Transformation of Green Economic Recovery Based on Photovoltaic Solar Canopy

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Abstract— **electrical energy has become a significant need to run the country's economy. Especially during the Covid-19 pandemic, teaching and learning activities were in the main realized at home. As a result, the national electricity demand has increased significantly. The solar power plant in the marine is also a good alternative in areas that are constrained by the lack of land as a Solar Power Plant development site. This research is motivated by the need for solar power plants using sustainable photovoltaic (PV) technology, aiming to accelerate the improvement of the quality and competence of lecturers and students in carrying out sustainable Renewable Energy (REY) research by applying the *Merdeka Belajar-Kampus Merdeka (MBKM)* model. The research method begins by conducting a Systematic Literature Review (SLR), which can support the relevance of sustainable REY research. The result of this research is a literature review of solar canopy PV, which is modified to be valuable in courses in the form of a sustainable REY Semester Learning Plan for one semester. From our current research, we hope that in future research, solar panel technology can not only be applied on land but also more broadly. For example, it can be applied in marine waters so that the use of solar panels can be used in many places.**

Keywords— green economic, MBKM, photovoltaic, REY, solar canopy.

I. INTRODUCTION

Energy supplies in Indonesia in 2020, one of which is REY, are affected by the COVID-19 pandemic. The total supply of REY is still much smaller than fossil energy. So the Indonesian government has made a big decision to pursue the REY mix target of 23% by 2025 [1]. Indonesia still relies on non-REY sources, fuel or fuel oil, a step from crude oil. Fuel is an exercise in various life sectors such as transportation, industry, and households. Total fuel consumption nationally reached about 1.63 million barrels per day. Of course, with the increasing number of people in Indonesia and the increasing productivity of the fuel consumption community will continue to rise over time.

That is behind the presence of this research to meet the needs of solar power plants using sustainable PV technology. The world of education is looking to be the leading pioneer, realizing the National Research Master Plan 2017-2045, which focuses on the development of [2] green economic and the implementation of Key Performance Indicators (KPI) of universities [3].

Identifying real problems regarding the downstream products currently refers to "Green Economic Recovery to support Indonesia's Energy Transition" initiated by the Director-General of REY and Energy Conservation Energy and Mineral Resources and the Indonesian REY Society. Until now, Indonesia still has a heavy dependence on fossil energy, namely petroleum, coal, and gas. The share of fossil energy use reaches 80% more in the national primary energy mix. While the utilization of REY only reached about 11%. The utilization of low-carbon REY, such as solar, water, wind, and geothermal power, is essential to protecting life on earth from climate change [4][5][6].

Referring to the above problem, the urgency of this research is that REY must be immediately distributed throughout the community to reduce the energy needs that are still cowardly on fossil fuels. Essential activities that campuses and partners must carry out in synergy in completing the global and national agenda are:

1. Together with Partner, build the *MBKM* culture/climate ecosystem in universities so that lecturers, students, and partners have the correct container to grow and synergize.
2. Together, Partners increase relevance while aligning the development of science and technology to develop REY in the country.
3. Together partners create added value so that they have a sustainable REY ecosystem.

This research aims to develop science and technology and improve society's welfare and the nation's competitiveness. KPI is a [7] benchmark to measure the achievements of the quality of graduates, lecturers, curriculum, and higher education learning. Improving the quality and relevance of higher education to improve the nation's competitiveness is the purpose of this research [8][9]. In addition, there are 5 (five) specific objectives in the framework of the creation of the ecosystem as an effort to complete the global and national agenda:

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1. Establish the right ecosystem so that partners and universities and all stakeholders, especially lecturers and students, can be more directly exposed to the professional atmosphere of the world of work practitioners.
2. Students actively involved in the off-campus learning process get the equivalent recognition of 21 credits mapped to regular courses to implement a learning model. This REY research is one of 9 activities.
3. Partner's lecturers and students can be more selective in science and technology in solving problems using project-based problem solving launched by REY.
4. Colleges can produce graduates of qualified undergraduate programs following industry standards.
5. This REY learning model can pass on as reference material for continuous learning.

The rest of this paper was adapted as follows. Section 2 discusses the methods used in this study and some of the previous studies completed on this topic. The results are in section 3, along with the implications of this research.

II. METHOD

This section discusses the methods used in this study and some of the previous studies completed on this topic. The research flow plan and roadmap are also seriatim in this section.

