IMPROVING SKILLS FOR THE ELECTRICITY SECTOR IN INDONESIA

NOVEMBER 2021

ASIAN DEVELOPMENT BANK

IMPROVING SKILLS FOR THE ELECTRICITY SECTOR IN INDONESIA

NOVEMBER 2021

ASIAN DEVELOPMENT BANK

6 ADB Avenue, Mandaluyong City, 1550 Metro Manila, Philippines
Tel +63 2 8632 4444; Fax +63 2 8636 2444
www.adb.org

ISBN 978-92-9269-143-1 (print); 978-92-9269-144-8 (electronic); 978-92-9269-145-5 (ebook)
Publication Stock No. TCS210444-2
DOI: http://dx.doi.org/10.22617/TCS210444-2

Note:
In this publication, "$" refers to United States dollars.

Cover design by Francis Manio.

Contents

Tables and Figure

Tables

Figure

Acknowledgments

Adddressing the mismatch between graduate skills and employer needs has been the major challenge for the education and training sector in Indonesia over the past few decades. Lessons from various studies show that skills providers need a strong understanding of the job market to produce quality and competent graduates. Universities, polytechnics, and vocational schools need to employ a range of measures to address the mismatch issue, for example, by updating their curriculum, providing better learning equipment, improving teacher competencies, and providing internships for students. These efforts will be successful only if skills providers work closely with industry players.

This publication presents the findings of a study analyzing trends in the demand and supply of skills in Indonesia's electricity sector. The electricity sector was selected because of its crucial role in Indonesia's development, because it is undergoing rapid changes due to technological developments, and because it is a sector in which Asian Development Bank (ADB) provides significant support. The study was carried out in 2019 with financing support from TA-9678 INO: Supporting the Advanced Knowledge and Skills for Sustainable Growth Project, funded by the Japan Fund for Poverty Reduction. The study explores the sector's labor needs in terms of skill type, quantity, and location, and compares these needs with what skills are available, at what level, to identify gaps. The report provides recommendations for skills providers, industries, and the government on how to improve the partnership among those actors in addressing the mismatch issue.

I would like to extend my sincere appreciation to Andre Susanto, the team leader of the study, as well as Coaction Indonesia, led by Nuly Nazlia. I also want to express my sincere thanks to the Ministry of Education, Culture, Research and Technology for its support for the study. Appreciation also goes to all partners—public and private companies, local governments, and education providers—who shared their invaluable time to provide data and information through focus group discussions and interviews. Thanks as well to Jet Damazo-Santos, who extracted the full report and prepared a short manuscript, and to Florian Kitt, ADB's energy specialist, who reviewed the manuscript and provided invaluable inputs.

Lastly, I would thank to the team that spearheaded this study: Rudi Hendrikus Louis Van Dael, ADB senior social sector specialist, who initiated the study during his tenure in Indonesia; Sutarum Wiryono, senior project officer, who took over the leadership and supervision of the study until its completion; and Maria Angelica Magali Vivar, associate project analyst, who tirelessly handled the administrative and managerial work for the study and publication.

Jakarta, October 2021

Jiro Tominaga
Country Director
ADB Indonesia Resident Mission

Abbreviations

ADB	Asian Development Bank
EPC	engineering, procurement, and construction
GW	gigawatt
LSP	Lembaga Sertifikasi Profesi (Professional Certification Body)
MEMR	Ministry of Energy and Mineral Resources
MW	megawatt
NZMATES	New Zealand–Maluku Access to Renewable Energy Support
O&M	operation and maintenance
PLN	Perusahaan Listrik Negara (State Electricity Corporation)
PV	photovoltaic
SCADA	supervisory control and data acquisition
SMK	Sekolah Menengah Kejuruan (senior vocational school)

I. Indonesia's Electricity Sector

Indonesia's Power Sector Outlook

Indonesia's industrialization and impressive economic development over the past few decades have resulted in rising living standards and rapid urbanization, all of which have had significant impacts on its power generation needs.

The Government of Indonesia, along with the state-owned power utility State Electricity Corporation (PLN), has made remarkable progress in improving the country's electrification rate from 66% in 2009 to 88.3% in 2015, with a near 100% electrification target for 2026. According to the Ministry of Energy and Mineral Resources (MEMR), key provinces like Bali have achieved 100% electrification as of 2019, while others range between 92% and 99%.

Despite the progress, more work needs to be done. Investments in power generation capacity need to keep pace with the growth in electricity consumption, which is projected to triple between 2010 and 2030 to 77.3 gigawatts (GW) under a business-as-usual scenario.[1] In addition, not all of the areas with access to electricity are connected to PLN's grid infrastructure, which means there are still households relying on solar-powered lamps or expensive diesel generators that pollute the air and cause health problems.[2] These are areas PLN still aims to expand to.

To meet its electrification goals, Indonesia has increasingly relied on coal-fired power, which accounted for 62.8% of total generation in 2019, followed by gas (21.2%), renewables (11.4%), and oil (4%). This is in line with the government's overriding philosophy for managing the country's energy mix, which favors energy independence and low-cost sources.

Coal is viewed as the most efficient source of energy for medium- to large-sized grids—as it is indigenous and generates jobs and economic benefits in the mining sector—followed by gas. This means that both fossil fuels will continue to play a large role in the future of Indonesia's power generation, as seen in the MEMR's power plant energy mix in Table 1.

At the same time, the government is taking steps to increase the contribution of renewable sources of energy. Medium-scale hydropower and geothermal plants, as well as small-scale applications of distributed and off-grid power plants utilizing hydro, bioenergy, solar photovoltaic, and wind complete the power generation makeup of Indonesia.

1 M. McNeil et al. 2019. Forecasting Indonesia's Electricity Load through 2030 and Peak Demand Reductions from Appliance and Lighting Efficiency. *Energy for Sustainable Development. 49 (April).* pp. 65–77.

2 There is no standardized method of defining the national electrification rate for Indonesia. PLN's definition is based on the number of households that are not yet connected to PLN, whereas the Indonesian government's definition includes those who have access to electricity by any means.

Against the backdrop of the unprecedented coronavirus disease 2019 (COVID-19) global pandemic, there is even more impetus to accelerate the shift to clean energy as part of efforts to ensure a more sustainable recovery. According to a new paper from the International Monetary Fund, the economic effects of green investments—including for clean energy—can be 2 to 7 times larger and longer lasting than non-eco-friendly spending.[3]

Table 1: Power Plant Energy Mix

Power Plant Energy Mix	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Fuel	4.0	2.9	1.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4
Gas	21.2	19.3	18.0	18.4	19.6	19.8	22.0	22.0	22.0	22.0
Coal	62.7	65.5	68.2	67.8	66.6	63.7	54.6	54.4	54.4	54.4
Renewable Energy	11.4	11.7	12.2	13.1	13.2	16.0	23.0	23.2	23.2	23.2
Imports	0.6	0.6	0.1	0.1	0.1	–	–	–	–	–

Source: Government of Indonesia. 2019. Ministry of Energy and Mineral Resources.

