNSP, and international partners. Provides ongoing strategic oversight, harmonizes cross-sector efforts, and institutionalizes public-private collaboration. One of the Council's mandates will be to **coordinate with regional bodies to ensure certification compatibility and promote ASEAN-wide labor market integration** in green sectors.

7   Implementation Plan and Timeline

239. The successful transition to a low-carbon economy in Indonesia hinges on the country's ability to develop and mobilize a skilled, adaptive, and inclusive workforce. This chapter presents the implementation strategy for specialized workforce development, with clear roles, coordination mechanisms, performance metrics, and continuous improvement processes.

7.1   Institutional Responsibilities and Governance

7.1.1   Lead agencies and coordination mechanisms

240. The implementation of this workforce roadmap adopts a whole-of-government approach **anchored within SATGAS TEH (National Task Force on Energy Transition and Green Economy)**, established by Coordinating Ministerial Decree No. 141/2025. SATGAS TEH acts as the umbrella or "supra-task force" that ensures alignment of sectoral workforce strategy with Indonesia's national energy transition governance framework:

   a. **Central Coordinating Body (CCB).** Between 2025–2030, BPSDM ESDM (under MEMR) will be formally mandated as the CCB for workforce planning in the energy transition. This body will operate within **SATGAS TEH's Human Resources Capacity Development Group** , ensuring strategic coherence and resource alignment with national policies. The CCB serves as the nexus for cross-sectoral coordination, reporting directly to SATGAS TEH's Steering Committee.

   b. **Inter-Ministerial Task Force.** An inter-ministerial workforce task force will be institutionalized **as a working group nested within SATGAS TEH's Human Resources Capacity Development Group**, incorporating representatives from MEMR, Ministry of Manpower, Ministry of Higher Education, Science and Technology, Ministry of Industry, Ministry of Finance (including DJP), Bappenas, and others. This cross-cutting mechanism drives policy alignment, resource mobilization, regulatory reform, and ensures equitable workforce outcomes under SATGAS TEH's high-level guidance.

   c. **Provincial focal points and multi-stakeholder platforms** will operationalize sub-national coordination aligned with SATGAS TEH's decentralized strategy. These platforms will scale nationally by 2035 and institutionalize permanent governance structures by 2046.

   d. **Legal institutionalization**. By 2045, coordination frameworks will be embedded in ministry budgets and RPJMN cycles. A standalone Green Workforce and Just Transition Act is envisioned by 2050.

7.1.2   Roles of government, industry, and academia

241. Effectively building a green and inclusive workforce requires clearly defined and coordinated roles among government, industry, and education sectors, all facilitated through **SATGAS TEH's governance ecosystem**:

- **Government** leads strategic direction, enabling policies, and financing. Ministries including Manpower, MEMR, Bappenas, and Finance harmonize labor, education, and energy policies under RPJMN and climate frameworks. Government agencies finance infrastructure, define SKKNI standards, mandate social safeguards, and ensure inclusion. SATGAS TEH's Socio-Economic & Human Resource Working Group coordinates these efforts, ensuring integration with national energy transition priorities.

- **Industry** acts as the primary driver of green skills demand and a partner in training development. Renewable energy companies co-develop curricula, provide apprenticeships and internships, contribute labor market data, and help define occupational standards. Industry engagement and funding commitments are aligned through SATGAS TEH's platforms, embedding social responsibility into project licensing.

- **Academia and TVET institutions** implement training aligned with certification standards and labor market needs. They innovate curricula, participate in SKKNI development, engage in applied research, and enhance instructor capacity through international exchanges and industry placements. Digital and mobile learning expand access, supporting just transition goals. Their roles and quality assurance are integrated through SATGAS TEH's working group coordination.

242. The following RACI (Responsible, Accountable, Consulted, Informed) matrix consolidates all interventions under the six pillars of Indonesia's National Roadmap for a Specialized Workforce to Support the Energy Transition. It enhances cross-sector coordination and institutional clarity by clearly defining roles.

243. RACI role definitions:

a. Responsible (R): Leads day-to-day implementation.

b. Accountable (A): Ultimately answerable for delivery.

c. Consulted (C): Provides input and feedback; involved in two-way communication.

d. Informed (I): Kept up-to-date on progress; receives one-way communication.

Table 22. RACI matrix for the national roadmap

#	Intervention	R	A	C	I
1	**Pillar A. Improving the Institutional Framework**				
1.1	Designate BPSDM ESDM as Coordinating Body	MEMR (BPSDM)	Bappenas	SATGAS TEH, MoM, MoF, House of Representatives	Provincial Govts
1.2	Endorsement by the House of Representatives	MEMR	House of Representatives	SATGAS TEH, Bappenas, MoF	Public, CSOs
1.3	Establish inter-ministerial and cross-cutting mechanism anchored in SATGAS TEH	SATGAS TEH, MEMR, Bappenas	CMEA	MoM, MoHE, MoI, MoF, House of Representatives	CSOs, Dev Partners
1.4	Establish Regional Focal Points	MEMR Regional Offices	MoHA	SATGAS TEH, Provincial Govts	Local Training Institutions
1.5	Launch Regional Pilot Programs	MEMR, MoM	MEMR	SATGAS TEH, Local Govts, PLN, IPPs	Community Orgs
1.6	Review Overlapping Mandates	Bappenas, MoLHR	Bappenas	SATGAS TEH, MoM; MEMR; Ministry of Higher Education, Science, and Technology	Industry Assoc
1.7	Amend Labor and Education Laws	MoM; Ministry of Higher Education, Science, and Technology; MoLHR	Bappenas	SATGAS TEH, House of Representatives, MEMR, CSOs	Educ Institutions
1.8	Establish Policy Harmonization Framework	Bappenas	CMEA	SATGAS TEH, MEMR, MoM, MoI	TVETs, Prov Govts
1.9	Enact Green Workforce Law	Bappenas, MoLHR	House of Representatives	SATGAS TEH, MoF, MoM, MHEST	Public, Legal Experts
1.10	Embed M&E in Renstra/RPJMN	Bappenas	Bappenas	MoM, MEMR, MHEST, MoI	Regional Planners
2	**Pillar B. Improving Quality of Training Programs and Strengthening Certification**				
2.1	Launch Digital Training Platforms	Kominfo, MoM	CMHDC	MHEST, MEMR, SATGAS TEH	Learners, Providers
2.2	Equip Training Centers	MoM, MEMR, MoPUPR	MoM	Prov Govts	Students, Communities, SATGAS TEH
2.3	Develop Regional Training Hubs	MEMR, Universities	MoM	Industry, Local Govts, SATGAS TEH	Donors, Media
2.4	Introduce Advanced RE Modules	MHEST, MEMR	MoM	Industry Experts, SATGAS TEH	Trainers

