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How Important Energy Awareness in Vocational Education to Support Energy Transition

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***Abstract*—Renewable energy is the energy choice of the future for developing countries. The processing of renewable energy resources and technologies has not been optimal. There are many multidimensional obstacles to be faced. Environmental factors, resilience and scarcity of fossil energy, rising fossil energy prices, and clean energy needs have resuscitated several developing countries to accelerate the renewable energy transition. With a systematic method of review literature this paper presents a discussion of the renewable energy barriers of some developing countries in the three regions of the Asian continent. At the same time presenting an overview of energy education in vocational education systems in some developing countries. Conclusions that can be obtained renewable energy barriers in several developing countries cannot be separated from economic or financial factors, the sustainability of fossil energy is still high, infrastructure that does not meet standards, unclear regulations and regulations, lack of experts and professionals, and lack of public awareness. Integration of renewable energy in vocational education systems in some developing countries, through the secondary and higher education. That is, with the existence of a special study program related to energy or incorporating energy materials in the school curriculum. The goal is as a way to promotion, providing knowledge and insight, to increase awareness about renewable resources and technologies.**

Keywords—renewable energy, energy education, energy awareness, vocational education

I. INTRODUCTION

It is already a global issue where renewable energy will be a promising energy source option in the future. There are at least three key benefits that are processed from the renewable energy transition i.e. clean energy supply, energy independents, and sustainable development [1]. There are compelling reasons why energy transitions should be accelerated, especially in developing countries. First, environmental factors, according to the report [2] about two-thirds of greenhouse emissions are contributed by energy use that is not environmentally friendly. Not to mention environmental pollution caused by the use of vehicle fuel contributes to changes in the global climate [3–5]. Second, the resilience and scarcity of fossil energy sources. There are concerns about the depletion of fossil energy sources that are currently still used by all developing countries. In addition, the rising supply price of fossil energy sources is becoming a problem for developing countries that are still importing energy [6].

Third, the need factor in the majority of developing countries that until now have not had access to clean energy [7]. This is in line with the global energy agenda which realizes low-carbon, environmentally friendly and efficient energy sources [3,8,9]. To achieve a successful renewable energy transition, policies and regulations, information access, funding, education, and social support for renewable energy are needed [1,10]. Energy education is considered as one of the way of promotion and education of renewable energy to the public, as well as providing functional knowledge and understanding of the facts, concepts, and principles of renewable energy resources and technologies [1,11].

Energy education also serves as a driver of public awareness of the utilization of renewable energy resources and technologies [12]. Energy education as part of the vocational education system, can be used as a stand-alone branch of science such as at the higher education level, or used as subjects in the curriculum of various majors, such as at the level of higher education and secondary education [11]. Because one of the factors of failure to implement renewable energy in almost every country, especially developing countries, is the low public awareness [5,8,10,13,14].

So the existence of energy education in the vocational education system is expected to be able to develop public knowledge and awareness of renewable energy. This paper aims to enrich discussions of energy transitions in developing countries and give an overview of energy education to vocational education systems in some developing countries. The aim is to contribute to the literature on this subject which reviews not only the barriers to energy transition in some developing countries, but also looks at how the response and efforts made by some developing countries integrate energy education into their vocational education systems.

II. METHODS

This paper begins by asking:

"What are the barriers to renewable energy and how is energy education in vocational education systems in some developing countries?"

Research focuses on how some developing countries are responding to energy transition issues and integrating renewable energy awareness through education, expecially vocational education. This study uses systematic review of review literature with three stages as in [15] are sourcing, Screening and analyzing articles.

A. Sourcing the Articles

Article searches were carried out in several journals from Elsevier publisher. Some keywords were entered during the search, namely 'energy education and renewable awareness'; 'energy education and vocational'; 'energy awareness and vocational'; and 'renewable awareness and vocational'. The year of publication of the article is limited from 2011 to 2021 with the type of article is research article. As for the subject areas of the article is not limited to representing the diversity of science in vocational education. Articles must come from journals with Q1 rank based on Scimago Journal and Country Rank sites. A total of 2,450, 322, 261, and 164 articles were found for four keywords. The total collected is 3,197 articles.

B. Screening the Articles

Some duplicate articles were removed so from 3,197 articles to 852 articles. Furthermore, 612 articles are not used because the research place and the context of the discussion of the article is not in the developing country. Of the remaining 240 articles re-examined ranging from abstracts, research subjects, to results. Articles whose research subjects are not from the scope of vocational education, do not mention about energy education in the scope of vocational education, do not mention about energy awareness and renewable energy awareness in the scope of vocational education will be removed from the sample. The total number of articles to be published is 33 articles.

