

1402_044059

by Bayu Rudianto

Submission date: 04-May-2020 12:09PM (UTC+0700)

Submission ID: 1315310281

File name: Wahyudi_2019_J._Phys.__Conf._Ser._1402_044059.pdf (769.8K)

Word count: 2053

Character count: 11391

PAPER · OPEN ACCESS

How vocational high-school students understand geothermal energy

2

To cite this article: W Wahyudi *et al* 2019 *J. Phys.: Conf. Ser.* **1402** 044059

View the [article online](#) for updates and enhancements.



IOP | ebooks™

Bringing you innovative digital publishing with leading voices
to create your essential collection of books in STEM research.

Start exploring the collection - download the first chapter of
every title for free.

How vocational high-school students understand geothermal energy

W Wahyudi¹, N A Pambudi^{1*}, M K Biddinika², B Basori¹ and B Rudiyanto³

¹ Mechanical Engineering Education, Universitas Sebelas Maret, Jl. Ir. Sutami No. 37A, Surakarta, Indonesia

² School of Environment and Society, Tokyo Institute of Technology, 2 Chome-12-1 Ookayama, Meguro-ku, Tokyo 152-8550, Japan

³ Renewable Energy Department, Jember State Polytechnic, Jember 68121, Indonesia

*agung.pambudi@staff.uns.ac.id

Abstract. Indonesia has the highest potential of geothermal energy in the world with 28,5 GW. However, the utilization ratio is low with around 6% only. This situation occur since there are several geothermal energy targets failed to be achieved. The development of geothermal energy has several problems and one of them is rejection in the community when geothermal development begins. To overcome this situation, an increase in community understanding of this technology usage needs to be conducted. Therefore, the objective of this study is to discover public understanding by exploring the knowledge of vocational high school students about geothermal energy. This is conducted because they are young people who are part of the community. Their knowledge plays an important role in selecting energy sources for the country in the future. This study uses a triangulation strategy model that combines quantitative and qualitative methods. Respondents were students in Indonesia with a case study in Karanganyar Regency, Central of Java. Knowledge is measured by an indicator of the level of understanding of geothermal technology.

1. Introduction

The transition to renewable energy source has been prominent in recent years due to its enormous potential and the awareness created on the issue of global warming. However, there has not been optimum utilization of its potential. An example of the renewable energy experiencing this underutilization is the geothermal energy with only 10% or 122 GW of available resources and the new installed capacity of 13 GW recorded to be in use throughout the globe.

1.1. Geothermal of Indonesia

Table 1 shows different countries with large resources and use capacity for geothermal energy, and they include the United States, Indonesia, Kenya, New Zealand, and Mexico. Although Indonesia was found to have a large potential of 28,500 MW, only 6.85% of this is currently being utilized. The country is continuously developing this by procuring 13 power plants and the installed capacity as of 2015 was 7241 MW. Moreover, according to the energy mix plan for 2025, the use of new and renewable energy is expected to reach 25% and 31% respectively by 2050.

Table 1. World geothermal utilization [1,2].

No	State	Resources (MW)	Installed Capacity (MW)	Ratio
1	UN	30,000	3,591	11.97%
2	Indonesia	28,508	1,948,5	6.83%
3	Filipina	4,000	1,916	47.90%
4	Kenya	15,000	1,116	18.24%
5	New Zealand	3,650	986	27.01%
6	Mexico	4,600	951	25.20%

1.2. Community's acceptance

Governmental policy, regulation, human resources, and infrastructures led to the low ratio previously stated [3]. Some uncertain exploitations of resources were observed through the selection of drilling target, estimation of resources volume, allocation of capital, and communication between parties involved [4]. Furthermore, high uncertainties in the community and low levels of understanding also have potential to cause problems in the development of geothermal power plant [5]. It was also reported that less involvement of the community and lack of belief in the information provided by the company led to the rejection of energy project [6]. This was observed in some areas such as Gunung Rajabasa and Tangkuban Perahu in 2013; Sorik Merapi in 2014; Gunung Lawu in 2016; as well as Gunung Talang, Baturaden, and Sokaria, in 2017 [7].

1.3. Understanding geothermal

This involves the level of knowledge of the community about geothermal energy and technology. People with a high understanding of the concept have more possibility of assessing its risks and benefits objectively in order to make feasible decisions. However, using this as a foundation for the selection or acceptance of usable energy sources may trigger some problems. Wang et.al reported that the risks, benefits and people's understanding of renewable energy affected its acceptance [8]. Therefore, it is important to improve the understanding and consciousness of the environment in establishing responsible future energy consumers [9].

1.4. Education on renewable geothermal energy

The public, especially young individuals, are vital elements in the process of implementing renewable energy because their limited understanding may result in problems. Therefore, necessary education coupled with understanding and responsibility to solve ecologic problems, especially energy generation, should be provided for them [10].