2.5	Enhance Trainer Exchange Programs	MoM, MoFA	MoM	Universities, Donors	Trainer Networks, SATGAS TEH
2.6	Establish Global Recognition Program	MoM, BNSP	CMHDC	Certifying Bodies, SATGAS TEH	ASEAN/EU Platforms
3	**Pillar C. Promoting Data-Driven Green Job Market Structuring**				
3.1	Develop LMIS	MoM, BPS, MEMR	Bappenas	MoF, Industry Associations, SATGAS TEH	Training Providers
3.2	Build Skills Forecasting Model	MoM, Bappenas	Bappenas	Energy Employers, Universities, SATGAS TEH	TVETs, Planners
3.3	Collect gender-disaggregated data across all metrics	MoM, TVET Providers & Training Institutions	Bappenas	MoWECP, MoF, BPS, SATGAS TEH	Employers / Industry Associations
3.4	Mandate Industry Reporting	MoM	MoM	PLN, IPPs, RE Developers, SATGAS TEH	Workers, Labor Unions
354	Launch Skills Passport & Heatmaps	Bappenas, MoM	Bappenas	Kominfo, MEMR, SATGAS TEH	Local Govts, Job Seekers
4	**Pillar D. Promoting Inclusive Workforce Development**				
4.1	Conduct Regional Labor Assessments	Reg Energy & Labor Offices	MEMR, MoM	PLN, IPPs, SATGAS TEH	Local NGOs
4.2	Integrate Workforce Plans in RPJMD	MoHA	MoHA	MoM, Bappenas, SATGAS TEH	Local Govts
4.3	Develop measurable indicators to track gender outcomes in workforce development programs	MoM	Bappenas, BPS, TVET Institutions	MoWECP, CSOs & Gender Advocacy Groups, SATGAS TEH	Industry Associations & Employers
4.3	Mandate Local Hiring Quotas	MEMR	MoM	Local Govts, Industry, SATGAS TEH	Public, Media
4.4	Deliver Targeted Programs	MoM	MoM	MoWECP, CSOs, SATGAS TEH	Communities, Beneficiaries
4.5	Integrate Social Inclusion Dashboard	MoM, Kominfo	MoM	CSOs, Advocates, SATGAS TEH	Researchers, Public
4.6	Strengthen Gender Equity Frameworks	MoWECP, MoM	Bappenas	IPPs, PLN, MHEST, SATGAS TEH	CSOs, Media
5	**Pillar E. Increasing Investments in Green Skills Development**				
5.1	Establish Green Skills Fund	Bappenas, MoF	Bappenas	MoM, MEMR, SATGAS TEH	TVETs

5.2	Introduce Fiscal Incentives	MoF	MoF	Industry Associations, SATGAS TEH	Employers, Auditors
5.3	Launch Skills Factories and development of Distributed Renewable Energy (DRE) demonstration centers	MoM, MEMR	MEMR	Prov Govts, Industry, SATGAS TEH	Public, Students
5.4	Mandate Apprenticeships	MoM	MoM	MEMR, Industry, SATGAS TEH	Learners, Trainers
5.5	Disburse Outcome-Based Grants	MoM, Bappenas	MoM	MoF, TVETs, SATGAS TEH	Evaluators, Public
6	**Pillar F. Enhancing Partnerships**				
6.1	Establish PPP Platforms	MEMR, MoM	MEMR	Industry Associations, SATGAS TEH	Donors, Public
6.2	Co-develop Curriculum	MEMR, MoM	MoM	TVETs, Employers, SATGAS TEH	Trainers, Media
6.3	Launch Green Skills Council	MEMR, MoM	CMEA	BNSP, Industry, Dev Partners, SATGAS TEH	ASEAN, Public
6.4	Enable Global Certification Recognition	BNSP, MoFA	Bappenas	IRENA, ASEAN, UNESCO, SATGAS TEH	Institutions, Employers

244. Given Indonesia's complex, multisector governance landscape, this matrix helps to:

    a. Avoid duplication of roles and responsibilities;

    a. Clarify leadership and coordination needs across sectors;

    b. Promote cross-ministerial and regional coherence;

    c. Enable performance tracking and accountability during implementation.

245. This RACI should be reviewed annually and updated alongside RPJMN cycles and evolving institutional mandates.

7.2 Phased implementation strategy (2025–2060) aligned with energy transition milestones and Stakeholder engagement roadmap

246. A resilient, inclusive, and skilled workforce is essential to ensure a successful energy transition in Indonesia. This roadmap chapter outlines a phased, multi-pillar strategy for developing specialized human capital aligned with RE goals from 2025 through 2060. It provides a detailed implementation timeline, responsible agencies, and key performance indicators for coordinated national action.

247. Indonesia's pathway toward a low-carbon, resilient energy future will succeed only if it ensures that no one is left behind. A well-planned and inclusive workforce development strategy is not merely a technical necessity—it is the social backbone of a just energy transition.

248. Through the phased implementation of six strategic pillars—ranging from institutional coordination to training quality, inclusive access, and green financing—Indonesia is building the human capital architecture required for its transition to a renewable energy economy. By embedding green job creation, local hiring, gender parity, and regional equity into every stage of workforce planning, this strategy addresses the social and economic disruptions posed by the shift away from fossil fuels. When fully implemented, this workforce development agenda will enable Indonesia to realize an equitable energy future that is both climate-compatible and socially inclusive.

249. The below matrix will detail the interventions that will be required to achieve the goals of the six objective pillars. Each intervention is categorized under the goals and objectives that it helps achieve and has the following aspects defined for it:

- Performance indicators: Measure of the success of the intervention
- Base year indicators: The progress made as of 2024
- Targeted Indicators: The targets to be achieved for the intervention in the short, medium and long term
- Responsible Ministry/ Agency: The organization/ organizations responsible for the intervention
- Strategic alignment: The existing policy/ policies with which the intervention is aligned to.

Table 23. Detailed matrix of intervention and performance indicators

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
1. Improving the Institutional Framework								
1.1.	Establish Central Coordinating Body	Formalized coordination with endorsed mandates, Governance structures with inter-ministerial task forces, integration into work plans and budgets	No formal coordinating mechanism exists	BPSDM ESDM as the Central Coordinating Body designated; Task force created; Collaborative governance framework fully implemented, Inter-ministerial coordination improved; CBB fully integrated in RPJMN; budget autonomy	-	-	MEMR, MoM, Bappenas, House of Representatives	RPJMN 2025–2045
1.2.	Strengthen Sub-national Engagement	Provincial focal points appointed, Regional consultations conducted, regional pilots launched, Coordination platforms in all provinces, 5-year	Lack of coordination with provinces	≥10 provinces completed regional consultations; 3+ pilots launched; focal points assigned	Regional platforms scaled to all provinces; Multi-level platforms established; Formal		MEMR, Provincial Governments, Ministry of Home Affairs	RPJMN 2025–2045; Green Jobs Just Transition Strategy

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#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
		workforce strategies aligned with RPJMN, Mid-cycle reviews institutionalized			partnerships with ≥3 ASEAN countries, policy cycles institutionalized, Annual multilevel coordination forum held			
1.3.	Initiate Policy Harmonization	Completed mandates review, finalized policy matrix, amended laws, established green apprenticeship standards, launched M&E framework, published green jobs report, activated training dashboards, enacted Green Workforce & Just Transition Act, embedded green workforce provisions in laws, included	National green job policies are not aligned with international labor standards	Overlapping mandates reviewed, Legal framework for green jobs, green apprenticeships, and industry certification standards improved; M&E system launched; workforce coordination and green jobs policy enshrined into a standalone national law or as			Bappenas, Ministry of Law & Human Rights, MoM, MHEST, MEMR, Ministry of Finance	RPJMN 2025–2045, Long-Term Strategy for Low Carbon and Climate Resilience 2050

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
		funding in MTEF, and allocated climate training budgets		a key chapter within broader climate legislation; Fiscal planning tools in place				
2. Improving Quality of Training Programs and Certification								
2.1.	Strengthening certification frameworks	Certifications aligned internationally, Number of new/revised SKKNI	Outdated SKKNI, Limited global alignment	Certification platforms launched, Revised SKKNI in RE sectors (solar, wind, energy efficiency, etc.)	Integration of advanced sectors (hydrogen, digital); AI-driven certification		MoM, BNSP, MEMR, Kominfo	RPJMN 2025–2045, Digital Roadmap 2030
2.2.	Launching Digital learning and certification platforms	- Portal operational with at least 5 core RE courses (solar, wind, EE, grid) available online; - Share of portal content accessible via mobile and low-bandwidth mode; - % increase in users from rural or underserved regions;	Lack of digital training and certification portal	National digital training and certification portal launched, mobile- and low-bandwidth e-learning solutions promoted	Digital portal enhanced with AI personalization, gamification. Partnerships for expanding e-learning content developed; AR/VR introduced in renewable		Kominfo, MoM, MEMR	Digital Roadmap 2030