In previous studies, solar canopy was secondhand for street lighting on several corners of campus entrances and reduced electricity consumption from the State Electricity Company. During the day, the use of electricity can be secondhand as electricity from sunlight, and because at night, there is no sunlight, so there is no electricity production from solar panels, it can use electric current from the State Electricity Company. While in this study, the authors used solar-powered canopy technology PV as a roof for on-campus buildings [10][11].

Improving the quality of relevance to higher education in order to contribute to improving the soft skills of student leadership in the quality of the nation's competitiveness makes state of the art in this study using the concept of *MBKM*, [12] which includes the criteria of 9 (nine) activities. In line with Presidential Regulation of the Republic of Indonesia No. 8 of 2012 on the Indonesian National Qualification Framework, which explains the framework of the extension of competency qualifications that can be juxtaposed, equalized, and integrated between the field of industrial occupational education and training accompanied by work experience that is given recognition of work competence by the structure of employment in various industrial sectors.[13][14]

Of course, to run the existing mechanism, there must be a curriculum planning that supports it; an Academic curriculum with development and testing using Results-Based Education Methods wherein one-semester students can directly create effective and efficient REY in the community [15].
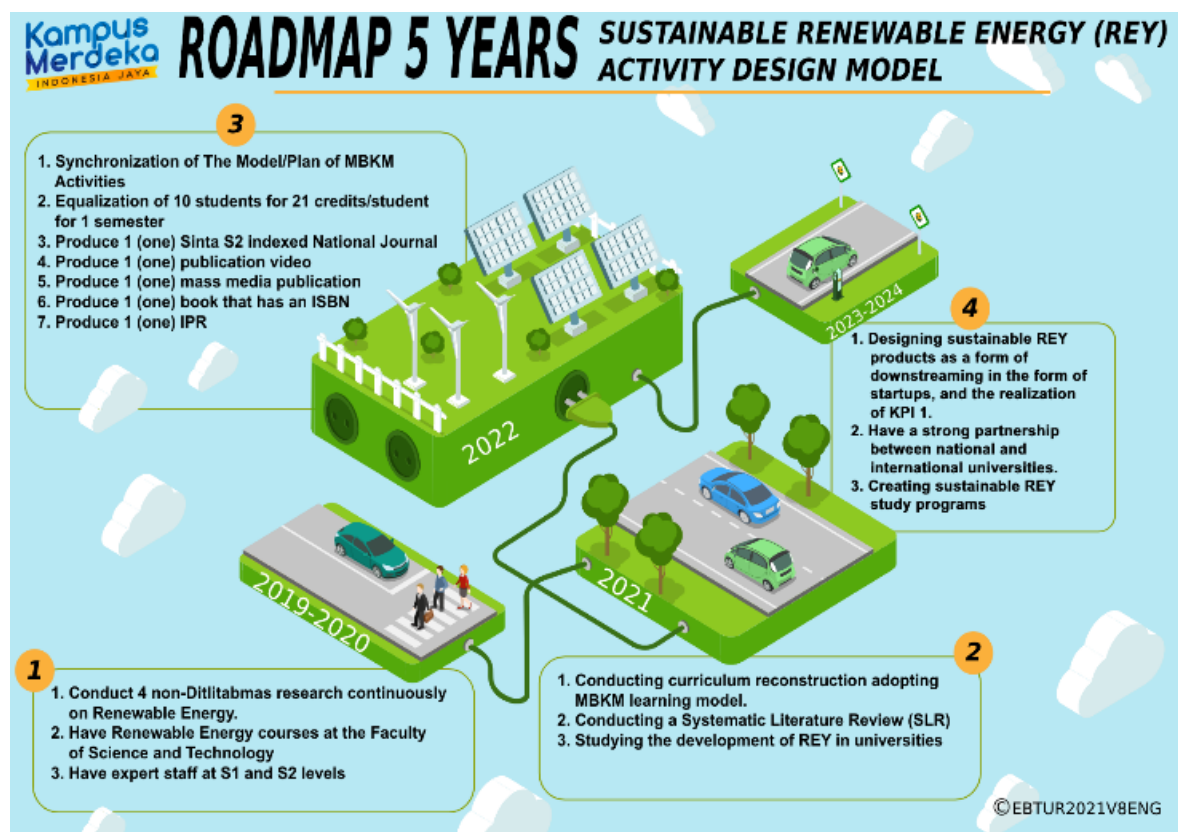

Figure. 1. Roadmap 5 years of REY

With the Outcome-Based Methods of Education strategy, students can also create REY in a village to reduce fossil burning. In addition, the use of REY can also make the environment cleaner and reduce air pollution due to fossil combustion; REY will also not run out even though it has been envious repeatedly. The maximum application of REY in the community will impact the reduced use of fossil fuel-based energy, reducing dependence on fossil energy and oil imports [16][10][17].