Transitioning to modern and diversified power generation methods, however, presents both opportunities and challenges. On one hand, it will generate new job opportunities, especially in the regions where the new power plants will be established. In fact, the same International Monetary Fund study found that more jobs are created for each unit of electricity generated from renewable sources than from fossil fuels.

The International Renewable Energy Agency projects that some 1.3 million jobs could be available in the country's renewable energy sector by 2030, up from just over 100,000 in 2017. A study from the Global Green Growth Institute is even more optimistic, projecting about 2.1 million to 3.7 million jobs in renewable energy by 2030.[4]

On the other hand, this modernization could exacerbate the problems the industry currently has in terms of finding skilled workers. In 2017, a survey found that 57% of power sector players in Indonesia identified "skills development" as a "high" or "very high" concern.[5] While electricity-related educational programs in the country appear to produce enough graduates to meet the demand, power sector companies often struggle to hire workers with the multidisciplinary competencies they need.

With the anticipated growth in renewables, skills shortages will present an even bigger challenge, as current training levels have yet to catch up to advancing technology. Renewable energy and its integration to the existing grid require a workforce able to plan and manage grid operations, as well as keep up with new technologies such as energy storage and innovations in ancillary services. Flexible grid planning, operation, and management to allow least-cost dispatch given the decrease in renewable energy costs will be needed to reduce the cost of generation. The successful adoption of these new technologies will require forward-thinking skills development strategies that anticipate technological changes.

3 N. Batini et al. 2021. Building Back Better: How Big Are Green Spending Multipliers? *IMF Working Paper*. No. 87. Washington, DC: International Monetary Fund.

4 Global Green Growth Institute. 2020. *Employment assessment of renewable energy: Indonesian power sector pathways.*

5 PwC. 2017. *Powering the Nation: Indonesian Power Industry Survey 2017.*

These are just some examples of additional skills that are currently not widely available in Indonesia. A lack of local expertise has already caused operational problems in micro and mini-grid photovoltaic (PV) and hydro systems installed through PLN, MEMR, and donor projects in the past, leaving a number of renewable energy projects stranded in various regions.[6]

This means that even if Indonesia's electricity sector continues operating under a business-as-usual scenario, the country would still need to upgrade education and capacity development resources to ensure remote renewable energy projects can be properly operated and maintained. But if Indonesia wants to keep pace with global trends and leapfrog innovations, it would have to ensure its training institutions and capacity development programs are able to produce the kind of skilled labor force a modern power sector would need over the coming years.

The Mismatch in Workforce Supply

Most stakeholders recognize that the electricity sector needs a multidisciplinary workforce, and yet most vocational schools and polytechnics still apply the conventional curriculum focusing on training students in specific skills that are increasingly out of step with industry requirements. To understand why this is the case, it is first important to understand the central and dominant role played by PLN, and how its training approach affects the rest of the industry.

State Electricity Corporation's Dominance

Since it was established in 1965, the state-owned company had mostly operated as a monopoly. With control over all aspects of the power sector, therefore, it was the sole employer in the domestic electricity industry.

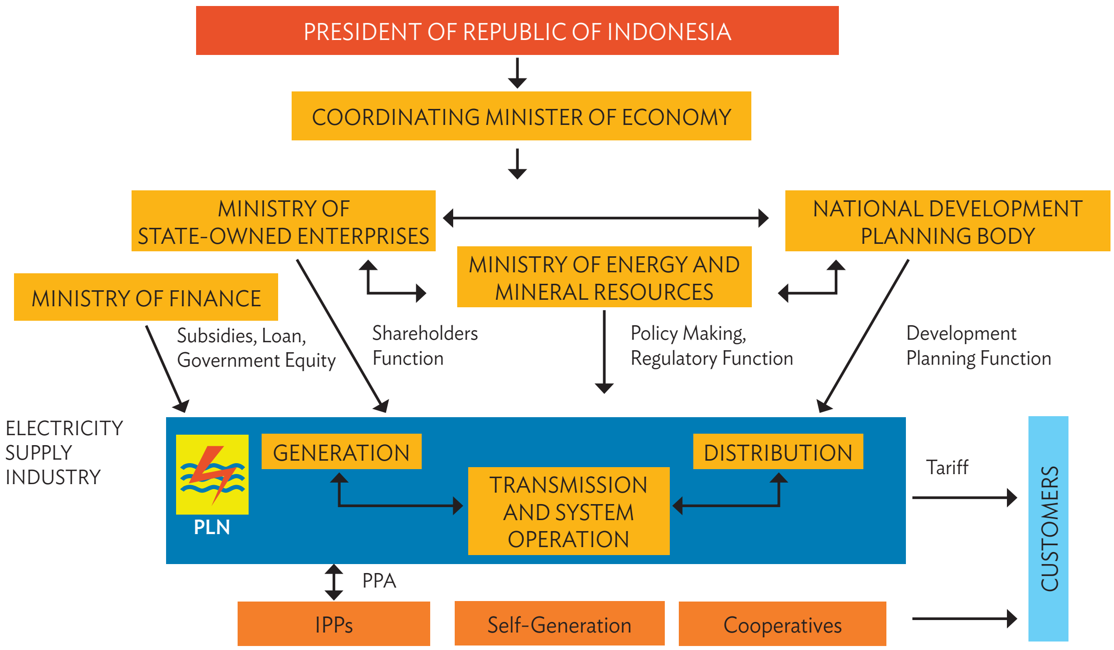
In the 1990s, power supply shortages led the government to invite the private sector to participate in the sector as independent power producers. However, as PLN still controlled the transmission and distribution systems, it continued to be the sole buyer of power from these private entities. This changed in the 2010s following the passage of the 2009 electricity law and the subsequent issuance of MEMR decrees to allow independent power producers to distribute power as well.[7] Though there are now about 50 power companies with business area licenses across Indonesia, most of them only cover industrial complexes and captive power users. PLN and its subsidiary, PT PLN Batam, still hold the electricity supply license for most of Indonesia's land mass.

All this means that the electricity sector in Indonesia is largely driven by MEMR's and PLN's decisions and planning. As most graduates of electricity-related programs will work directly or indirectly for PLN or PLN-related projects, the state-owned company and MEMR have heavily influenced the country's approach to skills training and assessment. For example, MEMR and PLN collaborate to develop specific competencies, establish training curricula, and set up the professional certification institution (LSP). They then charged government agencies fees for the training and certification of their own employees.

In this type of skills development system, the competencies taught and tested represent only the needs of the noncompetitive marketplace and can quickly depart from the actual current and future needs of the sector.

[6] World Bank. 2013. *Clean Energy Resources to Drive Advances in Schooling in Indonesia*. Washington, DC.
[7] R. Prakoso. 2016. Gov't Ends PLN's Monopoly, Brings In Independent Power Producers. *Jakarta Globe*. 30 November.

Figure: Electricity Supply Industry Framework



IPP = independent power producer, PPA = power purchase agreement.

Source: Country Nuclear Power Profiles-Indonesia. https://www- pub.iaea.org/MTCD/Publications/PDF/cnpp2018/countryprofiles/Indonesia/Indonesia.html.