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
		- AI-powered adaptive learning features deployed (e.g., personalized paths); - At least 3 gamified modules (quizzes, badges, progress scoring) implemented; Number of training modules using AR/VR simulations (e.g., for solar PV install, wind turbine O&M); - Number of training institutions adopting AR/VR tools.			energy training. Digital platforms expanded into a global network			
2.3.	Upgrading training infrastructure and instructor capacity	- Number of upgraded facilities equipped with solar, wind, EV, and battery storage labs; - Number of functional regional training hubs serving	<10 institutions partially equipped, no expansion to meet 2060 RE demand yet, Ad hoc trainer development	BLKs and PPSDM EBTKE upgraded with modern labs and equipment, Regional training hubs established	Training facilities and regional hubs are expanded, advanced renewable energy training modules introduced,	Smart, green energy-driven training centers developed, International Centers of Excellence (e.g., hydrogen, smart	MoM, MEMR, Ministry of Public Works	Indonesia TVET Revamp Strategy; Digital Roadmap 2030

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
		priority RE sectors (solar, geothermal, bioenergy, etc.); - Number of trainees served annually by regional hubs; - Number of facilities expanded or built to accommodate new demand - Number of new advanced training modules (e.g., AI in energy) introduced; - Number of national upskilling programs or exchanges for trainers; - Number of SKKNI or equivalent standards updated or created for advanced RE roles - Number of certified trainers or trainees in those areas;			national and international networks for trainer development strengthened, specialized certifications in advanced renewable energy technologies developed	grids) established		

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
		- Number of newly built or retrofitted training centers powered by RE (solar, geothermal); - % of training centers meeting "green building" or energy self-sufficiency standards.						
2.4.	Enhancing trainer competencies	- Number of bilateral or multilateral instructor exchange agreements signed; - Number of Indonesian instructors participating in international placements; - % of instructors completing industry placements (e.g., at RE companies, utilities);	No formal exchange programs; Separate, small-scale efforts, Limited international certification or visibility	A strengthened and mobilized national trainer workforce through upskilling programs, strategic deployment mechanisms, and structured industry collaboration frameworks (2000 trainers by 2030).	International instructor exchange programs launched, industry-embedded training for instructors organized; National and international networks for trainer development strengthened	Global trainer exchange and research programs created, global recognition of Indonesian trainers achieved	MoM, MEMR, Ministry of Foreign Affairs, BNSP, Universities, International partners	Indonesia TVET Revamp Strategy

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
		- Number of industry partners offering placements annually;						
		- Number of national trainer capacity-building programs conducted annually.						
3. Promoting Data-Driven Green Job Market Structuring								
3.1.	Development of a Labor Market Information System (LMIS)	LMIS launched; Forecasting models operational	No integrated green labor market system	LMIS design and piloting; centralized database for green job forecasting and scenario planning established	Micro-credentials and worker matching implemented, LMIS data used to fast-track certifications in critical roles and update SKKNI standards, Skills Passport system and green job heatmaps introduced; Cross-ministerial		MoM, MEMR, BPS, Bappenas, Ministry of Manpower, Ministry of Finance, Ministry of Foreign Affairs, Industry Associations	Green Jobs Data Strategy; ASEAN labor integration

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
					LMIS integration; Levy mechanisms in place, LMIS integrated with international green job platforms			
3.2.	Data collection and validation mechanisms	Survey data collected	No integrated green labor market system	Mandate industry skills reporting introduced, Baseline surveys conducted, 5-year skills forecasting model for RE jobs developed	An inter-ministerial **a**nd cross-cutting mechanism anchored in SATGAS TEH is established; District and provincial labor offices trained in data collection, visualization, and LMIS utilization	-	MEMR, Ministry of Manpower, Bappenas, Office of the President	Green Jobs Data Strategy; ASEAN labor integration
4. Promoting Inclusive Workforce Development								

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
4.1.	Expanding Regional Training Opportunities	% of provinces with regional labor assessments and RPJMD workforce plans; # of modernized TVET institutions with mobile units, labs, or simulation centers; % of RE projects with local apprenticeship quotas	<10% of provinces; <15 institutions <5% of projects	All provinces with integrated RPJMD plans and labor forecasts; 38 regional centers upgraded; 30% of RE projects with local training/apprentice quotas	-	-	MEMR, MoM, PLN	JETP Implementation Strategy, Local Content Regulations
4.2.	Enhancing Inclusivity in Workforce Development	Training centers upgraded; Employment quotas applied, Inclusion dashboard active, Social inclusion dashboard integrated into LMIS	BLKs outdated; No inclusion monitoring	Regional labor market assessments and forecast RE job demand developed, workforce needs integrated into RPJMD and grants allocated, BLKs and polytechnics equipped with mobile units and simulation centers, mandate	Targeted programs for underrepresented groups implemented; Inclusion institutionalized with LMIS; Dashboard operational; gender-responsive education and employment systems,		Regional Energy and Manpower Offices, PLN, IPPs, Ministry of Home Affairs, Ministry of Manpower, MEMR, Regional Governments	Just Energy Transition Partnership (JETP); Gender Equity Plan

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
				for local employment quotas in energy projects introduced	stakeholder commitments to fair hiring and career growth for women institutionalized			
4.3.	Ensure Accountability and Transparency in Inclusive Development							
5. Increasing Investment in Green Skills Development								
5.1.	Mobilize and Incentivize Green Skills Financing	National fund operational; Apprenticeship participation rates; Performance grants disbursed	No coordinated green skills funding	Green Skills Fund and Blended Finance Facility launched; Public-private "Skills Factories" and Distributed Renewable Energy			Bappenas, MoF, MoM, MEMR	JETP Finance Framework; Climate Budget Tagging Strategy

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
				(DRE) demonstration centers in key regions established; fiscal and tax incentives for green training investments introduced				
5.2.	Link Training Investments to Labor Market Outcomes	Align training funding with job placement and skills demand	No link between training funding and labor market outcomes		Performance-based grant mechanisms piloted in select provinces; Outcome-based TVET funding scaled regionally, Job placement metrics tracked, industry-led apprenticeships with quotas for RE companies mandated, performance-	-	Bappenas, MoF, MoM, MEMR	JETP Investment Plan; Labor Market Intelligence (LMI) Strategy

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
					based grants to TVETs linked to job placement outcomes provided, regional fund allocation for transition-affected areas strategized			
5.3.	Link green skills training to energy projects and planning through transparent, accountable governance.	Institutionalize long-term green skills and financing accountability	Ad hoc coordination; No monitoring of training outcomes or project-level contributions	-	-	Public dashboards in use; Developer training budget commitments required as part of project permitting; Integrated planning with RPJMN/energy strategies begins Transfund governance framework established, Financing	Bappenas, MoF, MoM, MEMR	JETP Finance Framework; Climate Budget Tagging Strategy

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
						integrated in RPJMN; Developer training budgets mandatory		
6. Enhancing Partnerships								
6.1.	Build Strong Public–Private Collaboration Frameworks	Number of PPPs; Curriculum updated biannually; National Skills Council established	No dedicated green workforce partnerships	PPP platforms created;	Internships mainstreamed; Employer satisfaction ≥80%	National Green Skills Council operational; ASEAN/IRENA links formalized	MEMR, MoM, Bappenas, Industry Associations	IRENA Green Skills Agenda; ASEAN Skills Recognition Agreement
	Strengthening the alignment between industry needs and training curricula	Institutionalize regular curriculum co-development and labor market feedback	No systemic curriculum alignment with labor market demand	--	Industry working groups formed; TVET curricula reviewed every 6 months in RE sectors; Mandatory 3-month internships embedded in 80% of RE and		MEMR, MoM, Bappenas, Industry Associations	IRENA Green Skills Agenda; ASEAN Skills Recognition Agreement

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
					green TVET certification tracks; ≥70% employer satisfaction across sectors			
6.3	Deepen global engagement and ensure alignment with global standards	Increase international mobility, recognition, and cross-border capacity-building	Minimal engagement with international green skills networks	-	Bilateral MOUs signed with IRENA, GIZ, ILO, and ASEAN Secretariat; Green jobs taxonomy development initiated; National certification systems aligned with regional standards; 1,000+ trainers participate in ASEAN/IRENA exchange and	-	MEMR, MoM, Bappenas, Industry Associations	IRENA Green Skills Agenda; ASEAN Skills Recognition Agreement

#	Goals/ Interventions	Performance Indicators	Base Year Indicators (2024)	Short Term (2025–30)	Medium Term (2031–45)	Long Term (2046–60)	Responsible Ministry/ Agency	Strategic Alignment
					scholarship programs			

8   Resource Allocation Plan

8.1   Budget Allocation Strategy

8.1.1 Projected financial needs for workforce development programs.

250. This chapter presents a detailed assessment of the financial requirements for implementing the SWIFT Roadmap. The methodology is results-based, linking resource needs to the target indicators and actions defined under each of the six pillars.