The roadmap and program design in sustainable REY learning models will be spiteful in Figure 1. The stages of activities that have been in charge are implemented and will sink to achieve targets outlined one by one in the planning [18]. The stages are as follows.

1) In 2019-2020, researchers conducted four non-continuous types for two years on REY. The faculty funded the research. Already has REY courses in the faculty of Science and Technology, which runs for two years, and already has expert staff for undergraduate and undergraduate levels.

2) Therefore, in 2021, a curriculum reconstruction must adopt the learning model as an upstream of REY development. A Systematic Literature Review SLR has been conducted by reviewing what researchers from other universities have done to develop REY.

3) In 2022, researchers coordinated the *MBKM* Model/ Activity Plan, equalizing ten students by 21 credits/students for one semester, producing 1 (one) national journal indexed Sinta S2, producing 1 (one) video publication, 1 (one) mass media publication, 1 (one) book that has an International Standard Book Number (ISBN) and produced 1 (one) IPR.

4) In 2023-2024, researchers began designing sustainable REY products downstream in the form of Startup and realization of IKU 1. Have strong partnerships between national and international colleges. In 2024 create a sustainable REY Program green economic.

A. Design and Flow of Research

This REY research design will be immoderate through the description in Figure 2 of the Research Flow. The activities will make good to achieve the REY target to run optimally and well according to outlined one by one.
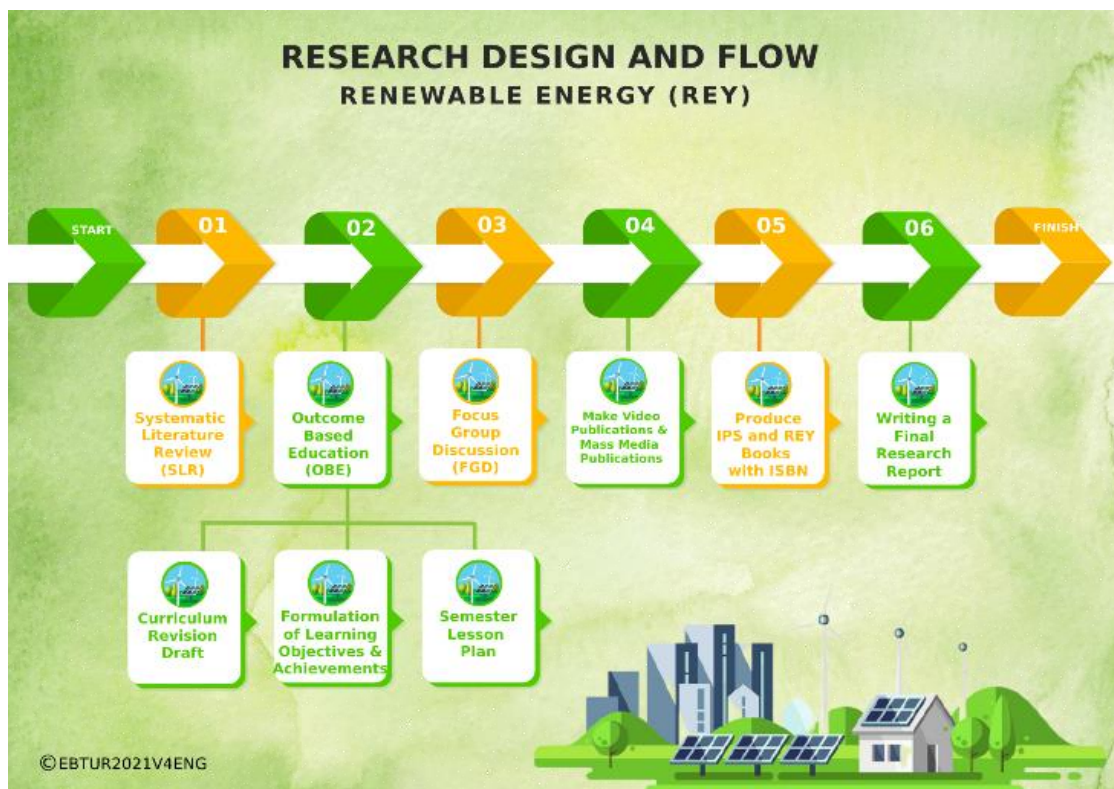