"Ready-to-Use" Mentality

This divergence between the needs of PLN and the rest of the marketplace is evident in the state-owned company's preference for a vocational training system that provides a *siap pakai* (ready-to-work) workforce.[8]

PLN works with several vocational high schools (SMKs) and polytechnics to align their training curricula with what the company needs from the graduates. In these collaboration programs, PLN still expects to provide further upskilling through its own training institution, the PLN Corporate University, as needed.

But the Ministry of Education and Culture, SMKs, and polytechnics have also adopted this *siap pakai* mindset in developing their curricula and programs, with a focus on hands-on activities and classroom lectures that equip students with specific skill sets. The expectation is that vocational school graduates would be ready to work, almost without additional on-the-job training, including in companies other than PLN.

This creates a problem; the fast pace of innovation and development in the electricity sector means that these academic institutions can easily fall into the trap of utilizing outdated equipment, methodologies, and skills if they fail to closely collaborate with a wide range of industry stakeholders.

8 The Indonesian phrase literally translates to "ready-to-use," but in this context, it refers to graduates who are ready to start working because they have the skills needed by the sector.

The sector also needs a workforce with a broad set of multidisciplinary skills. Electricity sector engineers, for instance, also need to possess knowledge and understanding of civil engineering and mechanical engineering. A pressure vessel engineer in a steam turbine power plant would also have to have the same knowledge as a mechanical engineer to safely operate high pressure and high temperature steam-powered equipment.

The siap pakai mindset might also result in a lack of preparedness to learn and adjust to new technologies in the near future. While core technical skills will always be important, new skills required by future technologies should be considered and anticipated. New technologies such as renewable energy power plants, energy storage, artificial intelligence and machine learning in grid management, smart grids, and many others require that the workforce continuously learn and adapt. It is important that the new workers understand this and are trained to have the right attitude to do so.

Industry Survey Findings

In contrast to the *siap pakai* approach, private sector players identified specific attitudes such as self-motivation and willingness to learn among the highly sought-after traits by the industry, instead of specific skills.

This was gleaned from interviews and surveys conducted for this study, which is part of the technical assistance for Supporting the Advance Knowledge and Skills for Sustainable Growth Project, a collaboration between the Government of Japan through the Japan Fund for Poverty Reduction, the Government of Indonesia through the Ministry of Education and Culture, and the Asian Development Bank.

Core stakeholders interviewed—including those from international companies—agree on a number of important items regarding the training, education, and skills of their employees (see Table 2 for the excerpt of the interviews):

(i) They do not hire entry-level employees and even some mid-level employees based on specific trainings or competencies, as knowledge of fundamental academic topics is enough (mechanical, electrical, or civil engineering; accounting; physics; and others).

(ii) It is expected that all employees will be provided opportunities for on-the-job training to build the skills needed to perform their tasks.

(iii) Willingness to learn, self-motivation, confidence, an open mind, and curiosity about new skills are attitudes that are sought after by all interviewees.

(iv) Even if specific skills training is available, the companies expect that they will still have to provide on-the-job training programs beyond the onboarding process of new employees.

In addition to subjective and qualitative interviews with various stakeholders, an online survey was conducted to engage other stakeholders in the electricity sector. Of the 19 respondents, 81% are project developers, and the rest are PLN staff members or are involved in construction, manufacturing, and operation and maintenance (O&M) work related to the sector. A range of technologies was represented, including hydropower, solar photovoltaic, biogas, biomass, and wind, representing power plants of various sizes.

Mirroring the results of the interview with core stakeholders, over 80% of the survey respondents believe that attitude is "important" or "very important" in selecting employees to hire. Based on the interviews, these highly sought-after attitudes are (i) a willingness to learn, (ii) self-motivation, (iii) confidence, and (iv) curiosity. These are difficult to teach in workshops or even in a vocational institution.

Table 2: Excerpts of Interview Responses

Subsector	Education Required	Skills Needed	Notable Insights
Power Generation	Bachelor's degree or higher	Specific industry experience appreciated, but not required at entry to mid-level. Senior- level employees require specific knowledge, experience, and sometimes, manufacturer's skills certifications.	This subsector requires multidisciplinary skills to work together in a project setting. Mechanical, civil, and electrical engineering must work together with other specialized engineering fields as well as nontechnical fields. A well-operating power plant requires the coordination and the collaboration of many disciplines.
Transmission	Bachelor's degree or higher, except for construction and maintenance positions	Technical, regulatory, electrical, power flow simulation for interconnection studies and operation planning	Planning and operation of transmission assets are mainly within PLN. Third-party involvement in these functions is strictly for simulations for development of power generation projects.
Distribution	Bachelor's degree or higher, except for construction and maintenance positions	Technical, regulatory, electrical, power flow simulation for interconnection studies and operation planning	Planning and operation of transmission assets are mainly within electrical business area license holders. Third-party involvement in these functions is typically for simulations for development of power generation projects and other consulting and advisory work.

PLN = PT Perusahaan Listrik Negara (State Electricity Corporation).

Source: ADB. 2019. Study on Skills for the Electricity Sector. Final Report. TA 9678-INO: Advance Knowledge and Skills for Sustainable Growth (unpublished).

Indonesia's Skills Development Landscape

The skills development landscape for the electricity sector in Indonesia comprises a number of layers of formal and informal systems, operated by both the government and private institutions.

The Ministry of Education and Culture oversees the secondary and tertiary formal education institutions, as well as thousands of nonformal training institutions along with the Ministry of Manpower. Private companies and nongovernment institutions, including industry associations and donor agencies, also offer nonformal training programs for specific skills and certifications. At each level, certain challenges exist.

Formal Education System

For skills development in the formal education pathway, the Ministry of Education and Culture regulates SMKs at the secondary level, and polytechnics and universities at the tertiary level.

Of the country's over 14,000 SMKs, more than 2,500 are operating study programs aligned to the electricity sector. Theoretically, an SMK student should be able to study electrical engineering for 3 years, graduate with the theoretical and practical skills needed to pass competency tests, and be able to enter the workforce with these competencies.

In practice, however, factors such as unqualified teachers, outdated lessons, under-equipped schools, and a poorly regulated certification system have left large gaps between the skills supplied by SMKs, the skills tested by certification entities, and the skills demanded by power companies.

At the tertiary level, Indonesia has more than 1,400 higher education institutions offering mechanical engineering; electrical engineering; construction engineering; and energy conversion, and physical engineering among others that relate to the energy sector. More specifically, 383 polytechnics and universities provide electrical program studies, and 21 of these provide energy program studies (including on renewable energy, energy conversion, and power plants).

University graduates and 4-year polytechnic graduates are expected to be able to take on planning and management responsibilities that require multidisciplinary competencies. Polytechnics in Indonesia have a long history of partnering with specific companies to provide specialized training (e.g., automotive assembly) pipelines for job placement.[9] PLN, for example, has a collaboration program with about 15 polytechnic schools across Indonesia, including ones in Papua and Maluku, whose graduates are hired as long as they pass requirements.

