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Renewable Energy Literacy in Supporting Geothermal Project in Indonesia: Where Are We Now?

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ABSTRACT

In developing geothermal energy as one of the backbones of renewable energy in Indonesia's energy mix, all stakeholders' participation and collaboration are required. The level of involvement will most likely be influenced by the level of energy literacy education, which might be implemented through formal and informal education. The initial question raised by this study is the extent to which Indonesia applies energy literacy education. To answer this question, the authors conducted a mapping of all learning types related to renewable energy, especially geothermal, in Indonesia's various institutions. Furthermore, this study will also compare geothermal producing countries' energy education methods other than Indonesia. Finally, this study is expected to provide recommendations regarding various things that can be improved to support Indonesia's geothermal development.

1. INTRODUCTION

The need for renewable energy as the primary energy source in Indonesia and the world has been increasing recently. This need is inseparable from awareness of the risks faced by non-renewable energy, such as pollution and carbon footprint. Furthermore, Indonesia and more than 170 countries have signed a Paris agreement as a commitment to curb global warming, one of which is by reducing energy generation from fossil energy and increasing renewable energy use.

One method to increase renewable energy use is to raise literacy about this energy in the community. Education has played a crucial role in developing the renewable energy industry, formal education, and in-service training to increase student knowledge about various aspects of renewable energy (Jennings, 2009; Acikgoz, 2011). The expansion of energy literacy can even change human behavior towards the rational use of energy (Zografakis et al., 2008). Hence, the educated generation will automatically choose renewable energy in their future life due to the shortcomings of conventional energy sources and the advantages of using renewable energy.

Kandpal & Broman (2014) explained that the goals of renewable energy education are as follows:

1. Develop awareness among students about the energy-related challenges faced by the world community.
2. Educate students on the benefits and disadvantages of various types of non-renewable and renewable energy sources.
3. Motivate students to make efforts to develop renewable energy sources that are efficient and effective.
4. Develop values and attitudes of students towards using renewable energy sources and the associated socio-economic and environmental dimensions.

In the context of geothermal development in Indonesia, the lack of educational programs in local communities related to geothermal projects is one of the biggest challenges because it causes community resistance to this project in various regions (Umam et al., 2018). The lack of education in renewable energy, especially in geothermal, is also evident in Indonesia's higher education. At least five universities that offer this program, namely:

1. The Bandung Institute of Technology (ITB) offers a geothermal master program covering the broad fields of geothermal exploration, exploitation, utilization, management, economics, and the environment.
2. Gadjah Mada University (UGM) offers a master's degree in geology with geothermal engineering and geoscience courses.
3. Universitas Indonesia (UI) offers a master's program in geothermal energy exploration at the physics department.
4. The Surabaya Institute of Technology (ITS) offers a master's program in geothermal engineering in the geomatics engineering department, under the faculty of civil, environmental, and mechanical engineering
5. Diponegoro University (Undip) offers a master of energy program under the faculty of science and mathematics.

1.1 Geothermal Energy Development in Indonesia

Energy plays a strategic role in achieving social, economic, and environmental goals in sustainable development. Energy demand is expected to increase as a consequence of population and economic growth. By paying attention to the energy condition and its problems, it is necessary to take concrete steps from the government to deal with Indonesia's energy problems. Indonesia, which is located along the Ring of Fire, where most volcanoes are located, has abundant geothermal energy potential, should utilize this energy source to support the energy transition towards clean and renewable energy in Indonesia.

Indonesia has abundant geothermal resources that can help meet the country's rising electricity demand and increase electrification rates. Indonesia's estimated conventional hydrothermal geothermal resource base is generally considered to be among the world's largest. The Government of Indonesia plans to achieve around 7,200 MW of installed geothermal power capacity by 2025, as stated in the Presidential Decree No. 22/2017 regarding the National Energy Plan. This ambitious plan will require strong government support in issuing regulations that facilitate licensing, tariff provisions, cooperation, and human resources preparation (Meier et al., 2014). The resource, reserved, and installed capacity of geothermal energy in Indonesia is shown in Table 1.