251. The financial estimates provided in this Roadmap serve as indicative planning figures, not rigid budgets. Their purpose is to inform multi-stakeholder dialogue, align expectations across government and development partners, and provide a sound basis for mobilizing blended finance—combining public, private, and international contributions. The scope of the estimates covers all six pillars of the SWIFT framework over three phases: short-term (2025–2030), medium-term (2031–2045), and long-term (2046–2060).

252. Apply gender-responsive budgeting principles across all pillars, ensuring that a portion of workforce development funds are earmarked for initiatives targeting female inclusion, safe training infrastructure for women, and childcare support to facilitate participation.

253. All cost figures are indicative, based on comparative international case studies, global and regional benchmarks, expert judgement, and known cost structures in Indonesia's vocational training and institutional reform landscape, Expert assumptions from TVET, labor, and RE project costing, unit-cost scaling and triangulation.

254. Each cost component was estimated using the following formula (when possible):

$$\text{Total Cost} = \text{Quantity} \times \text{Unit Cost per Facility or Measure}$$

255. When applicable, fixed costs (e.g., institutional setup) and operational budgets (e.g., policy rollout, surveys) were treated as lump sums.

256. Key assumptions used in the cost estimations—such as average unit cost per training center, staffing ratios, and expected regional coverage—were derived from recent national and international projects of comparable scope. Sensitivity analysis was conducted on major cost drivers, including construction materials, labor, and imported equipment, using ±15% fluctuation margins. These scenarios helped assess the financial implications of potential cost escalations and ensure adequate contingency planning. The most cost-sensitive areas identified include training center infrastructure, RE simulation equipment, and blended finance leverage ratios.

257. Each measure was assigned to one or more of the following cost categories (Table 24).

Table 24. Cost categories for the budget.

#	Category	Category Description	Measures	Estimation Method
1	Investment	Capital expenditures necessary to implement infrastructure, equipment, or long-term assets supporting the measure.	Construction or renovation of training centers or facilities. Purchase of hardware and specialized equipment (e.g., simulators, laboratory tools). Digital infrastructure (e.g., LMS systems, data platforms for skills tracking).	Based on unit costs from similar previous projects or market benchmarks. Scaled to the scope of implementation (e.g., number of centers, students, or regions covered).
2	Consultancy	Expenditures related to hiring external expertise to support the development, evaluation, or technical advice on implementing the measure.	International or national experts for feasibility studies. Labor market analysis or skill-gap assessments. Third-party advisors for curriculum alignment with energy transition needs.	Calculated as daily or monthly rates multiplied by estimated engagement duration. Benchmarked against standard consultancy rates in the sector and region.
3	Design	Costs associated with the conceptualization and planning of programs, curricula, facilities, or systems before implementation.	Curriculum development and instructional design. Engineering or architectural design of new training facilities. IT platform prototyping or UX/UI development for digital tools.	Lump-sum or percentage of total investment cost (typically 5–15%). May include iteration rounds depending on user feedback cycles.
4	Training/ information	Costs incurred for capacity building, knowledge	Workshops, training-of-trainers (ToT), and re-	Per participant or per session costing (e.g.,

		dissemination, and awareness-raising among stakeholders.	skilling/upskilling programs. Development and distribution of manuals, guides, or e-learning content. Awareness campaigns for workforce, employers, and institutions.	trainer fees, venue, materials). Adjusted for delivery mode (in-person vs. online), frequency, and scale.
5	Regulation	Costs related to developing or updating regulatory frameworks, certification standards, and compliance mechanisms.	Drafting of regulatory texts and national occupational standards. Stakeholder consultations (public-private dialogues, validation workshops). Implementation of certification systems or licensing mechanisms.	Staff time, consultancy inputs, and administrative costs aggregated over the regulatory cycle. Often, a one-time or recurring periodic cost, depending on the regulatory nature.
6	Policy act	Costs involved in formulating, endorsing, and mainstreaming new policies or integrating workforce priorities into broader national strategies.	Policy research and drafting. Inter-ministerial coordination and policy alignment meetings. Dissemination and operationalization workshops.	Primarily based on process facilitation costs and expert input. Scaled to the number of institutions and geographic coverage involved.

258. The investment cost estimates are presented in Table 25 for all six pillars. The cost estimated for each pillar implementation are provided in the Annex.

Table 25. Investment cost estimates by categories, million US$

AREA - TYPE	Investment	Consultancy	Design	Training/information	Regulation	Policy act	Total
Pillar A	4,02	2,29	0,80	0,00	0,65	0,28	8,04
Pillar B	112,00	2,75	6,85	9,40	0,00	0,00	131,00
Pillar C	4,50	4,85	2,00	4,00	0,60	0,30	16,25
Pillar D	13,90	5,90	0,50	56,30	0,25	1,90	78,75
Pillar E	20,50	0,00	16,50	0,50	3,00	0,50	41,00
Pillar F	2,50	2,00	0,50	4,50	3,50	0,00	13,00

TOTAL	157,42	17,79	27,15	74,70	8,00	2,98	288,04

8.2 Implementation Notes and Limitations

259. This costing exercise is intentionally conservative and indicative. It is subject to:

- Inflation and exchange rate fluctuations.

- Cost escalation due to infrastructure bottlenecks or technology dependencies.

- Underestimated delivery capacity constraints, especially at subnational levels.

- Inadequate private sector participation or policy uptake.

260. Moreover, indirect costs such as land acquisition, procurement delays, or coordination friction are not included. These must be tracked during implementation through a dynamic cost-monitoring mechanism under the Central Coordinating Body.

261. To ensure methodological rigor, the costing projections were validated through a triangulation process involving expert consultations, cross-checking against global and regional benchmarks. Feedback was obtained from relevant technical experts in TVET and labor economics to verify unit costs, assumptions, and scaling factors. While projections remain indicative, this validation process reinforces their reliability for planning and financing purposes.

262. A basic sensitivity analysis was applied to test the resilience of major cost items against market fluctuations and institutional risks.

8.2.1 Funding sources (government, SOEs, international donors, private sector).

263. To meet these projected financial demands, the roadmap adopts a multi-pronged funding approach that leverages both public and private resources, as well as international support. The national government will remain a funding provider through strategic allocations in the RPJMN and sector-specific budgets across the Ministry of Energy and Mineral Resources (MEMR), the Ministry of Manpower, the Ministry of Industry, and the Ministry of Education, Culture, Research and Technology. In parallel, state-owned enterprises (SOEs) such as PLN and Pertamina are expected to play a pivotal role by earmarking portions of their project development budgets toward workforce training and upskilling efforts in alignment with regional development strategies.