However, these educational institutions often face difficulties in finding instructors with extensive or recent experience within the industry. Their instructors are required to have a bachelor's degree or even higher levels of academic achievements, rather than years of relevant experience, exacerbating the problem vocational schools have in keeping up with industry needs.

SMKs and polytechnics also often employ rigid curricula that are difficult to adjust and adapt to changing industry trends. There is also a general perception that the vocational education stream in Indonesia is a second choice for students who were not accepted into the general education stream.

Informal and Continuing Education

Continuing education sources and other forms of nonformal education such as training workshops, online courses, and webinars are expected to supplement the formal education system by teaching workers specific skills or specializations.

Specializations in specific technologies are not skills that can be obtained without strong fundamentals. Steam boiler engineers, for example, need to have very strong mechanical engineering backgrounds before specializing in that technology, whereas solar photovoltaic engineers typically need to have strong backgrounds in electrical engineering.

Backed with strong fundamentals, workers are expected to obtain specializations through workshops and other continuing education sources. In Indonesia, these kinds of trainings are provided by various government agencies, academic institutions, private companies, and even donor institutions like Asian Development Bank:

---

[9] See, for example, R. Maclean, S. Jagannathan, and B. Panth. 2018. Case Study of a Private Sector Firm in Indonesia. *Education and Skills for Inclusive Growth, Green Jobs and the Greening of Economies in Asia: Case Study Summaries of India, Indonesia, Sri Lanka and Viet Nam*. Volume 27. Singapore: Springer.

(i) The MEMR's Human Resource Development Agency for Renewable Energy for New and Renewable Energy and Energy Conservation is one of the leading providers of short-term training in the fields of electricity production and distribution.

(ii) The Ministry of Manpower operates free industrial work training centers across the country called *Balai Latihan Kerja Industri.* Many of them work closely with private sector companies such as Toyota and Nissan to provide trainees with the specific competencies needed by the industry.

(iii) PLN has its own training centers for its employees, with the primary institution called PLN Corporate University. It has a management training center in Jakarta and 13 education and training centers in various cities across the country, each focusing on a specific subject. For example, the training center in Makassar is focused on renewable energy, while centers in Jakarta focus on leadership and corporate culture, assessment, and certification.

(iv) Internationally recognized private training institutions offer health, safety, and environment training and certification in the country, which is usually required for many electricity sector workers. These include Swiss multinational SGS, training and consultancy firm Astutis, and German certification and consultancy service provider TÜV Nord.

(v) Other local training institutions provide specific training and certification for electrical safety as accredited by MEMR, including companies such as Sinergi Solusi, KMMI group, and Lentera Safety. Like health, safety, and environment training, electrical safety training is also important for electricity sector workers.

(vi) Various donor agencies also conduct training programs as needed, such as Asian Development Bank, the Japan International Cooperation Agency, Agence Française de Développement, the United States Agency for International Development, Deutsche Gesellschaft für Internationale Zusammenarbeit, and the New Zealand Geothermal Development Acceleration Program.

Academic institutions such as SMKs, polytechnics, and universities also provide short courses to the public. These are useful for upskilling and mid-career development of those who are already working in the industry.

These informal education sources, though, face a number of challenges. While many informal training institutions are accredited by relevant government institutions, they do not necessarily have the respect of the private sector. As a result, those who finish these courses are not always appreciated as truly competent in their subject.

For donor agencies, the trainings—which range from grid and operations planning to grid integration of renewable energy technology—often overlap with each other and, in some cases, even contradict each other due to a lack of coordination.

Most of the donor-assisted initiatives are also designed for specific knowledge development rather than practical training and certification that enable the participants to earn employment in the field. This is because most donor initiatives have a limit on either the project's implementation period or resources.

Certification Systems

A number of certification systems are available in Indonesia, which can create some confusion.

There are LSPs that are authorized to issue official certifications from the National Professional Certification Agency for short courses. LSPs can be established by education or training institutions, by individual companies, or by professional associations or industry associations for their respective workforces.

Education or training institutions aligned with LSPs are typically available all over the country, and many vocational schools and polytechnics are associated with them so that they can deliver testing to their graduates. However, a conflict of interest can arise when the same trainers from these institutions conduct the assessment and certification of their students, even if it is in cooperation with private sector experts. Under global best practices, trainers do not certify their own students, as doing so could encourage leniency to boost graduating numbers.

In contrast to LSPs, electricity competency certification institutions only provide certifications issued by MEMR for the electricity sector.

Typically, electrical contractor associations such as the Mechanical and Electrical Contractor Association Indonesia, Association of Electric Power Contractors, and the Mechanical and Electrical Contractor Company Association Indonesia provide training for their members and are associated with specific competency certification institutions to issue certifications. These certifications are usually required to participate in government tenders and to conduct electrical installations and repairs.

In addition to these two national certification systems, more and more training providers are offering international certifications from international testing and certification service providers such as TÜV. These are typically not based on agreed-on international qualification standards, but rather on tailor-made qualifications specific for the training provided.

In addition, PLN also has a competency certification agency accredited by MEMR's Directorate General Electricity. Most of the workers certified by PLN's certification agency are those who have gone through its internal training centers. However, they have been able to certify non-PLN employees during open testing and certification workshops.

This means there are different certification systems in place, which serve different purposes. There are no common qualification standards established to compare them, but there are discussions underway on how to harmonize the different systems.

Geographical Challenges

One challenge frequently mentioned by most stakeholders interviewed, both Indonesian and international, is the lack of skilled workers outside of Java. PLN has both fossil fuel and renewable energy power plants even in remote provinces such as Papua and Maluku, however, it often has to bring workers from Java to construct and operate them.

In practice, skilled workers from Java are sent to project locations during the various phases of implementation, starting from construction, commissioning and inspection, operation, and repair and maintenance. This often results in higher labor costs, which directly affects the cost–benefit analysis and financial performance of projects in more remote areas.

The reason for this issue can be seen in the geographical concentration of learning institutions. In Java, the Special Capital Region of Jakarta has the greatest number of institutions at 204, followed by East Java (197), West Java (175), Central Java (128), Jogjakarta (68), and Banten (38). On the other end of the spectrum are provinces like North Kalimantan and West Sulawesi, which only have three higher education institutions offering courses related to the energy sector.

To illustrate, across all 5 provinces in Kalimantan, there are only 19 universities offering mechanical engineering programs, which produced 602 graduates in 2018. The 5 provinces of Sulawesi have 31 schools offering this degree that saw 626 graduates in 2018, East and West Nusa Tenggara have 6 schools with 147 graduates, Papua and West Papua have 9 schools with 89 graduates, and Maluku and North Maluku have 4 schools with 11 graduates.

That makes for a total of just 69 schools producing 1,475 mechanical engineers in 16 of Indonesia's 34 provinces. In contrast, the capital of Jakarta alone has 77 higher education institutions that produced 3,521 mechanical engineers in 2018.

This same pattern is consistent for other courses and in vocational schools. East Java province alone has 134 vocational schools with almost 25,000 electrical engineering students as of March 2020, while all 5 provinces in Kalimantan had 41 vocational schools with fewer than 6,000 students.