Table 1: Geothermal energy potential and installed capacity (the Republic of Indonesia, 2017; MEMR, 2019; Geological Agency, 2019)

No	Location	Resources (MW)	Reserves (MW)	Total (MW)	Installed (MW)
1	Sumatera	3,833	5,846	9,679	744.3
2	Java	2,455	5,652	8,107	1,253.8
3	Bali	91	244	335	0
4	Nusa Tenggara	338	1,025.5	1,363.5	12.5
5	Kalimantan	169	13	182	0
6	Sulawesi	1,727	1,341	3,068	120
7	Maluku	651	505	1,156	0
8	Papua	75	0	75	0
Total		**9,339**	**14,626.5**	**23,965.5**	**2,130.6**

1.2 Human Resource Constraints

Geothermal energy can become a superior sector if supported by reliable technology, competent human resources, and good management. Further, geothermal projects' success formula includes regulatory support, technical prowess (competence), and funding availability. However, several obstacles were found in the geothermal industry field. Human resources for project activities and geothermal energy operations require specific competencies. Hence, Intricate knowledge and abilities are needed. For example, a person with mechanical engineering background must also know the fields of electrical, chemistry, geology, and social sciences.

Geothermal development companies in Indonesia usually hold on-site training for new workers to gain the competencies needed for daily activities. The training duration varies for one year, six months, or only four weeks, each with different methods, materials, and competency standards. Companies that pay close attention to human resources' technical skills will apply high standards for this training. The company expects that all activities in the industry will run safely, reliably, and efficiently. However, due to several causes, there are still work accidents, damage during repeated operation of the equipment, incorrect installation of tools that cause material and non-material losses.

1.3 Study Objectives and Method

This study conducted by:

1. Mapping the renewable energy education currently available in Indonesia, especially those related to geothermal. Mapping is carried out in both formal and informal education.
2. Publish a public opinion survey on the availability of renewable energy education in Indonesia.

By conducting the activities as mentioned above, this study aims to:

1. Obtain a big picture about renewable energy education in Indonesia.
2. Obtain initial data that can be discussed for planning further studies.

2. RENEWABLE ENERGY EDUCATION CURRENTLY AVAILABLE IN INDONESIA

2.1 Higher Education Level

At the university level, there are two divisions of fields, namely science and science. Renewable energy is taught in the science program. Several majors have courses related to renewable energy. However, engineering majors usually learn more about renewable energy. Engineering majors that study renewable energy include chemical engineering, physical engineering, electrical engineering, petroleum engineering, geophysics, industrial engineering, marine engineering, nuclear engineering, and energy conversion engineering. The engineering majors that study renewable energy in the geothermal field are primarily mechanical engineering, chemical engineering,

physical engineering, electrical engineering, petroleum engineering, geophysics, and energy conversion techniques. Table 2 shows some of the majors and materials taught related to renewable energy at universities in Indonesia.

Table 2: Departments and materials taught related to renewable energy at universities in Indonesia