Figure. 2. Research Design and Flow

This research begins with the first stage of a systematic literature review, which can support the relevance of sustainable REY research that is being direct. Furthermore, the second stage is the Outcome-Based Education (OBE) method which includes a revised curriculum design (graduate profile study material), formulation of learning goals and achievements, and a comprehensive sustainable REY Semester Learning Plan [19]. The third stage is Focus Group Discussion (FGD), which includes the dissemination of systematic literature review results, the results of REY curriculum revision, the formulation of goals and learning achievements to achieve REY targets, and the draft results REY semester learning plan sustainable. The fourth stage is to make a video publication about REY published on Massive Online

Open Course (MOOC) in *Sistem Pembelajaran Daring (Spada)* Indonesia and mass media publications. The fifth stage produces IPR and REY Books with ISBN, and the last stage makes the final report of REY research [20][21]. Solar autonomous energy generation and storage are currently the key enablers of offshore IoT, and are used in a wide variety of marine and coastal applications [38].

B. Data Analysis

In this study, researchers conducted a survey using a systematic literature review that can support the relevance of sustainable REY research that is being direct. There are 125 scientific articles from various reputable scientific databases such as Scopus and WoS. After going through the screening and elimination stages of 75 articles whose research themes are not in line with REY, especially solar power, the results of as many as 50 relevant articles were over it to support this research [22][23].
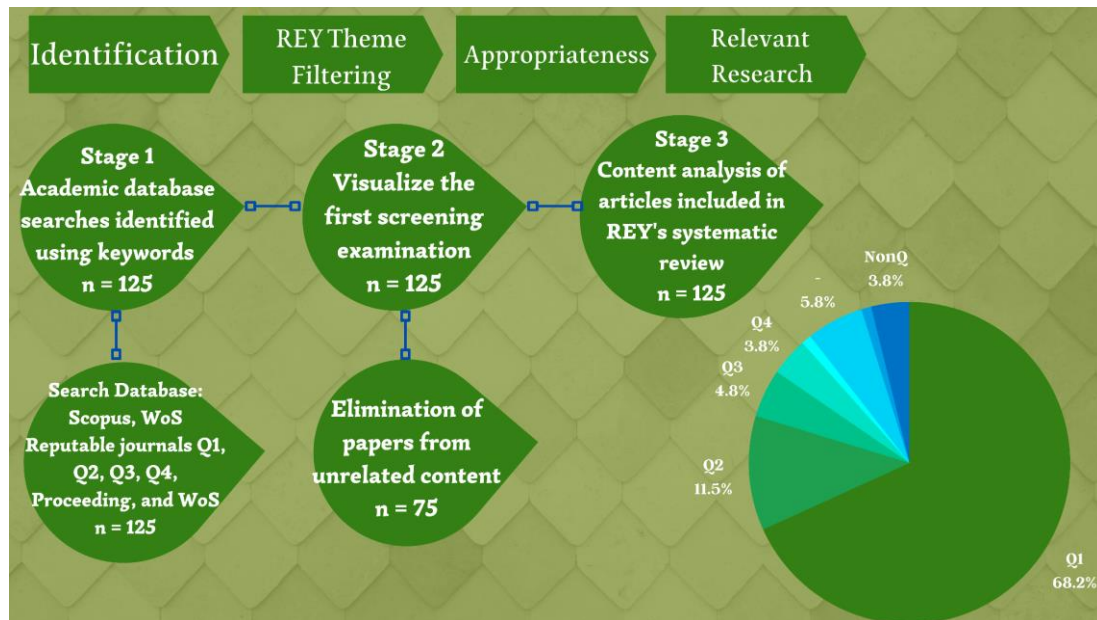

Figure. 3. Systematic Literature Review (SLR)

Furthermore, through Focus Group Discussion and presentation, a diverse staff of experts will begin the initial survey analysis and final survey and make comparisons to obtain the level of significance from the utilization of this program [24].

C. Research Achievement Indicators

Key Performance Indicators is an important thing that is visible to know the status of achievement of a college program, even the status of the college itself. The transformation and achievements of Key Performance Indicators proposing universities creatively, innovatively, and collaboratively are in charge within the framework of with student involvement in various types of sustainable REY activities [25]. This study has 8 points of Main Performance Indicator (IKU) completed as many as 6 points [26].

III. RESULTS AND DISCUSSION

In this section we discuss the results and implications of this research.