264. International cooperation and donor engagement are integral to this plan. Indonesia's participation in the Just Energy Transition Partnership (JETP) and its engagement with institutions like the International Renewable Energy Agency (IRENA), the International Labour Organization (ILO), and development agencies such as GIZ and ADB, and other provide critical channels for securing technical assistance and concessional finance. The roadmap also encourages the private sector to invest

directly in workforce development, incentivized through fiscal mechanisms such as tax deductions for training expenses, co-investment grants for accredited programs, and preferential access to green project tenders for companies with demonstrable commitments to inclusive labor development. These incentives are designed not only to mobilize capital but also to institutionalize private sector accountability in the nation's just transition efforts.

8.3   Infrastructure Development for Training and Education

8.3.1   Expansion of existing training facilities and new vocational and technical training centers in key energy transition areas

265. Financial investment is the urgent need to enhance and expand the physical and digital infrastructure required to deliver high-quality training at scale. A key priority is the establishment of new vocational and technical training centers in regions identified as strategic to Indonesia's energy transition. Areas such as East Nusa Tenggara, Sulawesi, Kalimantan, and Papua, which are targeted for renewable energy deployment, will host new centers tailored to regional energy resource profiles—such as solar, geothermal, wind, and micro-hydro—while also providing specialized instruction in areas like energy auditing, electric vehicle systems, and energy storage technologies. These centers are envisioned not only as training grounds but also as community hubs for innovation and inclusive employment generation.

266. In parallel, the roadmap emphasizes the modernization and expansion of existing training facilities, particularly those managed by MEMR through the PPSDM network and by regional governments through Balai Latihan Kerja (BLKs) and polytechnics. These institutions will be upgraded through investments in industry-standard equipment, simulation labs, and digital learning tools. Strategic collaboration with PLN and the private sector will ensure that curriculum design, training content, and instructor capacity are aligned with real-world industrial practices and emerging sectoral needs. This includes embedding trainers within companies for upskilling and encouraging companies to co-develop hands-on modules and apprenticeship schemes.

8.3.2   Integration of digital learning platforms for energy workforce upskilling.

267. Digital infrastructure will be a cornerstone of Indonesia's strategy to democratize access to energy sector training. A national digital learning platform will be developed to provide accessible, flexible, and modular training programs to learners across the country. Designed with low-bandwidth and mobile-first features to reach underserved communities, this platform will include online courses on renewable energy technologies, energy efficiency practices, and digital tools for workforce planning. Over time, it could integrate advanced learning technologies such as

augmented and virtual reality simulations, enabling immersive training in high-risk or technically complex environments. Learners will also be able to earn stackable micro-credentials and certifications aligned with national and international standards, enhancing their employability across borders.

268. The roadmap underscores the importance of aligning these infrastructure investments with data-driven labor market intelligence and regional planning processes. Training centers will be situated and programmed based on workforce demand forecasts and energy deployment maps, ensuring relevance and minimizing skill mismatches. Moreover, inclusive design principles will guide the development of both physical and digital infrastructure, ensuring that women, youth, persons with disabilities, and residents of remote areas can fully access and benefit from the energy transition.

9   Conclusion and Call to Action

269. As Indonesia embarks on its ambitious journey toward a low-carbon and energy-efficient future, workforce development must serve as a foundational pillar to ensure the just and inclusive realization of this vision. The SWIFT Roadmap 2025–2060 presents a holistic, long-term framework to build a resilient and specialized green workforce capable of enabling the energy transition. However, the roadmap's success depends on coordinated action, timely investments, and strong cross-sectoral partnerships.

9.1   Summary of key actions

270. The roadmap outlines clear strategic actions across six interdependent pillars:

   a. Institutional Framework: Establish a Central Coordinating Body and inter-ministerial task force; embed collaborative governance at national and regional levels; institutionalize workforce development in legislation and national development planning (RPJMN, RPJPN).

   b. Training Quality and Certification: Modernize training infrastructure and curriculum; align SKKNI with international standards; expand digital platforms; develop national and international Centers of Excellence.

   c. Data-Driven Job Market Structuring: Develop and institutionalize a Labor Market Information System (LMIS); mandate data-sharing; utilize analytics for forecasting, policy-making, and curriculum design.

   d. Inclusive Workforce Development: Promote regionally driven training systems; increase participation of underrepresented groups (women, youth, rural communities, etc.); institutionalize gender equality and social inclusion in TVET systems.

   e. Investments in Green Skills: Mobilize public-private finance; offer outcome-based funding and tax incentives for workforce programs; link training financing with regional renewable energy deployment.

   f. Partnerships: Deepen collaboration with industry, academia, and international bodies; develop dual education models; promote innovation through joint R&D and knowledge exchange.

271. Each of these pillars supports the ultimate goal: to create a dynamic, inclusive, and high-quality energy workforce that powers Indonesia's energy transition.

9.2   Next steps and immediate priorities

272. To accelerate implementation, the following actions should be prioritized over the next 12–24 months:

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a. Formal Endorsement of a Central Coordinating Body.

b. Launch of a National Inter-Ministerial Task Force to coordinate cross-sectoral workforce policies and planning.

c. Development and Piloting of the LMIS Platform, with real-time green job data and regional labor mapping.

d. Issuance of updated SKKNI for priority renewable energy sectors (solar, wind, energy efficiency).

e. Modernization of 10–15 training centers across key regions, with industry partnerships and new curricula.

f. Establishment of Public-Private Training Hubs, especially in high-transition regions like East Java and Nusa Tenggara.

g. Design of gender-responsive and region-specific training incentives, including stipends and transport support.

h. National stakeholder consultation to finalize implementation modalities and secure multi-year budget allocations.

273. Swift action on these fronts will build credibility, attract investment, and deliver early impact for communities most affected by the transition.

9.3   Collaboration appeal to stakeholder

274. Indonesia's energy transition will only succeed if it is collective and inclusive. Therefore, we call upon the full spectrum of stakeholders to act boldly and collaboratively:

a. Government Ministries must unify efforts, align mandates, and prioritize green workforce development within their planning and budgets.

b. Provincial and Local Governments should actively shape regional training programs that reflect their economic and energy contexts.

c. Industry Players and SOEs are urged to co-invest in training programs, share labor demand forecasts, and embed local employment targets in energy projects.

d. Educational Institutions should adapt programs to fast-evolving skills needs and deepen partnerships with industry.

e. Development Partners and Donors are encouraged to provide catalytic funding, technical assistance, and global knowledge-sharing platforms.

f. Civil Society and Community Leaders must advocate for inclusive access to green jobs, with a focus on women, youth, and vulnerable populations.

275. Only through a coordinated national effort—guided by a shared vision and backed by political will and sustained investment—can Indonesia ensure a just transition that empowers its people, protects its environment, and secures its energy future.

Annex I. Employment factors

Table A1. 1 provides the employment factors used for the workforce projections in power generation in this study.

Table A1. 1. Employment factors in power generation

Technology	Average time of construction	Construction and Installation	Construction and Installation	Operation and Maintenance
	Years	*Job-yrs /MW*	*Jobs/ MW*	*Jobs/ MW*
Ocean	2	10.2	5.1	0.6
Solar (PLTS)	1	1.61	1.61	0.09
Wind (onshore)	2	2.65	1.325	0.21
Wind (offshore)	3	1.5	0.5	0.28
Hydro	2	7.36	3.68	0.14
Gas (all)	2	1.27	0.635	0.14
CCS (gas)	5		2.125	
Nuclear	10	11.8	1.18	0.6
Geothermal	2	6.8	3.4	0.4
Bioenergy	2	14	7	1.5
Coal (all)	5	11.08	2.216	0.22
CCS (coal)	5		2.125	
Pumped hydro	4	7.18	1.795	0.08
Utility-scale battery	1	0.53	0.53	0.03

Sources:
[a] Rutovitz, J. et al. 2025. Updated employment factors and occupational shares for the energy transition
[b] Rutovitz, J., Langdon., R, Mey, F., Briggs, C. (2022) The Australian Electricity Workforce for the 2022 Integrated System Plan: Projections to 2050. Prepared by the Institute for Sustainable Futures for RACE for 2030
[c] Ram, M., Aghahosseini, A., and Breyer, C. 2019. Job creation during the global energy transition towards 100% renewable power system by 2050
[d] US Department of Energy. 2024. Workforce Analysis of Existing Coal Carbon Capture Retrofits

Table A1. 2 provides the employment factors used for the workforce projections in energy efficiency in this study.