University Name	Courses related to Renewable Energy	Province	Remarks
Universitas Sumatra Utara	New and Renewable Energy	Sumatera Utara	Introduction of renewable energy
	Energy Water		Management and utilization of water energy
	Geothermal energy		Management and utilization of geothermal energy
	Solar Energy		Management and utilization of solar energy
Institut Teknologi Sumatera	Ocean Energy Technology	Lampung	Management and utilization of energy from the sea
	New and Renewable Energy Technologies		Introduction of new and renewable energy technologies
	Energy conversion		Introduction of energy conversion technology
Universitas Lampung	Energy Conversion Engineering	Lampung	Energy conversion engineering introduction
	Solar Energy Engineering		Management and utilization of solar energy
	New and Renewable Energy		Introduction of renewable energy
	Bioenergy		Management and utilization of energy from biological sources
Universitas Andalas	Geothermal Physics	Sumatera Barat	Introduction to geothermal energy
	New and Renewable Energy		Introduction of renewable energy
Universitas Negeri Padang	Basic Concept of Renewable Energy	Sumatera Barat	Introduction to the concept of renewable energy
	Energy and Energy Conversion		Introduction of energy and energy converting engineerings
Universitas Sriwijaya	Geothermal Exploration	Sumatera Selatan	Introduction to geothermal exploration techniques
	New and Renewable Energy		Introduction of renewable energy
	Energy Conversion Technique		Energy conversion engineering introduction
Universitas Jambi	Energy Conversion Basics	Jambi	Energy conversion engineering introduction
Universitas Negeri Riau	Energy Conversion Engineering	Riau	Energy conversion engineering introduction
Universitas Pelita Harapan	Renewable Energy System	Banten	Introduction of renewable energy systems
Universitas Prasetiya Mulya	Green Energy Management	Banten	Introducing the concept of green energy management
	Bioenergy		Introduction to bioenergy
	Solar Energy		Introduction to solar energy
Universitas Katolik Atma Jaya Jakarta	Energy Conversion Engineering	Jakarta	Energy conversion engineering introduction
	Capita Selecta Energy Conversion and Renewable Energy		Introduction of energy conversion technology and renewable energy
	Renewable Energy System		Introduction of renewable energy systems
	Solar Technology		Introduction to solar energy technology
Universitas Mercu Buana	Renewable energy	Jakarta	Introduction of renewable energy
	Basic Electrical Energy Conversion		Basic introduction to electrical energy conversion
	Wind Technology		Introduction to wind energy
	Micro Hydro Technology		Introduction to micro-hydro energy
	Solar Technology		Introduction to solar energy
Universitas Multimedia Nusantara	Renewable energy	Jakarta	Introduction of renewable energy
	Thematic New and Renewable Energy		Thematic introduction of new and renewable energy
Universitas Indonesia	Geothermal Exploration	Jawa Barat	Geothermal energy introduction and exploration
	Geological Geology		Introduction to the characteristics, distribution, and energy potential of geothermal resources
	Conversion and Conservation of Electricity		Introduction of the conversion engineering to electrical energy
Universitas Pembangunan Nasional Veteran Jakarta	Renewable energy	Jawa Barat	Introduction of renewable energy
	Energy Conversion and Conservation		Introduction of the conversion engineering to electrical energy
Institut Teknologi Bandung	Geothermal	Jawa Barat	Introduction to geothermal energy
	Energy Conversion Engineering		Energy conversion engineering introduction
	Bioenergy Process Technology		Introduction to bioenergy process technology