2. Method

Education is a vital and key element for the growth of a nation to stimulate scientific development, increase income, and develop expertise in the modern labor market [9]. Suggested the indicators to be used in measuring the understanding of geothermal to include the knowledge that geothermal energy serves as renewable resources, knowledge of geothermal technology, and available sources of information. Therefore, the students were asked questions around these indicators [6,11].

Likert scale was used as the instrument to measure the response of the students. It was designed to have 5 (five) answer grades starting from very positive to very negative. Furthermore, questionnaires were distributed to 35 vocational high-school students, because they were the nearest to the development of geothermal energy and would be future energy users. Moreover, this study made use of a combined research method.

Table 2. Research instrument.

Variable	Indicator	Question
Understanding	Level of understanding in geothermal	1. Environment-friendly geothermal energy
		2. Development of geothermal has a higher positive impact than a negative impact
		3. Indonesia has large potential for the geothermal energy source
		4. Indonesia is the largest user of geothermal energy
		5. Geothermal is usable in palm sugar production and coconut drying
		6. Geothermal is used to generate electric power
Available information sources		7. I have heard about geothermal energy in school lesson
		8. I have heard about geothermal energy in newspapers, magazines, and the Internet
		9. I got information about geothermal from projects
		10. I want to have advanced information on geothermal electric generator

3. Results and discussion

3.1. Understanding level of geothermal energy

The data obtained shows more than 50% of students agreed that geothermal is environment-friendly energy, 20% did not know while the remaining disagreed. The second question on the development of geothermal energy has a higher positive impact than a negative one with 60% in agreement, 22% did not understand, while the remaining disagreed.

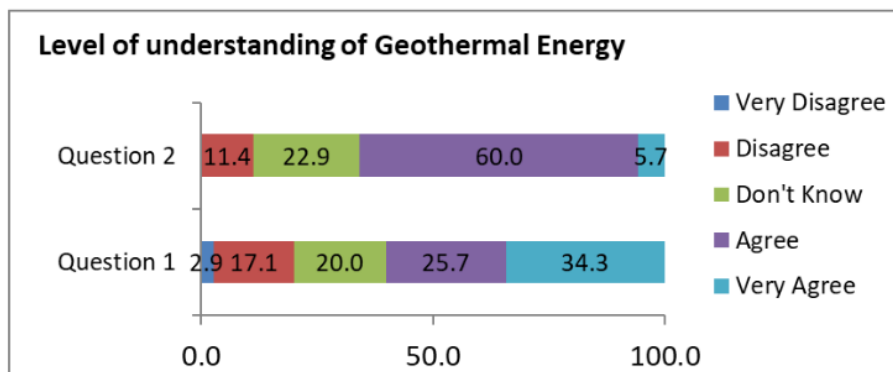


Figure 1. Level of understanding in geothermal.

These results showed that the students' understanding of geothermal energy is low. This was also observed from the interviews conducted where some of the students perceived the concept as the heat from the sun.

3.2. Understanding of geothermal technology

Questions on the knowledge of the students about the technologies used for geothermal energy were found from numbers 3 to 6 on the questionnaire.

The results showed almost all the students, except 20%, agreed that there are some geothermal technologies existing. However, this is contrary to their understanding of the use of the energy source, where 45% did not understand. Furthermore, in the direct use of geothermal energy, the students also had lower understanding, however, most of them agreed it is used as an electric generator.

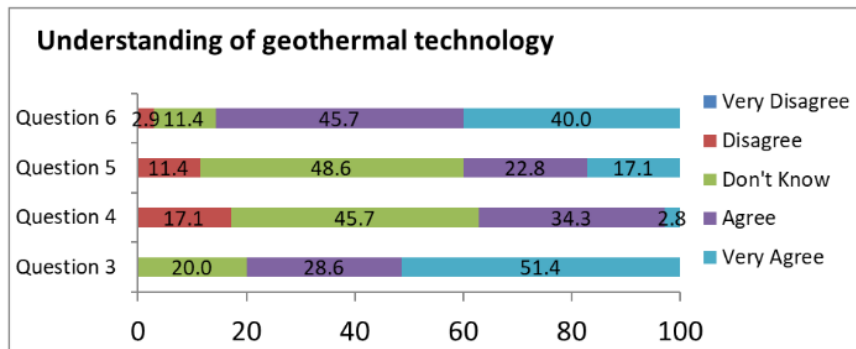


Figure 2. Understanding of geothermal technology.

3.3. Existing sources of information

Information has been observed to be the main factor affecting the understanding of an individual about a concept. Therefore, the information obtained by the students on geothermal energy was found to be from several sources based on the four questions in numbers 7 to 10.