C. Analyzing the Articles

TABLE I. JOURNAL SOURCES

Name of journal	Number of articles
Applied Energy	1
Children and Youth Services Review	1
Energy For Sustainable Development	1
Energy Policy	3
Energy Report	2
Journal of Cleaner Production	3
Renewable and Sustainable Energy Reviews	7
Renewable Energy	13
Solar Energy	2
Total	**33**

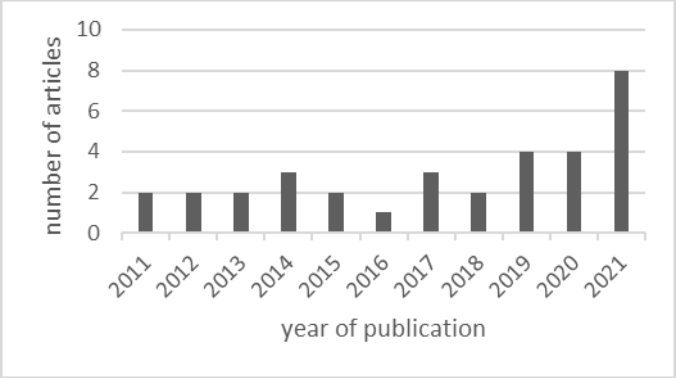

Fig. 1. Articles collected by year of publication.

The articles collected are not analyzed based on the method of collecting data but rather from the content. Some of the points that will be revealed when analyzing the article are barriers to the use and development of renewable energy, an overview of the conditions of energy education, and what efforts are being made to integrate renewable energy awareness in the scope of vocational education in some developing countries (see table 1 and figure 1)

III. RESULTS

A. Barriers to Renewable Energy Transition in Some Developing Countries

1) Southeast Asia region. The source of energy used by the majority of developing countries in the Southeast Asian region is fossil energy. The management and use of renewable energy is considered not optimal. This is evidenced by the high consumption of fossil energy for electricity supply in Indonesia, Thailand, Vietnam and Malaysia [16,17]. Laos has difficulty accessing clean energy to fuel and household technology. Despite having a enough good biomass, solar and wind energy potential. But because the demand for energy in the transportation and electricity sector is increasing for years, so the import of fossil energy cannot be avoided. The effect of Laos biomass share to fall dramatically in 2015 [18]. Vietnam in 2020 experienced the fastest increase in the share of solar and wind energy in the electric energy mix compared to other developing countries in the Southeast Asia region. Because the country has the most ambitious wind power development plan compared to the country in the region. In a study, Vietnam's success was influenced by several factors including [19], support and consistency of the government in providing access to clean energy. Public awareness is high enough for the environment so that the demand for clean energy is also high. However, the management of renewable energy in Vietnam cannot be separated from challenges such as additional rules regarding inadequate offshore wind power, poor transportation infrastructure hampering the movement of turbine

construction supplies, and lack of capital [19]. Malaysia, Indonesia, Thailand and the Philippines are predominantly solar, biomass and water energy for renewable energy share [20,21]. The development of solar energy is gaining more attention in Malaysia than biomass and water by utilizing geographical locations with hot and humid weather. But the difficulty of getting capital and lack of knowledge and awareness among the public asnd the business community are factors inhibiting the acceleration of solar energy development in this country [6,20].

2) Central Asia region. Solar, wind and microhydro energy are potential renewables in the main energy mixed in developing countries in Central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Among the five countries, Kazakhstan dominates in the management and development of renewable energy for electricity supply [21,22]. In a study mentioned there are six factors inhibiting the acceleration and development of renewable energy in the region including a less clear regulatory framework, infrastructure that does not meet the standards still used, lack of investors and research financing capital for renewable energy projects, awareness and access to information for the public is still lacking, the last is the lack of people who have special expertise and knowledge in the field of renewable energy [21].

3) West Asia region. In the West Asian region such as Turkey with the potential of renewable energy solar, geothermal and water [23], cannot be separated from various obstacles. Among them is the lack of skilled labor, the use of renewable energy as a power plant has not been maximized and still depends on fossil energy imports, lack of legislative and regulatory frameworks, and inadequate infrastructure [13,24]. Palestine, as a state under Israeli rule, has limited use of natural resources. The use of renewable energy must depend on the permission of the state that controls it, as well as the lack of information to the public makes the lack of public knowledge and awareness renewable energy [10]. Jordan has also experienced some renewable energy barriers. These include the lack of investors, renewable energy that has not been processed for mass commercial, the lack of skilled labor in the field of renewable energy, and public distrust of the government [25,26].