	Energy Conversion and Actuators		Introduction of electric energy conversion technology and actuator technology
	Renewable energy		Introduction to the concept of renewable energy
Universitas Pertamina	Geothermal Engineering	Jawa Barat	Introduction
	Geothermal Science and Technology		Introduction to geothermal energy resources
Universitas Padjajaran	Energy Resources Geology (Oil and Gas, Coal and Geothermal)	Jawa Barat	Introduction to the process of forming energy resources
	Geological Geology		Introduction to the characteristics, distribution, and energy potential of geothermal resources
Universitas Katolik Parahyangan	Renewable Energy Sources	Jawa Barat	Introduction to the concept of renewable energy
Universitas Diponegoro	Geochemistry Geothermal	Jawa Tengah	Introduction to geothermal systems in fluid chemistry interpretation
	Geothermal Geophysics		Introduction to geothermal, geological, and geochemical systems
	Renewable Energy Technology		Introduction of renewable energy technology
	Energy Management and Conservation		Introduction of energy management and conversion systems
	Renewable Energy Biotechnology		Management of biotechnology technology for renewable energy
Universitas Negeri Sebelas Maret	New and Renewable Energy	Jawa Tengah	The introduction of new and renewable energy
Universitas Gajah Mada	Nuclear Power Generation Technology	Yogyakarta	Introduction of nuclear-powered plants
	Water Energy Technology		Management and utilization of water energy
	Bayu Energy Technology		Management and utilization of wind energy
	Biomass Energy Technology		Management and utilization of biomass energy
	Geothermal Energy Technology		Management and utilization of geothermal energy
	Solar Thermal Technology		Management and utilization of solar energy
	Ocean Energy Technology		Management and utilization of marine energy
	Energy Conservation		Introduction of energy conversion tools
Universitas Muhammadiyah Yogyakarta	Renewable energy	Yogyakarta	Introduction to the concept of renewable energy
Institut Teknologi Sepuluh Nopember	Energy Conversion Engineering	Jawa Timur	Energy conversion engineering introduction
	Geothermal Exploration		Introduction to the conceptual model of geothermal exploration
	Bioenergy		Introduction of energy from biological sources
	Solar Energy		Introduction of energy from the sun
	New and Renewable Energy		Introduction of renewable energy technology
	Biomass-Biorefinery and Biomass Conversion		Introduction of biomass energy and its processing
	Energy Conservation and Conversion Systems Engineering		Introduction to energy conversion and energy conservation systems engineering
Universitas Brawijaya	Geothermal Exploration	Jawa Timur	Introduction to the geothermal exploration process
Universitas Negeri Jember	Water and Geothermal Energy Technology	Jawa Timur	Introduction to hydro and geothermal energy technology
	Wind and Solar Energy Technology		Introduction to the wind and solar energy technology
Universitas Kristen Petra	Renewable energy	Jawa Timur	Introduction to the concept of renewable energy
	Solar energy		Introduction of energy from the sun
	Energy Conversion System		Introduction of energy conversion technology
Universitas Surabaya	Renewable energy	Jawa Timur	Introduction to the concept of renewable energy
Universitas Udayana	Energy Conversion Engineering	Bali	Energy conversion engineering introduction
	Wind Energy		Introduction of energy from wind
	Solar Energy		Introduction of energy from the sun
	Geothermal energy		Introduction to energy from geothermal
	Biogas Energy		Introduction of energy from biological gases

When viewed from existing data and compared to engineering majors in Indonesia, the percentage of departments that study renewable energy is only 10 out of 51 or 19.6 percent. Meanwhile, only 7 out of 51 or 13.7 percent studied geothermal. This data proves that only a handful of departments learn geothermal at the university level. Among the energy-taking students, there are still many students who have

not had sufficient knowledge about geothermal. When the geothermal industry is growing in Indonesia, the need for human resources who have an adequate knowledge base about geothermal is likely to be less.

2.2 High School Level

In Indonesia's world of education, authors found that energy learning at the senior high school level in Indonesia is relatively low. This can be seen from the discussion of renewable energy, which is still limited in Indonesia's curriculum. At the high school level, the energy lessons are introduced through the discussion on natural resources. For students with a natural science background, energy learning is introduced through geography and physics lessons from class XI. The topic of energy is packaged in a geography subject.

However, not all schools have categorized geography as a specialization subject. Renewable energy learning is gained through analyzing natural resource distribution. For class XII, renewable energy is introduced by discussion topic included renewable energy sources. On the other hand, learning about renewable energy is discussed more complexly and more deeply in geography major as it is a compulsory subject. The topic includes renewable energy sources such as renewable energy, renewable water energy, renewable energy from geothermal energy, renewable energy from bioenergy, renewable energy from solar energy, renewable energy from ocean currents, and several other renewable energy potentials. There are also vocational high schools that have renewable energy majors. The lesson is mainly on technical matters such as basic knowledge of energy conversion engineering, assembly turbines, and other technical issues.