Based on the research done, the results of this study are in the form of a literature review on PV solar power, reconstruction of courses in the form of a Sustainable REY Semester Learning Plan for one semester currently. There are still few REY courses at universities in Tangerang and Starlet (Start-up Booklet) introducing REY at the University of Raharja [27]. PV technology or research on solar canopy by converting sunlight energy into electrical energy. [28] In general, PV Solar Power Plants are currently a more popular choice with a much larger market size than solar thermal Solar Power Plants. Because in previous research, solar canopy was used for street lighting of part of the campus entrance corner and at the same time to reduce electricity usage by State Electricity Company, then in [11][10]; this study, the author uses a new method, namely PV solar-powered canopy in campus buildings [29]. The solar power plant in the marine is also a good alternative in areas that are constrained by the lack of land as a Solar Power Plant development site [37].

This research implies that the application of REY in the community can make the environment cleaner and reduce air pollution due to fossil combustion; REY will also not run out even though it has been envious repeatedly. The need for solar power plants using [30][31] sustainable PV technology is still the focus of problems in the country today. The transformation and achievements of Key Performance Indicators college, creatively, innovatively, and collaboratively implemented in this research. This research can harmonize the development of science and technology to develop REY in the country. In the following study, it is fallacious that the application of PV solar-powered can pass on thoroughly so that the reduction of fossil fuel energy can be mean [32][33][34]. Figure 4 shows how a PV solar cell generates electricity.
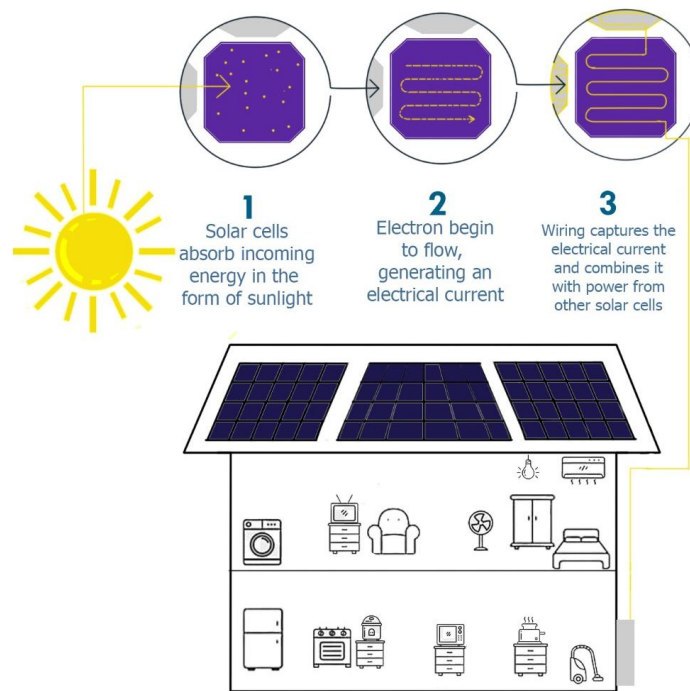
Figure. 4. How A PV Solar Cell Generates Electricity

We are building the ecosystem to bring the academic world closer and the Business World/Industrial World through the creation of REY technology products. The REY program becomes a place to seek experience for students so that later the experience gained through this REY program will accelerate the College to produce graduates of qualified undergraduate programs and by industry standards [35][36].

IV. CONCLUSIONS

The use of REY with solar power can reduce the consumption of fossil-fueled electricity. Fossil-fuel power plants should be replaced immediately with REY, such as PV solar power. Young Indonesian millennials should compete in long-term investment through REY and help preserve the environment. REY can reduce the energy needs that are still cowardly on fossil fuels. The solar power plant in the marine is also a good alternative in areas that are constrained by the lack of land as a Solar Power Plant development site.

The drawback of this research is that the use of Green Economic in the community is still tiny, so it is necessary to carry out thorough socialization of Green Economic so that its use can be more meaningful. Green Economic Management also needs to have elements of benefit, added value, sustainability, and community welfare so that the maximum application of Green Economic can reduce the use of fossil fuel-based energy; this is also looked for to be pleased in future research.

This research implies that the application of REY in the community can make the environment cleaner and reduce air pollution due to fossil combustion; REY will also not run out even though it has been envious repeatedly. The need for solar power plants using sustainable PV technology is still the focus of problems in the country today. From our current research, we hope that in future research, solar panel technology can not only be applied on land but also more broadly. For example, it can be applied in marine waters so that the use of solar panels can be used in many places.

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