B. Units Overview of Energy Education and Energy Awareness Levels in Some Developing Countries

Use Education is an important factor that can encourage the acceleration of the renewable energy transition and increase public awareness [15,27]. A country cannot combat energy and environmental issues without education [28]. Several studies reveal a link between education and energy. The quality of education is significantly related to renewable energy consumption [29], education can encourage greater public awareness of renewable energy [12], education produces professional workforce candidates in the field of renewable energy [30]. Education becomes one of the way of promoting and educating renewable energy to the public, as well as providing knowledge and understanding of the facts, concepts, and principles of renewable energy resources and technologies [1,11]. Articles discussing the level of awareness of renewable energy in vocational education in Turkey are more common than any other developing country. This shows the interest of researchers in Turkey to address energy issues in the scope of vocational education.

Turkey focuses energy education with the aim of fostering awareness among students about the nature and causes of the energy crisis they are experiencing, providing students with knowledge and insight of the different types of non-renewable and renewable energy sources, as well as the potential use of renewable energy resources and technologies [31]. The integration of energy in Turkish vocational education at higher education is the existence of a new study program specialized in energy engineering. In addition, Turkey also integrates energy materials in various curriculum of study programs such as electrical technicians, installations, and maintenance of technology. Not only at higher education, Turkey also integrates energy education in high schools, such as in the electricity and energy departments [13]. Based on the findings of some articles, Turkey's renewable energy awareness level is influenced by the level of education. For example, pre-service of vocational teacher who are studying in the final semester have a better level of knowledge and awareness than the early semester [32,33]. High school students of vocational pathways have a higher level of energy awareness than those from regular high schools [34]. But at the vocational high school level, materials about the energy obtained by students are not enough to raise awareness of renewable energy [13].

Malaysia as a developing country in southeast Asia pays attention to the energy awareness of its people through high schools and universities. At the secondary school level knowledge of renewable energy is included in the curriculum. and also held competence by the Malaysian Energy Commission, with the aim of students being able to participate in energy efficiency challenges to instill and practice an energy-efficient culture [6]. Article was found discussing the level of renewable energy awareness of polytechnic teachers and lecturers in Malaysia. As a result, the level of awareness of renewable energy teachers is lower when compared to lecturers [6]. This is due to the educational history that has been taken. Another thing that is noted is that polytechnic lecturers do not get special training on renewable energy.

Integration of energy issues into vocational education at the higher education level in Jordan, similar to Turkey. There are energy-specific study programs such as new and renewable energy, energy conversion and management, and renewable energy technologies or applications. The rest of the energy material is used as compulsory or elective courses in various engineering departments [25]. The level of awareness of final-level students in various engineering study programs in Jordan is still low. A study proves the majority of students in Jordan lack a basic understanding of renewable energy and its

importance to the local economy [25]. Other findings show final-level engineering students are untrained using a variety of renewable energy technologies and most of them are unaware of the principles of sustainable development [35]. This proves that the quality of energy education in Jordan's vocational education system has not been good enough. Other research also mentions the level of awareness of renewable energy students in Jordan is influenced by residence. Students studying in urban areas are more aware about renewable energy and more supportive of the application of renewable energy technologies [36]. Energy awareness levels of Palestinian and Nigerian students are also low. In general, the results showed students' awareness and knowledge of the widespread use of solar energy in Palestine and renewable energy laws are still minimal [10]. Nigeria the level of knowledge about renewable energy technologies is low because they are unaware of the benefits and importance of renewable energy [37].

IV. Conclusion

Aft Renewable energy in some developing countries is still not optimal due to multidimensional challenges. The challenge stems from financial factors such as lack of capital and investors, inadequate infrastructure factors and do not meet standards, factors of dependence on high fossil fuels, factors of lack of information among the public, awareness factors due to weak energy education, to regulations and rules that are not yet clear and detailed about renewable energy. One of these many problems can be solved by education, i.e. integrating this energy issue into the vocational education system. In this way it can encourage public awareness of renewable energy, produce professional labor candidates in the field of renewable energy, as a means of promotion and education of renewable energy to the community, and provide knowledge and understanding of the facts, concepts, and principles of renewable energy resources and technologies.

Education is not the only aspect that can solve all the problems arising from the energy transition, but education plays a key role in any solution. So it has become imperative to create (through educational efforts) awareness in society about energy aspects. Energy education in the vocational education system must be more optimized, the curriculum must be in accordance with the needs, educators must be ensured to have good knowledge and understanding of energy, the procurement of training for educators or prospective educators must be done. The provision of renewable energy-specific educational and training institutions can also be done as China does. They have special wind energy education and training institutions can also be done as China does. They have special wind energy education and training institutions accredited by the local ministry. They provide education degree level options and get a lot of internship requests from industries [38,39]. Not only that education about renewable energy can also be provided through informal education. Like a natural education secondary school in Turkey [40]. Outdoor learning methods can provide variety in energy learning by bringing students to see and experience firsthand.

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