Furthermore, the discussion of geothermal energy at the high school stage is taught briefly. Discussion topics are presented briefly and regarding the definition of geothermal, geothermal potential in Indonesia, some areas with the largest geothermal power plants in Indonesia, and the geothermal power generation cycle that is delivered with easy-to-understand content. Meanwhile, for class XI students majoring in social science, geothermal energy is in the geography lesson in the chapter "Food Security, Provision of Industrial Materials and New and Renewable Energy" in the "Renewable Energy" section. The discussion topic on renewable energy in the social science department is much simpler than the debate on geothermal energy in the natural science department. The subject includes the definition, potential of geothermal and geothermal power plants' distribution in Indonesia. However, geothermal social science students are taught earlier than natural science majors. In essence, geothermal is taught in senior high schools only in terms of basic knowledge.

2.3 Informal Education

Dissemination of knowledge about renewable energy and geothermal is mostly done in non-formal institutions such as training providers. Learning methods are used in various ways, including face-to-face classes, online classes, in-house training, webinars, and so on. Table 3 shows several training providers, both government and private, who teach geothermal topics.

Table 3: The list of geothermal training provider in Indonesia

Training Provider Type	Training Provider Name	Learning Method	Remarks
Private Training Provider	Enerka Bhumi Pratama (EnerKlaz)	E-Learning	- Introduction to geothermal - Geothermal resource assessment - Drilling in geothermal - Geothermal project management
	PT. Media Cendekia Utama	E-Learning	- Geothermal definition, systems, and differences. - Geothermal components as energy solutions - Feasibility study and geothermal investment analysis - Survey and expansion of geothermal projects - Standards and regulations fr geothermal power plant development - Fluids in geothermal operating processes - Core and supporting facilities of geothermal power plants
	PT. Anugrah Indonesia Lima	E-Learning	- The Epitome in our integrated geothermal software using a cloud computing system
	PT.Vyntech Multi Solutions	Offline Learning	- Geothermal concept - Geothermal history - The components - Geothermal system - Benefits of geothermal energy - Examples of geothermal uses - Case studies and discussions on geothermal
	Gemilang Training	Offline Learning	- Geothermal history - Geothermal system components - Benefits of geothermal energy - Application of geothermal science in environmental applications - Creating new tools or discoveries related to geothermal - Case studies and discussions on geothermal

Government Training Provider	Center for HRD of Electricity, New Renewable Energy and Energy Conversion	Blended Learning	- Geothermal webinars, such as: - Overview of Geothermal Education - New Zealand engagement with renewable energy in Indonesia
Academic/ Research Institution	Center for New and Renewable Energy Research (PPEBT) ITB	Blended Learning	- Development of geothermal technology - Production and supply of technology in Geothermal
	Center for Energy Studies Universitas Gadjah Mada	Blended Learning	- Assessing the potential energy from geothermal
	Center for Sustainable Energy ITS	Blended Learning	- Innovation in the geothermal field
	Training Program Geothermal Master Program - ITB	E-Learning	- Geothermal exploration - Geothermal Development - Utilization in Indonesia

2.4 Competency Certification

Education regarding renewable energy is a cognitive domain that is needed, one of which is that students have a basic knowledge of its advantages. Further, when these former students entered the industrial world, the knowledge alone is not enough. All labor in the energy industry, including renewable energy, must have specific competencies according to applicable standards. To prove that workers have mastered specific competencies, the government requires workers to take the certification at a competency certification body that has been appointed by the National Professional Certification Agency (BNSP).

Unfortunately, there are not many competency standards for renewable energy workers until recently. One of the references is the Attachment to the Decree of the Director-General of Electricity Number: 247/20/DJL.1/2019 concerning Guidelines for Competency Standards for Electricity Engineering Workers in Power Plant Maintenance Work. This regulation regulates competency standards for several generator operators, namely:

a. Steam Power Plant (PLTU)
b. Gas Power Plant (PLTG)
c. Gas and Steam Power Plant (PLTGU)
d. Geothermal Power Plant (PLTP)
e. Hydro Power Plant (PLTA)
f. Micro Hydro Power Plant (PLTMH)
g. Diesel Power Plant (PLTD)
h. Nuclear Power Plant (PLTN)
i. Renewable New Energy Power Plant (PLTEBT)