However, experiences by companies that provide training and capacity development such as social enterprise Inovasi and consultancy firm Dendrite indicate that it is not enough to have training institutions available locally. The successful training programs in the past were those that involved PLN and other private companies in the program design, which resulted in more than 90% of trainees getting hired.

What is needed, therefore, are demand-driven competency-based curricula in schools, especially polytechnics, and short courses for upskilling and mid-career training for those already in the job.

II. Workforce Needs

To determine what kind of educational system or training program would meet the needs of the electricity sector, the study conducted interviews with companies to understand the range of skills it needs. The study found that within each subsector—generation, transmission, distribution, and even retail sales—the workforce needs also vary based on the project's milestone within the value chain.

The findings emphasize that the electricity sector needs workers that not only have a broad set of multidisciplinary skills, but that also are capable of continuously learning and adapting as the industry evolves along with new technological developments.

The Skills Needed

Core Areas and Skills Required

Project Development

Skills needed: Project planning, project finance, regulatory analysis, resource assessment analysis, data analysis, negotiation and lobbying, environmental assessment, procurement, logistics, stakeholder engagement

At this stage of the value chain, a needs assessment of the project is performed and project planning documents are developed. This means a multidisciplinary team is needed to first analyze whether the project is needed, determine what resources are required, calculate the costs that will be incurred, assess its financial viability, and develop a business model.

Aside from project planning skills, the team will need to deploy workers with technical skills to analyze electricity grid demand. If the project involves new technologies such as energy storage, smart grids, and new power plants, the team will also need to be able to understand how they affect the operation of the existing grid.

System Design and Planning

Skills needed: Engineering drawings, engineering design, data analysis, procurement, logistics

Once the project proposal has been developed and approved, the next step is to design and plan for the construction. Typically, this is done by an engineering, procurement, and construction (EPC) company.

In this stage, the skills required are largely technical in nature, with the addition of procurement and logistics experts to help with the project planning. Workers needed here range from entry-level engineers performing basic engineering drawings and design, to more experienced engineers and those with specialized skills who are needed for the system design and planning. The skills and knowledge required here are typically obtained from work experiences and/or nonformal education.

Construction and Implementation

Skills needed: Engineering (civil, mechanical, electrical), project management, skilled construction works, procurement, logistics, budget control

The EPC company that designed and planned the project will then be tasked to procure and construct the project assets. During the construction, most of the workers needed will be field engineers and technicians, with some project supervisors and project management experts.

The skills required for this stage are the only ones that can potentially be taught in formal settings such as SMKs and polytechnics, due to the hands-on nature of the work at this stage. Electrical, civil, and mechanical engineering technicians and engineers trained specifically to perform the construction tasks and hands-on activities are largely the ones required here.

It is important, however, to ensure that formal training institutions remain updated with current technologies, to ensure that their training curriculum and methodologies are always relevant to the current needs on the field. These types of trainings also need to be provided outside the main islands of Java and Bali, as EPC companies often struggle to find these types of skilled workers, especially for projects in Eastern Indonesia.

Testing and Commissioning

Skills needed: Instrumentation, mechatronics, electrical engineering, electronics engineering

Within the EPC company, there needs to be a testing and commissioning engineering team relevant to the types of projects they are involved in. It is crucial that the testing and commissioning engineers are up to date on the latest technologies their company is installing on the field.

Third-party inspectors are also needed at this stage to test and commission the electricity installations, ensuring that they meet the standards set by the MEMR, before issuing operational readiness certificates. A worker can get training and certification to become a third-party inspector through nonformal training institutions such as accredited certification issuers for the relevant subsectors.

The skills required by both the internal testing and commissioning engineers and third-party inspectors are the same: good fundamental engineering knowledge with specific knowledge in the subsector the project is in.

Operation and Maintenance

Skills needed: Technical, maintenance planning, management, troubleshooting, inventory management

Once the project is built and commissioned, operations finally commence. This stage requires workers who are capable of not only performing the operations activities, but regular maintenance tasks and repairs as well.

Much of the tasks for O&M activities are prescriptive and usually follow standard procedures, which means they can be handled by workers who have good fundamental knowledge from formal training institutions, plus additional trainings specific to the sector and technology they are working in.

Because the level of skill required here is lower than in the other stages, it is usually easier to find technicians and engineers locally for O&M activities. However, there is still need for additional local workers due to the higher number of electricity infrastructure development projects in Eastern Indonesia, Kalimantan, Sulawesi, and even Sumatra. PLN's electricity supply plan shows significant numbers in additional transmission, distribution, substation, and power plants for the next 10 years.

Supporting Areas and Skills Required

Electricity Supply Planning, System Level Planning, and Grid Management

Skills needed: Technical, regulatory, electrical, power flow simulation for interconnection studies, and system planning

PLN and the private companies that hold electricity business area licenses are responsible for anticipating and planning for the growing energy needs of their customers. As new power plants are required, system-level planning and grid impact studies are required to ensure grid stability.

Closely related to these tasks is grid management. This requires ensuring that the dispatch of the power plants is in accordance with merit order rules, which involve factors such as take-or-pay clauses in each power plant's contract, true fuel costs, capacity charges (if any), minimum loading of the power plants, power purchase agreement tariffs, operational costs, and many others. Grid management is a crucial role that has never been transparent outside of PLN. However, this is what determines the country's electricity supply mix and how much renewable energy and fossil fuel-based energy is produced.

Therefore, this area requires a highly skilled and experienced workforce, with seniority to work across different departments. Grid management and planning is not a stand-alone activity, but requires inputs, data, and coordination with other subsectors within the value chain.

Information and Communication Technology

Skills needed: Instrumentation, mechatronics, electrical engineering, electronics engineering, information technology, information technology security

Seemingly unrelated to the power sector, information and communication technology is a key component of a modern power sector, especially as the use of smart grids and artificial intelligence increases.

The implementation of a supervisory control and data acquisition (SCADA) system is one of the most cost-effective solutions throughout the lifetime of most electricity supply assets. SCADA improves the overall efficiency of generation, transmission, and distribution systems, largely by automating many of the manual processes. To implement a SCADA system, two levels of workforce will be needed: One to design, install, and operate the SCADA hardware itself; and another to develop plans and strategies, and to manage the utilization of the SCADA system's capabilities for operating the electricity network in the best manner.

The next step up from the SCADA system is a smart grid, which uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end users. Smart grids coordinate the needs and capabilities of all generators, grid operators, end users, and electricity market stakeholders to operate all parts of the system as efficiently as possible, minimizing costs and environmental impacts while maximizing system reliability, resilience, and stability.

Similar to the implementation of a SCADA system, a smart grid needs two levels of workforce: One to design, install, and operate the system itself, and another to develop the logic for the system to operate and make decisions based on the information it collects and the type of equipment it is able to control remotely.

Extremely important in both smart grid and SCADA implementation is a reliable communications network. While installing this can often be outsourced to third-party service providers, it is important for electricity companies to have their own internal experts to develop reliable telecommunication strategies compatible with PLN's system.

The next evolution of SCADA and smart grid systems is the inclusion of artificial intelligence and machine learning, which incorporates additional information such as weather predictions to make decisions on the automated operation of an electricity utility grid.