Table A1. 2. Employment factors in energy efficiency

Technology	Direct jobs in energy efficiency
	Job-years/million USD
Energy efficiency (industrial)	3.69

Energy efficiency (residential)	3.78
Energy efficiency (commercial)	4.07
Energy efficiency (overall)	3.85

Sources:
[a] Brown, M.A., Soni, A., and Li, Y. 2020. Estimating employment from energy-efficiency investments

Annex II. Regional productivity factors

Table A2. 1 provides the regional productivity factors used for the workforce projections in this study.

Table A2. 1. Regional productivity factors

	Year							
	2025[a]	2030[a]	2035[a]	2040[a]	2045[a]	2050[a]	2055[b]	2060[b]
ASEAN regional productivity multiplier	1.93	1.77	1.63	1.58	1.52	1.47	1.42	1.38

[a] Calculated by Ram, M., Aghahosseini, A., and Breyer, C. 2019. Job creation during the global energy transition towards 100% renewable power system by 2050
[b] Extrapolated from data provided by Ram (2019)

Annex III. Breakdown of resource allocation plan by pillar

PILLAR A. Improving the Institutional Framework

Table A3. 1. Breakdown of the resource allocation plan in Pillar A: Improving the Institutional Framework.

#	Pillar	Measure	Type of measure	Quantity	Related facilities, type, equipment	Unit costs, k US$/ facility or measure	Total costs, million US$	Main source of funding	Type of funding	Time frame implementation	Implementation agency
#01	Pillar A	Designate BPSDM ESDM as the Central Coordinating Body	Policy act	1	Internal restructuring & mandate revision	150	0,15	Gov. Budget	Financing program	Short-term (2025-2030)	Central Gov.
#02	Pillar A	Obtain endorsement of the Central Coordinating Body from the House of Representatives.	Policy act	1	Hearings, drafting, consultations	10	0,01	Gov. Budget	Financing program	Short-term (2025-2030)	Central Gov.
#03	Pillar A	Establish inter-ministerial coordination mechanism on green workforce under SATGAS TEH	Consultancy	1	Secretariat setup, annual workshops, digital coordination platform, expert support	250	0,25	Gov. Budget	Blended (public + TA grants)	Short-term (2025-2030)	Central Gov.
#04	Pillar A	Conduct regional consultations and assign focal points in provincial governments to ensure subnational alignment	Consultancy	38	Workshops, travel costs, staff assignments	30	1,14	Donors	Grant	Short-term (2025-2030)	Central Gov.
#05	Pillar A	Initiate regional pilot programs aligned with national workforce plans	Investment	10	Training centers, demo projects, staffing	250	2,5	IFI/Donors	Grant	Short-term (2025-2030)	Central Gov.
#06	Pillar A	Review overlapping mandates and start aligning labor, education, and energy policies with workforce development objectives	Consultancy	1	Policy review workshops, expert team	150	0,15	Donors	Grant	Short-term (2025-2030)	Central Gov.
#07	Pillar A	Fully implement a collaborative governance framework linking workforce planning with national goals	Design	1	Digital coordination platform, training, stakeholder forums	300	0,3	IFI/Donors	Grant	Short-term (2025-2030)	Central Gov.

#										
#08	Pillar A	Embed coordination mechanisms within ministry budgets and planning documents	Regulation	5	Inter-ministerial planning units	80	0,4	Donors	Financing program	Short-term (2025-2030)	Central Gov.
#09	Pillar A	Scale regional coordination platforms to all provinces	Investment	38	Subnational coordination platforms	40	1,52	IFI/Donors	Grant	Mid-term (2031-2045)	Provincial Governments
#10	Pillar A	Amend national labor and education legislation to formally include green workforce development mandates	Consultancy	1	Legal advisory, parliamentary process	250	0,25	Gov. Budget	Financing program	Short-term (2025-2030)	Central Gov.
#11	Pillar A	Introduce legal instruments to institutionalize green apprenticeships and industry certification standards	Regulation	1	Technical drafting, consultation	150	0,15	Gov. Budget	Financing program	Mid-term (2031-2045)	Central Gov.
#12	Pillar A	Launch a national M&E system for workforce planning	Design	1	National platform, training, data systems	100	0,1	Donors	Grant	Mid-term (2031-2045)	Central Gov.
#13	Pillar A	Institutionalize CCB into RPJMN	Policy act	1	Policy integration support, stakeholder meetings	120	0,12	Donors	Grant	Short-term (2025-2030)	Central Gov.
#14	Pillar A	Secure authority & budget autonomy for CCB	Regulation	1	Legal and administrative support	100	0,1	Gov. Budget	Grant	Short-term (2025-2030)	Central Gov.
#15	Pillar A	Establish permanent platforms for regional, national, and international coordination	Design	1	Annual forums, digital infrastructure	400	0,4	IFI/Donors	Grant	Mid-term (2031-2045)	Central Gov.
#16	Pillar A	Enshrine workforce coordination and green jobs policy into a standalone national law or as a key chapter within broader climate legislation	Consultancy	1	Policy drafting, inter-ministerial consultation	300	0,3	IFI/Donors	Financing program	Short-term (2025-2030)	Central Gov.
#17	Pillar A	Ensure long-term budget commitments through fiscal planning tools	Consultancy	1	Integration in MTBF/MTEF tools	200	0,2	IFIs	Grant	Short-term (2025-2030)	Central Gov.
	TOTAL						8,04				

PILLAR B. Improving Quality of Training Programs and Strengthening Certification

Table A3. 2. Breakdown of the resource allocation plan in Pillar B: Improving Quality of Training Programs and Strengthening Certification.

#	Pillar	Measure	Type of measure	Quantity	Related facilities, type, equipment	Unit costs, k US$/ facility or measure	Total costs, million US$	Main source of funding	Type of funding	Time frame implementation	Implementation agency
#01	Pillar B	Align certification frameworks with international standards (e.g., ILO, IRENA)	Design	1	Expert group, consultation platform	300	0,3	Donors	Grant	Short-term (2025-2030)	Central Gov.
#02	Pillar B	Update/Develop SKKNI for priority sectors (solar, wind, energy efficiency, etc.)	Design	5	Consultant hiring, sectoral working groups, expert panels	60	0,3	Donors	Grant	Short-term (2025-2030)	Central Gov.
#03	Pillar B	Launch national digital training and certification portal	Investment	1	Cloud infra, UX/UI dev, certification engine	1000	1	Donors	Grant	Short-term (2025-2030)	Central Gov.
#04	Pillar B	Promote mobile- and low-bandwidth e-learning solutions	Investment	1	Mobile-responsive LMS, content adaptation	500	0,5	Donors	Grant	Short-term (2025-2030)	Dedicated program
#05	Pillar B	Upgrade BLKs and PPSDM EBTKE with modern labs and equipment	Investment	10	RE simulators, lab kits, software licenses	750	7,5	IFI/Donors	Loan/grant	Short-term (2025-2030)	Dedicated program
#06	Pillar B	Establish regional training hubs aligned with local renewable resources	Investment	10	Solar, wind, hydro kits, trainers, buildings	2000	20	IFI/Donors	Loan/grant	Short-term (2025-2030)	Provincial Governments
#07	Pillar B	Enhancing trainer competencies: conduct skills gap assessment, upskilling 2,000 trainers, certification upgrade, and industry partnership rollout	Training/information	2 000	Gap assessment (1 national + 3 regional), 80 ToT workshops, curriculum & module upgrades, certification processing, national trainer registry	Gap assessment (0.4M), ToT ($3k/trainer), certification ($200/trainer), tools/platforms (0.6M)	7,4	IFI/Donors	Blended (public + grant + concessional loans)	Short-term (2025-2030)	Central Gov.