On the other hand, the geothermal industry is the only renewable energy field with the most competency standards. This advantage may be due to its proximity to the oil and gas industry, which has a complete standard of competence from exploration to distribution. Apart from power plant operators, there is also a geothermal supervisor competency certification based on the Decree of the Director-General of Geology and Mineral Resources Number: 0228.K/40/DJG/2003 concerning Operational Supervisory Competence in Mineral and Coal and Geothermal Mining Companies. Moreover, the government is currently preparing a new competency standard in Geology, Geophysics, and Geochemistry (3G) for the geothermal industry. The standard has been prepared by the Ministry of Energy and Mineral Resources in 2016 and approved by the Ministry of Manpower in 2018. Currently, this standard is being proposed to BNSP to become a certification scheme by the Human Resources Development Agency of the Ministry of Energy and Mineral Resources (Susilawati & Umam, 2020)

2.5 Capacity Building: Grant from Abroad

2.5.1 GEOCAP (Geothermal Capacity Building Programme)

Geothermal Capacity Development Program - Indonesia-Netherlands (GEOCAP) is an international collaboration between Indonesian and Dutch institutions. The program's goal is to develop a closely related geothermal plan for education and training, research, and subsurface databases, through education and training programs; research program; data-based programs; use of low and medium enthalpy resources; and the 2050 geothermal program. The institutions involved in the GEOCAP include Twente University, INAGA / API, TNO - Dutch Organization for Applied Scientific Research, ITB, Delft Technical University (TUDelft), UI, UGM, Utrecht University, IF Technology, DNV-GL Energy, and Well Engineering Partners (Meer et al., 2015; Universiteit Twente, 2019).

2.5.2 USAID (United States Agency International Development)

The United States Agency for International Development Assistance (USAID) is an independent body of the United States government responsible for assistance to other countries in the world in support of US foreign policy. USAID supports clean and renewable energy projects to reduce greenhouse emissions through the ICED, Circle, and geothermal technology education development programs. One of Indonesia's capacity building programs is Indonesian geothermal capacity building in collaboration with the University of Southern California (USC), Bandung Institute of Technology (ITB), and Star Energy. (USAID, 2010). USAID has also worked with INAGA from

2011 to 2014 to provide a geothermal Human Resources program. The program includes a master's degree program, trainer training, and an introductory geothermal program.

2.5.3 United Nations University (UNU): UNU-GTP (Geothermal Training Programme)

UNU-GTP plays an essential role in developing human resource capabilities related to geothermal development in Indonesia, mainly through PT. Pertamina Geothermal Energy (PGE). The UNU-GTP program has been operating in Iceland since 1979 with six months of training on geological exploration, borehole geology, geophysical exploration, borehole geophysics, reservoir engineering, the chemistry of thermal fluids, environmental studies, geothermal utilization, and drilling technology. The first participant from Indonesia of the UNU-GTP activities was trained in 1982. The UNU-GTP program will continue to be implemented, especially in providing human resource capabilities for this development. (Karim, 2008).

2.5.4 The New Zealand Ministry of Foreign Affairs and Trade (MFAT)

MFAT regularly provides technical assistance and capacity building to accelerate Indonesia's geothermal development. The program offered is in the form of a Higher Education scholarship through the NZAS scheme and short training in the New Zealand Support for Training in Geothermal Support (NZSTIGS) scheme. MFAT was also signed an MoU with MEMR on September 5, 2018, to develop and provide practical training for technicians and geothermal operators for the next five years. Under this program, PPSDM KEBTKE organized the Training for the Trainers Mastery Level (TTT) with instructors from the Waikato Institute of Technology (WINTEC).

3. PUBLIC OPINION SURVEY

A survey on energy literacy has been conducted using a systematic random sampling method designed for students who are currently or have passed the tertiary level. The form of data collection techniques is disseminated online in the form of a simple questionnaire containing several questions, which will give an idea of the first level of education to teach renewable energy in Indonesia. The first question is about when did the respondent first get knowledge about various renewable energy sources. The resulting answer is shown in Figure 1.