Unfortunately, the full implementation of a SCADA system or smart grid can eliminate a significant number of unskilled to semi-skilled workers currently employed to perform manual tasks. At the same time, automation and the adoption of more sophisticated technologies create demand for more highly skilled workers. The more ambitious unskilled and semi-skilled workforce can succeed in obtaining the skills to fill these positions that come with better wages. What needs to be made available, therefore, are the capacity building and training programs that can provided these information and communication technology-based skills.

Electrical Health and Safety

Skills needed: Technical, regulatory, electrical, power flow simulation for interconnection studies, and system planning

Each energy technology has its own set of health and safety concerns. Like how the oil and gas, and mining sectors have strict health and safety requirements, the electricity sector also has specific health and safety needs that require a skilled workforce to uphold.

Working on "live" lines with medium and high voltage, for example, has inherent risks that are specific to the electricity sector. A boiler and pressure vessel engineer working in a biomass electricity power plant or coal power plant also needs to understand electricity-related risks and health and safety issues unique to their work.

Other occupational risks that the electricity workforce should have skills to minimize include electrical shocks, electrical fires, and falls from pole and tower climbing. Workers should also be knowledgeable in general electrical safety procedures and sector-specific personal protection devices.

Cross-Cutting Positions

Skills needed: Public policy and government affairs, finance, human resources and development, communication, management and administration

Aside from the core technical roles and skills, other occupations such as public policy and government relations, finance, human resources and development, communications, and management and administration are also needed. As they are responsible for activities that impact the entire project value chain, their roles can be very critical to the success of power projects.

Though these are nontechnical jobs, workers in these positions should still have a basic understanding of the business and regulatory framework and remain updated on sector issues.

Labor Supply and Demand

Based on numbers of graduates and students alone, Indonesia is not expected to experience a shortage in workers for the electricity sector over the medium or long term.

By the year 2025, it is estimated that there will be 757,230 technical skills related to the electricity sector available in the workforce. These estimates are based on the constant addition of electricity-related graduates every year, assuming the number of electricity-related programs offered in SMKs, polytechnics, and universities remains the same and the number of students in each program is constant. Based on this assumption and extrapolating from 2018 data (Table 3), that workforce will have a substantial number of construction, mechanical, and electrical engineers.

Table 3: Top Graduates Produced by Higher Education Institutions

Program	Graduates	Schools Offering the Program
Civil and construction engineering	19,047	447
Mechanical engineering	17,462	451
Electrical engineering	16,742	482
Energy, conservation, and physics engineering	1,101	26

Source: Government of Indonesia. 2018. Higher Education Database (PDDikti).

The expected number of skilled workers by 2025 is theoretically more than sufficient to supply the country's projected workforce needs based on a comparative factor method estimate of Indonesia's national electricity plan, and even a more aggressive forecast using a higher employment ratio from a Greenpeace study.[10] By that year, the electricity sector is only projected to need 74,696 full-time equivalent workers based on the Greenpeace estimate, which is less than 10% of the 757,230 skilled workers potentially available in the market by then.

However, the challenge in Indonesia is not about quantity, but of quality and skills mismatch, particularly as the use of renewable energy and more advanced technology grows. Renewable energy engineering, for instance, is offered by only 31 vocational schools across the archipelago, with 1,193 students as of March 2020 (Table 4).

Indonesia's national electricity plan includes significant targets for renewable energy power plant installations, especially beyond 2025. Hydropower is projected to be four times more than the current installed capacity, solar PV is projected to increase by 260 times the current installed capacity to 6.5 GW, and wind is projected to increase 11 times the current installed capacity. By 2030, therefore, there will be a significant increase in the skilled workforce specific to renewable types of energy (Table 5).

Table 4: Top Competencies Studied in Vocational Schools (SMKs)

Program	Students	Schools Offering the Program
Construction and property engineering	138,348	1,019
Geology and mining engineering	64,936	667
Building engineering	30,774	701
Electrical engineering	4,885	92
Petroleum engineering	2,367	38
Renewable energy engineering	1,193	31

SMK = Sekolah Menengah Kejuruan (senior vocational school).

Source: Data Pokok SMK. http://datapokok.ditpsmk.net/ (accessed March 2020).

10 Greenpeace International and European Renewable Energy Council (EREC). 2013. *Energy (r)evolution, a sustainable ASEAN energy outlook 1st edition*. Manila. pp. 76–78.

Table 5: Projected Full-Time Workforce Needs in Renewable Energy

	2030		2040		2050	
Type of Energy	CFM	GER	CFM	GER	CFM	GER
Geothermal	17,105.7	103,230.0	24,689.2	148,995.3	32,272.7	212,306.6
Micro hydro	25,939.6	172,263.0	36,861.5	236,126.5	47,783.4	306,990.0
Hydroelectric	30,962.2	171,517.3	42,234.1	233,958.7	53,506.0	334,400.0
Solar power	260,346.4	257,020.0	506,231.8	535,760.0	742,294.7	859,500.0
Wind power	5,638.2	61,952.0	14,031.5	154,176.0	22,424.8	274,400.0
Biomass	91,947.3	176,640.0	151,418.3	327,520.0	221,172.8	504,400.0

CFM = comparative factor method, GER = Greenpeace employment ratio.
Source: Government of Indonesia. 2017. Ministry of Energy and Mineral Resources.

PLN will also need additional skilled workers much earlier than in preparation for achieving these targets. Grid planning and operation and maintenance workers will need to be significantly increased to ensure the grid is ready for additional generation capacity. It is also expected that widespread use of SCADA systems for new power plants will require information and technology experts familiar with instrumentation and remote monitoring and control systems.

III. Recommendations

The following recommendations are short- to medium-term actions that can be implemented quickly and continue to be utilized in the long term to address the rapid changes in the electricity sector. They are designed to cater to mid-career and recent graduates who need to upskill their fundamental engineering knowledge.

Study programs to implement well-established practices and skills in the electricity sector may need to be updated and new ones created to adapt and to future-proof the graduates. Future electricity sector-specific study programs should be designed beyond the electrical engineering discipline, but also to include mechanical and civil engineering, and other related disciplines.

The solutions and recommendations provided here will be able to drive these new study programs because they provide the materials and the capacity development experiences before being finalized in the formal education system's new study programs. Universities and polytechnics can already be involved in providing these solutions similar to the way other higher learning facilities globally have provided capacity development and mid-career capacity development programs.

a. Shift to employment prospect-oriented training programs that are responsive to the market

As the *siap pakai* approach has not proven effective given the mismatch between supply and demand for graduates in the electricity sector, vocational schools and polytechnics should track the performance of their graduates in the market to evaluate the effectiveness of their programs. With updated information on market demand and changing requirements in consultation with the industry, the schools can then make adjustments to their programs and curricula.