#										
# 0 8	Pillar B	Launch international instructor exchange programs	Training/informati on	50	Travel, stipend, coordination costs	20	1	Donors	Grant	Mid-term (2031-2045)	International Partners
# 0 9	Pillar B	Organize industry-embedded training for instructors	Investment	100	Placement, industry training modules	10	1	PLN, IPP, Private sector	Financing program	Mid-term (2031-2045)	Industry Associations
# 1 0	Pillar B	Update SKKNI for emerging sectors (hydrogen, AI, digital energy, etc.)	Design	5	Consultant hiring, sectoral working groups, expert panels	100	0,5	Donors	Grant	Mid-term (2031-2045)	Central Gov.
# 1 1	Pillar B	Enhance digital portal with AI personalization, gamification	Design	1	AI engine, gamification modules	1000	1	IFI/Donors	Loan/grant	Mid-term (2031-2045)	Central Gov.
# 1 2	Pillar B	Develop partnerships for expanding e-learning content	Consultancy	10	MOUs, content development funding	100	1	IFI/Donors	Loan/grant	Mid-term (2031-2045)	Central Gov.
# 1 3	Pillar B	Expand training facilities and regional hubs	Investment	15	Buildings, training equipment	1500	22,5	IFI/Donors	Loan/grant	Mid-term (2031-2045)	Provincial Governments
# 1 4	Pillar B	Introduce advanced renewable energy training modules	Investment	10	Content development, ToT workshops	150	1,5	Donors	Grant	Mid-term (2031-2045)	Central Gov.
# 1 5	Pillar B	Strengthen national and international networks for trainer development	Training/informati on	5	Conferences, digital platforms	200	1	Donors	Grant	Mid-term (2031-2045)	International Partners
# 1 6	Pillar B	Update/Develop specialized certifications in advanced renewable energy technologies	Consultancy	5	Expert panels, testing systems	150	0,75	Donors	Grant	Mid-term (2031-2045)	Central Gov.
# 1 7	Pillar B	Fully Integrate AI, IoT, and Automation in Certification Processes	Design	1	Certification automation engine	250	0,25	IFI/Donors	Loan/grant	Mid-term (2031-2045)	Central Gov.
# 1 8	Pillar B	Introduce AR/VR in renewable energy training	Investment	10	AR/VR headsets, content licenses	300	3	IFI/Donors	Loan/grant	Mid-term (2031-2045)	Central Gov.
# 1 9	Pillar B	Expand digital platforms into a global network	Design	1	Interoperable LMS platforms, APIs	2000	2	IFI/Donors	Loan/grant	Mid-term (2031-2045)	International Partners

#	Pillar		Type		Components	Cost		Source	Modality	Timeframe	Lead
#20	Pillar B	Develop smart, green energy-driven training centers	Investment	5	Green buildings, RE installations	5000	25	IFI/Donors	Loan/grant	Long-term (2046-2060)	Central Gov.
#21	Pillar B	Establish International Centers of Excellence (e.g., hydrogen, smart grids)	Investment	3	Labs, researchers, M&E frameworks	10000	30	IFIs	Loan/grant	Long-term (2046-2060)	International Partners
#22	Pillar B	Create global trainer exchange and research programs	Design	5	Fellowships, researcher mobility	500	2,5	Donors	Grant	Long-term (2046-2060)	International Partners
#23	Pillar B	Achieve global recognition of Indonesian trainers	Consultancy	1	Certification alignment, promotional campaigns	1000	1	Donors	Grant	Long-term (2046-2060)	Central Gov.
	TOTAL						131,0				

PILLAR C. Promoting Data-Driven Green Job Market Structuring

Table A3. 3. Breakdown of the resource allocation plan in Pillar C: Promoting Data-Driven Green Job Market Structuring.

#	Measure	Type of measure	Quantity	Related facilities, type, equipment	Unit costs, k US$/ facility or measure	Total costs, million US$	Main source of funding	Type of funding	Time frame implementation	Implementing agency
#01	Establish the foundation of the Labor Market Information System (LMIS)	Regulation	1	Policy dev.	200	0,2	Donors	Grant	Short-term (2025-2030)	Central Gov.
#02	Establish centralized database for green job forecasting and scenario planning.	Investment	1	Cloud servers, modeling tools, dashboards	1500	1,5	IFI/Donors	Loan/grant	Short-term (2025-2030)	Central Gov.
#03	Mandate industry skills reporting	Regulation	1	Policy dev., compliance system	250	0,25	Gov. Budget	Financing program	Short-term (2025-2030)	Central Gov.
#04	Conduct biannual labor surveys	Consultancy	10	Enumerator training, digital tools, processing	300	3	Donors	Grant	Short-term (2025-2030)	Dedicated program
#05	Develop 5-year skills forecasting model for RE jobs	Consultancy	1	Labor modeling experts, scenario tools	750	0,75	Donors	Grant	Short-term (2025-2030)	Central Gov.
#06	Collect gender-disaggregated data across all metrics	Consultancy	1	Survey	100	0,1	Donors	Grant	Short-term (2025-2030)	Central Gov.
#07	Develop dynamic curriculum and micro-credentialing based on LMIS	Design	10	Curriculum teams, LMS integration	200	2	Donors	Grant	Mid-term (2031-2045)	Central Gov.
#08	Uses LMIS data to fast-track certifications in critical roles and update SKKNI standards	Consultancy	5	Workshops, working groups	100	0,5	Donors	Grant	Mid-term (2031-2045)	International Partners
#09	Implement targeted training subsidies and worker matching	Training/information	10 000	Digital portal, beneficiary mgmt.	0,2	2	Municipal budget	Financing program	Mid-term (2031-2045)	Provincial Governments
#10	Launch Skills Passport system and green job heatmaps	Investment	1	App development, job-matching AI	1500	1,5	IFI/Donors	Financing program	Mid-term (2031-2045)	Central Gov.
#11	Industry working groups and feedback loops	Consultancy	5	Meeting logistics, analysis, reporting	100	0,5	Gov. Budget	Loan/grant	Mid-term (2031-2045)	Central Gov.
#12	Enact a Presidential Regulation mandating cross-ministerial LMIS data-sharing and updates	Regulation	1	Drafting, consultation	150	0,15	Gov. Budget	Loan/grant	Mid-term (2031-2045)	Central Gov.
#13	Train district and provincial labor offices in data collection, visualization, and LMIS utilization	Training/information	100	Training, manuals, online platforms	20	2	Donors	Grant	Mid-term (2031-2045)	Provincial Governments
#14	Introduce skills development levy for large RE projects	Policy act	1	Legal study, stakeholder consultation	300	0,3	Donors	Grant	Mid-term (2031-2045)	Central Gov.
#15	Integrate LMIS with international green job platforms	Investment	3	API integration, data protocols	500	1,5	Donors	Grant	Mid-term (2031-2045)	International Partners
					TOTAL	16,25				

PILLAR D. Promoting Inclusive Workforce Development

Table A3. 4. Breakdown of the resource allocation plan in Pillar D: Promoting Inclusive Workforce Development.