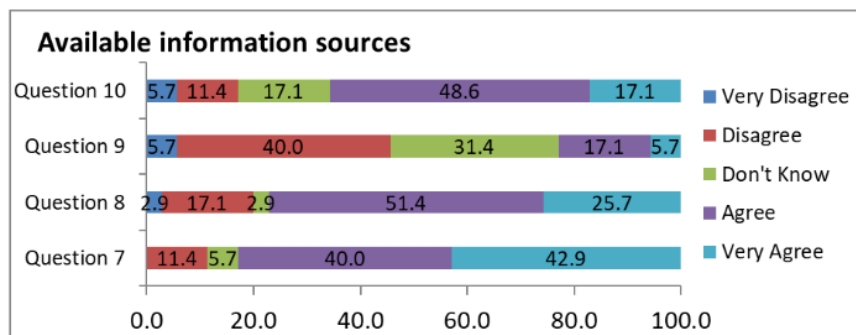


Figure 3. Available information sources.

Some of the students agreed that school lesson, as well as media distributed to the community such as newspapers, magazines, the Internet, etc., contain information on geothermal energy. However, 40% disagreed while 31% did not understand the sources of information. This shows there is a communication gap between the geothermal developers and the community, especially the young ones.

Furthermore, it was also discovered that 50% of the respondents wanted advanced information. Therefore, existing information on the concept should be useful for students in the future.

8 Conclusions

This research was conducted to study the understanding of people about renewable geothermal energy. Many technologies were observed to have been developed relating to the community, socialization and to provide adequate information needed for effective acceptance and usage of the energy. The results showed the level of understanding of the respondents about the concept to be low, with the possibility

of leading to future rejections and problems. Furthermore, the challenges observed in the development of geothermal energy include government policies and regulations, human resources, infrastructures, low level of understanding, and low involvement of community [3,5,6].

Moreover, low involvement and limited information were found to be the main factor causing low understanding. However, large energy potential cannot be effectively managed without the understanding and provision of information in the community. Geothermal energy can either be used directly or indirectly, it is the lack of understanding that causes fear of negative impacts.

Acknowledgement

This article has been funded from the research activities entitled Capacity Building of Geothermal Power Plants Using Exergy Analysis to Support Government Policies in the Development of 35 Thousand MW Power Plants according to research contract No. 516/UN27.21/PP/2019 (Featured Research Grants) PNBPN funding sources for budget year 2019.

References

- [1] International Renewable Energy Agency (IRENA) 2018 Renewable capacity statistics 2018
- [2] Kementerian Energi dan Sumber Daya Mineral 2018 Doing Business In Geothermal
- [3] Pambudi N A 2018 Geothermal power generation in Indonesia, a country within the ring of fire: Current status, future development and policy *Renew. Sustain. Energy Rev.* **81** 2893–901
- [4] Witter J B, Trainor-Guitton W J and Siler D L 2019 Uncertainty and risk evaluation during the exploration stage of geothermal development: A review *Geothermics* **78** 233–42
- [5] Pellizzone A, Allansdottir A, De Franco R, Muttoni G and Manzella A 2015 Exploring public engagement with geothermal energy in southern Italy: A case study *Energy Policy* **85** 1–11
- [6] Vargas Payera S 2018 Understanding social acceptance of geothermal energy: Case study for Araucanía region, Chile *Geothermics* **72** 138–44
- [7] Adityatama D W, Purba D P and Kristianto B 2018 Integrated Geothermal Direct Use Facility as an Alternative Approach in Community Engagement at Early Exploration Phase i ...
- [8] Wang S, Wang J, Lin S and Li J 2019 Public perceptions and acceptance of nuclear energy in China: The role of public knowledge, perceived benefit, perceived risk and public engagement *Energy Policy* **126** 352–60
- [9] Zyadin A, Puhakka A, Ahponen P, Cronberg T and Pelkonen P 2012 School students' knowledge, perceptions, and attitudes toward renewable energy in Jordan *Renew. Energy* **45** 78–85
- [10] Jennings P 2009 New directions in renewable energy education *Renew. Energy* **34** 435–9
- [11] Benighaus C and Bleicher A 2019 Neither risky technology nor renewable electricity: Contested frames in the development of geothermal energy in Germany *Energy Res. Soc. Sci.* **47** 46–55

ORIGINALITY REPORT

10%

SIMILARITY INDEX

8%

INTERNET SOURCES

7%

PUBLICATIONS

7%

STUDENT PAPERS

PRIMARY SOURCES

1	earchive.tpu.ru Internet Source	3%
2	digilib.uinsby.ac.id Internet Source	2%
3	"Geothermal Energy and Society", Springer Science and Business Media LLC, 2019 Publication	1%
4	www.mdpi.com Internet Source	1%
5	iopscience.iop.org Internet Source	1%
6	Submitted to Coventry University Student Paper	1%
7	pangea.stanford.edu Internet Source	<1%
8	dergipark.org.tr Internet Source	<1%
9	publications.jrc.ec.europa.eu	

Exclude quotes Off

Exclude matches Off

Exclude bibliography On