This can be done by providing supplementary courses to their existing curriculum (such as mechanical engineering, electrical engineering, and others) that are tied to industry and business needs. They can establish new training programs, update their current syllabus with new technologies, and incorporate green skills. Introduction and access to industry can also be considered, such as through internship programs.

b. Private sector-driven competency certification

To ensure that competency certifications are recognized and respected by the private sector, industry-focused competency certification accreditation agencies are needed. These agencies can collaborate with the private sector to develop training programs and competency certification schemes tailored to their needs.

The certification should be voluntary and should not be a requirement for employment, business licenses, or government tenders. This significantly reduces the possibility of corruption and conflicts of interest. The important point is that employers can be confident that the workers who possess the competency certificates indeed have the competencies stated in them.

One successful example of this scheme is the North American Board of Certified Energy Practitioners, which issues various occupations-based competency certifications for solar PV and solar thermal workers. These certifications are voluntary, but have gained very high respect from the industry and government. Many state governments require that solar PV installations are done by certified technicians and engineers before they become eligible for any solar PV incentives.

Another successful example of this scheme is the Clean Energy Council's various occupations-based competency certification for solar PV professionals. Its requirements for receiving the certifications are very high and match very well with what the industry needs. Clean Energy Council-certified workers and inspectors are highly sought after and respected in Australia's solar industry.

c. State Electricity Corporation-driven competency certification

Similar to the above recommendation, a competency certification that is tailored to meet industry best practices and that specifically meets PLN's requirements can be developed. Both the formal education sector (such as polytechnics and universities) and informal education sector (such as training institutions) need to work closely with PLN in developing common occupational competency requirements.

While PLN already has collaboration programs with 15 universities and polytechnics across the country, these are still focused on the supply side of the labor force, with their graduates able to enroll in PLN's training program for its employees. Instead, the recommendation is for PLN to work with the schools so that they can teach the skills and knowledge currently only taught within PLN's training centers.

PLN's training centers should instead be used to upskill existing employees to adapt to new technologies and skills, not to teach new graduates skills and knowledge that can be taught in schools. If schools are able to teach these skills, they can produce graduates that are ready to work not just for PLN, but for other electricity-related companies as well.

d. Electricity sector capacity development board

To support recommendations b and c, there needs to be a coordination board that will organize the capacity development needs of various electricity sector stakeholders. Its members should comprise representatives from various relevant ministries, PLN, private sector companies, and formal and nonformal educational institutions. This board should be high-level enough to have sufficient credibility and influence across all stakeholders.

The board will be tasked with reviewing existing electricity sector training and education curriculum and training materials for relevance and recommendations for any new technologies, industry best practices and standards, and new techniques. With inputs from all the stakeholders, the recommendations will be utilized by educational institutions to improve and update their curriculum and training materials as needed, and as resources become available.

e. Online platform for electricity sector capacity development

Currently, there are hundreds of training workshops available for capacity development and certifications in the electricity sector, making it difficult to search and find the exact training program needed.

It would be more efficient if MEMR can operate an online platform where all electricity-related trainings, workshops, and certification programs must report to. Once the capacity development program is reported, it is publicly displayed on a searchable online platform. Donor-assisted initiatives will also be required to report their training activities.

This will allow anyone to search a single online database for the competency training and certification they need for the electricity sector. In addition, this will allow all the stakeholders to better coordinate the amount and type of training needed by the workforce.

f. Massive online open courses

To address the problem of formal trainings being too rigid and difficult to adapt to new technologies and skills, MEMR can develop massive online open courses that can easily adapt to changing technologies and provide timely and relevant trainings to the electricity sector workforce.

These online courses should have standard formats and procedures that are voluntary, but available for instructors who must come from the industry. The standard format and procedures allow the instructors to quickly provide new materials by focusing on the content rather than the format of the media. However, it should be voluntary to accommodate instructors who have a unique style of delivery or have developed unorthodox, but effective training tools and methodologies.

This allows the online open courses to provide very relevant information to the workforce in a timely manner and be able to adapt to new technologies.

g. Modular training for formal education and mid-career capacity development

Training and capacity development modules that meet the occupational skills standards accepted by the industry can be developed for both formal education and mid-career capacity development.

The modules, when taken together in series, can serve as the basis of graduation requirements for formal education students, such as a bachelor's degree in engineering with electricity specialization.

If the modules are prepared properly, they can also be taught separately to serve a very focused topic, such as solar PV system O&M, medium voltage substation switchgear repair, and many others. These modules can then be taught as separate courses to workers seeking to build their capacity while working.

When these training modules are designed and deployed to match with the Indonesian National Qualification Framework, an employee can take these courses while working to eventually attain the same competencies and certification that a formal education program graduate has.

This approach streamlines and coordinates both the short courses (1–4 weeks) that most working people are able to attend, and the need for improvements in the competencies of formal education sector graduates. The same training modules and materials can be used in both the formal and informal sector to give students and training participants the same level of competencies.

IV. Case Studies

South Sulawesi: Educational Institutions as Labor Providers

By 2028, South Sulawesi province aims to reach a total power plant generating capacity of 2.1 GW, including 1.3 GW from renewable energy plants. Based on this, more than 2,900 professional technicians are projected to be needed in the province by 2028, based on conservative estimates. Specifically for the renewable energy sector, the planned 1.2 GW of hydropower plants will increase workforce demand by 2,448 technicians. The development of transmission and substations will require another 606 technicians for O&M services.

However, South Sulawesi only has five higher education programs related to the energy sector. Its mechanical engineering programs produced 57 graduates in 2018, while the undergraduate program for machine engineering available in 12 universities had 292 graduates that year. For electrical engineering, there are 21 study programs, while civil engineering has a total of 22 programs. There is only one program for both energy and conservation engineering and electrical engineering.

To help overcome the anticipated shortfall, PLN signed a cooperation agreement with Politeknik Negeri Ujung Pandang in South Sulawesi in 2010 for a diploma III program in electrical engineering. The curriculum developed by PLN and Politeknik Negeri Ujung Pandang, based on competency standards of the Ministry of Education and Culture, is tailored to the needs of the company. The program also features a 6-month internship program in PLN operations, and requires a thesis related to PLN's business processes. Graduates are then employed by PLN. While the cooperation program is successful, it is, however, limited with only 250 graduates as of 2019.

The province also only has one renewable energy program, offered by SMKN 3 Makassar. Supported by Millennium Challenge Account Indonesia, the program is assisted by PEKA SINERGI, a national system of training and certification for Indonesia's renewable energy technology workforce. It started with two teachers specialized in renewable energy and five teachers specialized in the electrical technical knowledge and building construction.

Given this, the province has developed a five-tiered plan to improve and increase its workforce by connecting education and the private sector.

(i) **First, curriculum development related to industry demands.** Education institutions expect the private sector to advise them on the exact skills needed.

(ii) **Second, teacher improvement.** SMKN 3 Makassar has done this by sending their teachers to training programs related to renewable energy in Cimahi, West Java. The school is also discussing its curriculum with the companies such as UPC Renewables and Kalla Electrical System. In 2020, UPC Renewables initiated a memorandum of understanding with the school for internship opportunities and site visits to their wind power plant in Sidenreng Rappang, South Sulawesi.