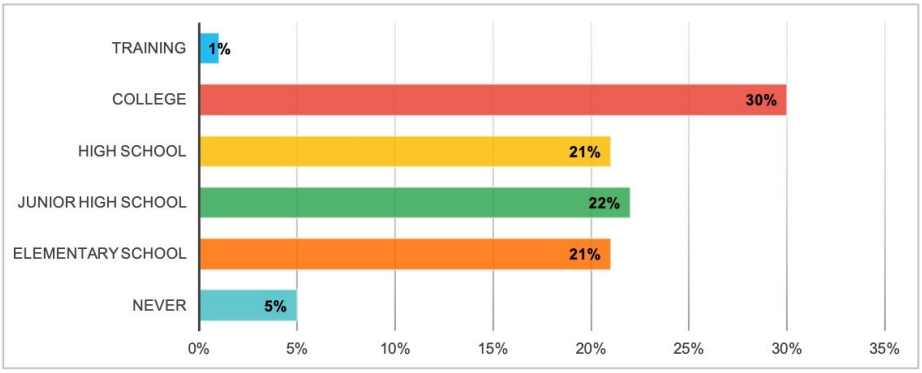

Figure 1: The response to the question: "At what level do you recognize various sources of renewable energy?"

The learning curriculum in Indonesia has briefly included several discussions on renewable energy. However, the results of the application of this learning are further strengthened at the tertiary level. This is supported by survey data, which shows that 30% of the respondents answered that they received renewable energy lessons at the tertiary level. Meanwhile, only 21% have learned about renewable energy at the senior high school level. Higher education and senior high schools are our focus at this time, even though at the levels below 22%, respondents said that their first time of learning about renewable energy at the junior high school level and 21% at the elementary school level. This shows that energy learning has been given from an early age. Apart from that, there are still 5% of respondents who answered that they never received any renewable energy lessons. This means that there are still Indonesian students who have not received education about renewable energy.

In the next question, we provide more specific questions regarding geothermal energy, as shown in Figure 2a. In the survey results, tertiary education and high school levels are still our primary focus. The results showed that 36% of respondents answered that they received lessons about geothermal energy at the tertiary level. Furthermore, 16% of respondents answered that they received lessons about geothermal energy at the senior high school level. Meanwhile, 18% of respondents answered that they received geothermal energy learning in elementary school. 25% of respondents answered that they received learning about geothermal energy at junior high school, 1% of respondents answered that they received learning about geothermal energy at junior high school, 1% answered through training, and 3% answered that geothermal energy.

To support these questions, we provide the last question, where we ask where the respondents get learning resources about geothermal energy, as shown in Figure 2b. From the survey results, 80% of the respondents answered that they received learning resources about geothermal energy during school lessons. 12% answered via the internet, 4% answered via family / Fiend, 2% answered training, and 2% responded that they never received learning resources about geothermal.