#	Pillar	Measure	Type of measure	Quantity	Related facilities, type, equipment	Unit costs, k US$/ facility or measure	Total costs, million US$	Main source of funding	Type of funding	Time frame implementation	Implementation agency
#01	Pillar D	Conduct regional labor market assessments and forecast RE job demand	Consultancy	38	Surveys, analytics tools	100	3,8	Gov. Budget	Financing program	Short-term (2025-2030)	Central Gov.
#02	Pillar D	Integrate workforce needs into RPJMD and allocate grants	Policy act	38	Technical assistance, workshops	50	1,9	Donors	Grant	Short-term (2025-2030)	Central Gov.
#03	Pillar D	Modernize BLKs and polytechnics with mobile units and simulation centers.	Investment	38	Mobile labs, VR/AR kits, equipment	300	11,4	IFI/Donors	Loan/grant	Short-term (2025-2030)	Central Gov.
#04	Pillar D	Mandate local employment quotas in energy projects	Regulation	1	Legal drafting, enforcement framework	250	0,25	Gov. Budget	Financing program	Short-term (2025-2030)	Dedicated program
#05	Pillar D	Develop measurable indicators to track gender outcomes in workforce development programs.	Consultancy	1	Technical support, training	100	0,1	Donors	Grant	Short-term (2025-2030)	Central Gov.
#06	Pillar D	Implement targeted programs for underrepresented groups	Training/information	10 000	Scholarships, mentoring, facilities	0,3	45	Gov. Budget	Financing program	Mid-term (2031-2045)	Central Gov.
#07	Pillar D	Scaling up inclusive outreach, financial assistance, and wraparound services	Training/information	10	10 national campaigns: Communications, case managers, childcare vouchers, financial assistance	50	7,5	Gov. Budget	Financing program	Mid-term (2031-2045)	Central Gov.
#08	Pillar D	Integrate social inclusion dashboard into LMIS	Investment	1	UI/UX dev., indicators, data linkages	500	0,5	Donors	Grant	Long-term (2046-2060)	Central Gov.

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#09	Pillar D	Integrate energy transition labor issues into the Ombudsman's mandate; build institutional capacity and complaint handling mechanisms	Design	1	& capacity building 1 national mandate revision, 1 technical working group, 3 regional pilots	500	0,5	Donors	Grant	Long-term (2046-2060)	Central Gov.
#10	Pillar D	Embed workforce development into local governance structures and investing in community-driven projects	Training/information	38	Technical support, grants, training	100	3,8	Donors	Financing program	Long-term (2046-2060)	Central Gov.
#11	Pillar D	Institutionalize gender-responsive education and employment systems	Investment	10	Curriculum dev., gender mainstreaming	200	2	Donors	Financing program	Long-term (2046-2060)	Central Gov.
#12	Pillar D	Formalize stakeholder commitments to fair hiring and career growth for women	Consultancy	100	Legal tools, MOUs, workshops	10	1	Private	Private investment	Long-term (2046-2060)	Central Gov.
#13	Pillar D	Achieve gender parity and avoid job loss during energy transition	Consultancy	1	Scorecards, incentives, reporting	1000	1	Donors	Grant	Long-term (2046-2060)	Central Gov.
	TOTAL						78,75				

PILLAR E. Increasing Investments in Green Skills Development

Table A3. 5. Breakdown of the resource allocation plan in Pillar E: Increasing Investments in Green Skills Development.

#	Measure	Type of measure	Quantity	Related facilities, type, equipment	Unit costs, k US$/ facility or measure	Total costs, million US$	Main source of funding	Type of funding	Time frame implementation	Implementing agency
#01	Establish a National Green Workforce Development Fund (blended finance: APBN, climate finance, private sector levy)	Design	1	Legal design, admin setup, seed capital	10000	10	IFI/Donors	Loan/grant	Short-term (2025-2030)	Central Gov.
#02	Launch a blended finance facility to support TVET upgrades and retraining	Design	1	Technical assistance, fund design, PPP structure	5000	5	IFI/Donors	Loan/grant	Short-term (2025-2030)	Central Gov.
#03	Introduce fiscal and tax incentives for green training investments (e.g., tax deductions, import duty waivers, payroll subsidies)	Regulation	1	Tax code revision, payroll subsidy design	1000	1	Donors	Grant	Short-term (2025-2030)	Central Gov.
#04	Launch public-private "Skills Factories" in key regions	Investment	10	Co-investment in green tech labs, equipment, trainers	1000	10	Private	Private investment	Short-term (2025-2030)	Dedicated program
#05	Mandate industry-led apprenticeships with quotas for RE companies	Regulation	200	Policy rollout, compliance monitoring	10	2	Private	Private investment	Mid-term (2031-2045)	Central Gov.
#06	Provide performance-based grants to TVETs linked to job placement outcomes	Investment	100	Disbursement based on verified job placements	100	10	Gov. Budget	Grant	Mid-term (2031-2045)	Provincial Governments
#07	Strategize regional fund allocation for transition-affected areas (e.g., East Kalimantan, NTT, North Sumatra)	Design	3	Needs assessment, fund disbursement framework	500	1,5	Municipal budget	Grant	Mid-term (2031-2045)	Central Gov.
#08	Establish Transfund governance framework with monitoring committee and real-time public dashboards	Investment	1	Dashboard dev., committee operations	500	0,5	Donors	Financing program	Long-term (2046-2060)	Central Gov.
#09	Require RE developers to allocate training budgets as condition for project approval	Training/information	100	Legal drafting, monitoring mechanism	5	0,5	Private	Private investment	Long-term (2046-2060)	Central Gov.
#10	Embed green skills financing into national development plans (RPJMN, Long-Term Energy Strategy)	Policy act	2	Expert TA, policy revisions, consultations	250	0,5	Donors	Grant	Long-term (2046-2060)	Central Gov.
					TOTAL	**41,00**				

PILLAR F. Enhancing Partnerships

Table A3. 6. Breakdown of the resource allocation plan in Pillar F: Enhancing Partnerships.

#	Measure	Type of measure	Quantity	Related facilities, type, equipment	Unit costs, k US$/ facility or measure	Total costs, million US$	Main source of funding	Type of funding	Time frame implementation	Implementing agency
#01	Establish green skills public-private partnerships (PPPs) with RE developers and industry (e.g., PLN, Siemens)	Investment	20	MoUs, co-investment models, project facilitation	100	2	Donors	Grant	Short-term (2025-2030)	Central Gov.
#02	Enact policy enablers for PPPs including tax breaks and permitting support	Regulation	1	Policy drafting, consultations, implementation toolkit	500	0,5	Gov. Budget	Financing program	Short-term (2025-2030)	Central Gov.
#03	Establish partnerships with CSOs and women's organizations for inclusive training co-design	Training/information	50	Partnership MOUs, technical assistance, co-design workshops, inclusive community outreach	50	2,5	Donors	Financing program	Short-term (2025-2030)	Central Gov.
#04	Launch sectoral working groups to co-develop and revise curricula every 6 months	Regulation	10 sectors x 2 yrs	Roundtables, coordination secretariat, expert facilitation	50	1	Gov. Budget	Financing program	Mid-term (2031-2045)	Central Gov.
#05	Require mandatory ≥3-month internships in RE systems	Training/information	200	Placement monitoring, reporting, compliance	5	1	Private	Private investments	Mid-term (2031-2045)	Dedicated program
#06	Develop competency-based certification frameworks and micro-credentials	Regulation	10	Framework dev., validation, rollout	200	2	Donors	Grant	Mid-term (2031-2045)	Central Gov.
#07	Track industry satisfaction and job placement outcomes to guide funding	Consultancy	1	Platform dev., surveys, analytics	500	0,5	Donors	Loans	Mid-term (2031-2045)	Provincial Governments
#08	Align with global standards via partnerships (e.g., IRENA, ASEAN)	Design	5	Policy dialogues, benchmarking missions	100	0,5	Donors	Grant	Mid-term (2031-2045)	International Partners
#09	Implement knowledge exchange and train-the-trainer programs	Training/information	200	Workshops, curriculum, certification	5	1	Donors	Financing program	Mid-term (2031-2045)	Dedicated program
#10	Facilitate international study tours for TVET leaders	Investment	50	Study tours to e.g. Germany, Korea, Singapore, etc.	10	0,5	Donors	Financing program	Mid-term (2031-2045)	Central Gov.
#11	Establish National Green Skills Council (NGSC) for governance	Consultancy	1	Secretariat, stakeholder board, operational budget	1500	1,5	Gov. Budget	Financing program	Mid-term (2031-2045)	Central Gov.
					TOTAL	**13,00**				