(iii) **Third, improve educational infrastructure and facilities that support student skills.** At present, the renewable energy laboratory owned by SMKN 3 Makassar requires optimization and updating. It needs funding assistance from the provincial government for the construction of laboratories with the latest technology according to market needs.

(iv) **Fourth, provide internship programs.** These are so far not widely available within the province though, and practical work experience in renewable energy for SMKN 3 Makassar students is only available in Bandung (with Global Pratama Powerindo and Heksa Prakarsa Teknik).

(v) **Fifth, renewable energy competency certification.** For this, students need to travel to the Professional Certification Institute for Renewable Energy in Cimahi, West Java. The competencies provided include mini-hydro off-grid and on-grid operation, small-scale wind power installation and O&M, off-grid as well as on-grid solar PV, installation for solar PV rooftop, and hydropower on-grid turbine maintenance.

The experiences of SMKN 3 Makassar showed some of the challenges in producing skilled workers from vocational high schools. But it also showed the importance of partnership, cooperation, and networking between key stakeholders, and that these should be more intensive, coordinated, and structured.

Facilitation from the local government, including education and staffing agencies, should encourage the involvement of local companies, training centers, certification institutions, and parents. Companies should offer internship opportunities that can simulate best practices and provide hands-on experience for students.

Maluku: Capacity Development for Institutions

Maluku aims to reach a power plant generating capacity of 458 megawatts (MW) by 2028, including 142 MW (31%) from renewable energy, and it is estimated that an additional 1,147 technicians will be required to support this target. Consisting of a scattered groups of islands, Maluku plans to increase its use of renewable energy, particularly bioenergy, which will require some 391 certified technicians by 2028. Although planned solar power plants require only 59 technicians by 2028, it will also be crucial for the O&M of the installed capacity.

However, Maluku only has seven study programs related to the energy sector in five higher education institutions. There are also just nine vocational school across Maluku offering electricity engineering programs. There are no available renewable energy programs, even though Maluku has around 84 MW of hydropower and 46 MW bioenergy power plants planned by 2028.

It is against this backdrop that the New Zealand–Maluku Access to Renewable Energy Support (NZMATES) was established in April 2018. This program, supported by New Zealand Aid Programme, aims to increase the province's access to energy by accelerating development of renewable energy through on-grid and off-grid schemes. At the same time, it seeks to address the challenge of inadequate skills and knowledge regarding renewable energy power generation.

NZMATES adopted a comprehensive approach to address this issue. After assisting the PLN and the government in understanding the unique renewable energy issues in the challenging Maluku landscape, it provided training to PLN, the local agency of MEMR, as well as to lecturers and teachers in educational institutions in Maluku to increase their capacities and competence. It also provided new facilities to educational institutions to enable students to practice and pursue careers that will contribute to local development needs.

(i) Capacity building was provided to the provincial government of Maluku and PLN to address problems related to existing solar and small hydroelectricity systems. Trainings focused on solar and storage mini grids were given to PLN and MEMR agency in Maluku.

(ii) Mentoring sessions were provided to a working group from PLN Maluku and Maluku Utara focusing on the use of renewable energy design and planning software, as well as assessment and design methodologies and principles.

(iii) NZMATES arranged for two lecturers to participate in solar system training-for-trainers course conducted by Deutsche Gesellschaft für Internationale Zusammenarbeit in Makassar and Jakarta. The lecturer from the faculty of engineering in Unpatti, Anthony Simanjuntak, immediately developed a course on solar panels in his institute's electrical engineering department and began teaching the course in 2019.

With its activities, NZMATES aimed to nurture an environment where local skilled graduates are the ones sought by local government, PLN, and the private sector to participate in the development and sustainability of the renewable energy systems across Maluku.

By collaborating with central and local governments, educational institutions, the private sector, and the community, NZMATES also showed that multistakeholder collaboration not only helps to close the gaps, but also increases the acceptance of the activities carried out under the program.

The key factor of the success of the NZMATES program lies in its comprehensive approach. It created an enabling environment that generates demand for an appropriately skilled workforce through partnerships with key stakeholders. Involving the government to make sure that renewable energy is mainstreamed in the development of such power plants provides avenues for investment in this sector to increase.

West Nusa Tenggara: Partnership between Sectors

West Nusa Tenggara aims to reach a total installed capacity of 917 MW by 2028, including 59 MW (6.4%) from renewable energy, which is estimated to require an additional 1,223 technicians. But with slow growth in the deployment of renewable energy in the province, there is a lack of available teachers and, consequently, skilled workers.

In fact, the province already receives many grants in the form of solar panels, micro-hydro installation, and more from various government ministries and nongovernment agencies. Most of these installations are not working correctly, however, mainly due to improper planning and lack of collaboration with relevant stakeholders. Cases in Labangkas, Dompu, Moyo Village, and Penggadungan prove that many installed power plants become stranded assets as soon as they are handed over. It is very challenging for the receiving parties to take charge since they have limitations in terms of jurisdictions, resources, and capacity.

The approach taken by the Millennium Challenge Account—Indonesia in the province tries to answer the workforce part of this renewable energy challenge. In 2015, it appointed PEKA SINERGI to act as an implementing agency for a project designed to develop skills for technicians in renewable energy:

(i) In line with industry needs, the project developed competency standards for professionals in four renewable energy technology fields—solar, wind, hydro, and biomass—and piloted competency-based training and certification at the Technical Education Development Centre Bandung, the University of Mataram, and senior vocational schools in Lombok.

(ii) Working with local vocational schools, the program trained teachers in renewable energy technologies and provided the schools with equipment that enables the teachers to teach practical skills to their students.

(iii) PEKA SINERGI also partnered with local companies that can potentially absorb the skilled workforce, such as PLN regional and Vena Energy. For example, PEKA SINERGI partnered with Vena Energy, which at that time needed local workers to hire for its solar power development projects in three locations in Lombok. PEKA SINERGI conducted trainings and assessments for 60 local installers and 20 operators.

(iv) Working together with the Indonesian Renewable Energy Community, the program helped set up the Renewable Energy Certification Institution to certify graduates and people in the workforce in 2016. There are now 10 competency test locations for renewable energy certification and 35 certified assessors, including four from West Nusa Tenggara.

Another key lesson from this case study is the importance of selecting the right educational institutions to participate in the program. School and teacher readiness play a big role in the quality of the results achieved. In conducting its assessments, PEKA SINERGI also cooperated with the local government, especially the local education agency, to reduce envy from other schools that were not selected to participate.

Improving Skills for the Electricity Sector in Indonesia

This publication presents findings from a study that analyzes trends in the demand and supply of skills in Indonesia's electricity sector. The study explores the sector's labor needs in terms of skill type, quantity, and location. It compares these needs with what skills are available, and at what level, to identify gaps. The study provides recommendations for skills providers, industries, and the government on how to improve partnerships among those actors to address the gaps. This publication is timely given the electricity sector's crucial role in Indonesia's development as the country experiences rapid changes due to technology and innovation.

About the Asian Development Bank

ADB is committed to achieving a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty. Established in 1966, it is owned by 68 members —49 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

ASIAN DEVELOPMENT BANK
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
www.adb.org