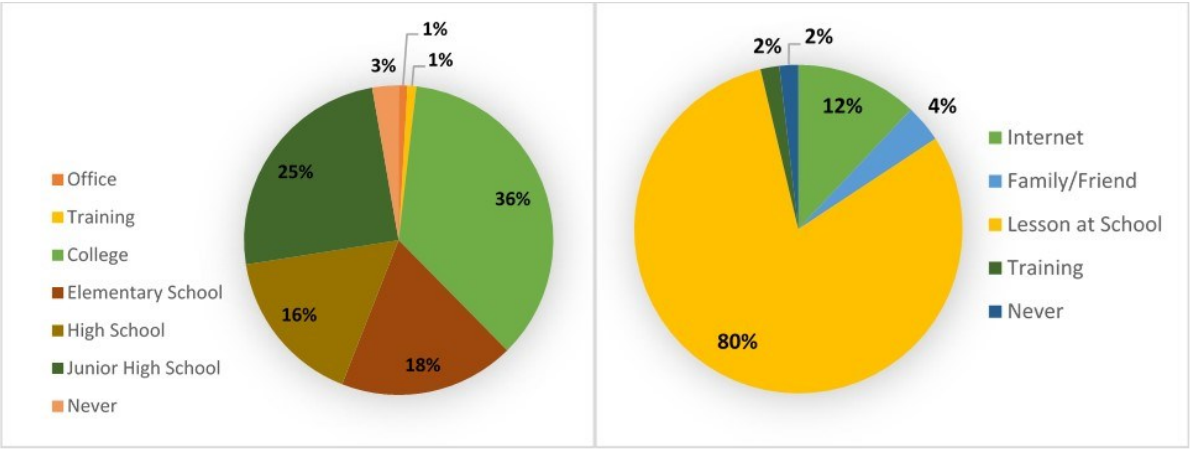

Figure 2: (2a/left) The response to the question "At what education level did you learn about" Geothermal Energy?", (2b/right)The answer to the question "Where do you get learning resources/counseling about geothermal energy?"

From the survey results, we conclude that geothermal learning has been introduced at several school levels, especially in high schools and colleges. It can be seen from the survey results that most Indonesian students get geothermal learning at the tertiary level. The majority of Indonesian parliaments also get geothermal learning resources from lessons in schools. This shows how important education is to help the process of exploiting geothermal energy sources.

4. DISCUSSION

Energy has been taught from basic level to advanced education in Indonesia. However, literacy levels vary by province in Indonesia. Our findings reveal that energy literacy level greatly affects a renewable energy development project's acceptability in a region, including geothermal projects. Thus, the government cooperates with other stakeholders, including through assistance from other countries, continuously organizing socialization programs through non-formal education and capacity building to support the acceleration of renewable energy development.

The capacity building program results can be seen from the rapidly increasing number of workers in geothermal development projects starting in 2014 (DG-NREEC, 2019). The government has also prepared regulations on standard competencies for workers in geothermal power plants and other power plants. Specifically for geothermal, competency standards also exist for geology, geochemistry, and geophysics officers. However, the scope of work in geothermal areas is still largely unregulated. Work areas that require specific competencies to be standardized include operators for production and injection wells, mechanical, electrical, instrumentation, civilian maintenance technicians, and supply chain management.

Increasing the capacity of geothermal human resources is a necessity to increase productivity in this industry. Prospective workers with formal educational backgrounds cannot immediately work and need additional competencies needed. Apart from experience, competence can also be obtained from training. The knowledge and skills gained from this experience and training can be proven at least by certification in the field of renewable energy generation.

Unfortunately, training on renewable energy currently lacks in Indonesia. From the data presented in the previous chapter, it can be seen that there are only five private training providers and only one from the government that regularly conducts training in geothermal. In addition, there are still pieces of training held by educational institutions such as ITB, UGM, and ITS. This indicates a lack of support in training for prospective operators on renewable energy sources.

The shortage of training venues is compounded by the absence of specific competency standards for renewable energy generation. This standard is critical to maintaining the quality of human resources who will operate the plant. Part of the reasons put forward was that no proposal or even the plant had never existed before. The government should have been quicker in preparing this standard, although the implementation will be later after the power plant is already there.

5. SUMMARY AND RECOMMENDATION

The development of renewable energy in Indonesia, especially geothermal energy as one of the baseload, requires a high level of energy literacy in society to develop rapidly. Lessons about this energy are still lacking, and the introduction should be early for school children. The survey results show that most people get knowledge about energy during college. Likewise, training and dissemination of information on renewable energy informally should also be increased. With the energy mix target of 23% by 2025, it will be difficult to achieve with the number of today's training institutions.

Energy literacy is one aspect that supports the success of renewable energy development in Indonesia. The low level of energy literacy in several regions has been proven to cause delays in renewable energy development projects, including geothermal development. The government should see this as a starting point for earlier teaching about energy in schools. So, the dissemination of information about renewable energy advantages does not appear to be given only when an energy resource development project is to be carried out.

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