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Review of Uncommon Power Generation Methods

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***Abstract*— Fossil fuel shortage is a common problem in every country. Day by day it going to discreet also fuel prices going to increase. When burning fossil fuels have made a few problems. The main problem is environmental pollution. Considering the current rate of usage of fossil fuels will let its life up to the next five decades only. Most countries referred to the use of renewable energy. Wind power, Solar power, sea wave power, Hydropower, and Geothermal heat are a few of the renewable energy they have used. Also, few countries have used nuclear power plants, charcoal power plants, and diesel power plants. But when using charcoal or diesel power plants, it has to spend a lot of money on one unit of electricity. Nuclear power plants are not suitable for small countries like Sri Lanka. In history, the most powerful kingdoms had used uncommon and hidden power for their living area. The main objective is this review paper is to identify uncommon power generation methods and weaknesses of the existing renewable power generation system and To what extent are these suitable for Sri Lanka. Performance analysis has been carried out in this study along with the literature review.**

Keywords*— *renewable energy, sea wave power, vibration power, wind power, hydropower, solar power, energy storage, Gravity power

I. INTRODUCTION

Fossil fuels were the main source of energy during the Industrial Revolution. But due to the increasing demand and excessive consumption pattern of these, several problems had to be faced. It highlighted the environmental problems caused by excess carbon emissions, the increasing rate of fossil fuel consumption relative to the time it takes to produce fossil fuels, and high prices due to high demand. For these reasons, people started turning to alternative energies.

Renewable energies are the most widely used alternative energies in the world. While widely used renewable energy exists, there are many examples of uncommonly used renewable energy around the world. Examples of widely used renewable energies in Sri Lanka include wind power, hydropower and solar power.

At present, 1399 megawatts are produced in Sri Lanka through hydroelectricity. It is only 30% of Sri Lanka's electricity requirement. In addition, only 527 megawatts of solar power is produced in Sri Lanka. Wind power plants will also add 600 megawatts to the national electricity grid. Among these, the most cost-effective generation of electricity is hydropower.

Solar power and wind power are quite expensive. Hydroelectricity is currently being produced at the maximum capacity that can be produced in Sri Lanka. But Sri Lanka can still build solar power plants. Ocean waves, geothermal energy, gravitational potential energy storage, hydrogen gas (produced and stored from water), vibration etc. are examples of renewable energy that can be used in Sri Lanka in extraordinary ways. Following are some of the problems of renewable energy currently used in Sri Lanka.

A. *Absence of geological features to generate hydropower in all parts of the island :* High potential land and catchment areas are essential for water storage for hydropower generation.

B. *Variations in sunlight :* Not every part of the island gets the same amount of sunlight. And it is not available uniformly throughout the year.

C. *Variation in wind speed :* Even if a few limited areas of Sri Lanka get enough wind flow to generate electricity, they do not get it uniformly.

D. *Price rise :* Although renewable energy is available for free, there is a cost to generate electricity as it costs money for maintenance.

Also, as the problems of uncommon used renewable energy,

A. *Being able to generate electricity only in special stations:* Electricity can be produced only in places where underground heat can be obtained for the process of electricity generation by geothermal energy.

B. *Strength of ocean waves :* Ocean waves must be powerful enough to generate electricity. Without that, electricity cannot be extinguished.

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C. *Technical problems:* Some constructions and systems require high technology or special machine tools.

There are many systems in the world that have been developed in response to the above-mentioned problems.

II. LITERATURE REVIEW

A. *Power generation from sea wave :*

Ocean Trader is a type of floating item that is partially immersed in water and uses ocean waves to create electricity. The total theoretical energy generated by sea waves is close to 8x106TWh per year. That is 100 times the energy necessary to generate hydroelectricity globally. The energy of a wave is mostly determined by a few things. Trough (the lowest point of the wave), Wavelength (the horizontal distance between one crest and the next crest), Wave height (the vertical distance between a wave's trough and its crest), and Frequency. The frequency of the waves is proportional to the amount of power generated.Tidal and wave energy can only be used to produce electricity by running a turbine or generator. The moon's gravity causes tides and wind causes waves. An ocean wave can generate electricity 24 hours a day. The tide comes in and lasts about 10 hours a day. Tides can generate power when water waves move in one direction. However, the number of efficient locations where this can be used is limited. [1] [2].

Currently, several methods are used to generate electricity from oceans. Attenuators, point absorbers, Overtopping Devices, Overtopping Devices and Tidal lagoon power can be mentioned as examples. can generate electricity, Using mechanical parts on the bottom of the deep sea, the floating material on the surface of the ocean, in small power plants built, near the coast. Figure 1 shows a method of generating electricity in shallow seas. This method captures or reflects the power of the wave that propagates perpendicular to the direction of the wave [3].

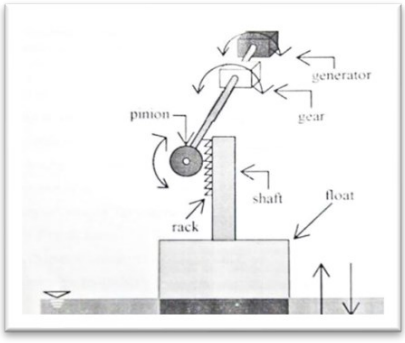

Figure 1: Generating electricity in shallow sea

Attenuators : Attenuators (Figure 2) are multi-segmented floating structures aligned parallel to the path of the wave. These floating structures are connected to each other by a coupling mechanism in the middle and through this the changes in the floating structures when a wave passes through it can produce electricity [4].

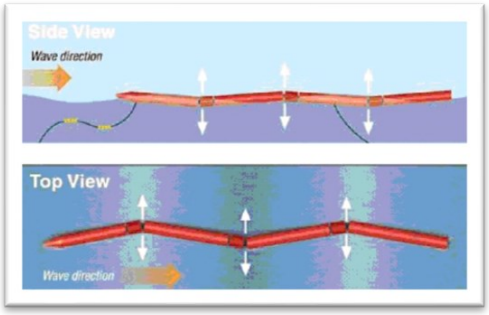

Figure 2: Attenuators

Point Absorbers (Figure 3) This is done by making one part relatively stationary while the other part is allowed to move with the wave. The stationary part is fixed at the bottom of the ocean. The kinetic energy generated here is converted into electrical energy and the electricity is sent to the land through cables under the sea.

Figure 3: Point absorbers

Overtopping Devices : Here, ocean waves are collected in a small reservoir built slightly above the sea level, and the water is made to spin a turbine and make it flow down to produce electricity (Figure 4).

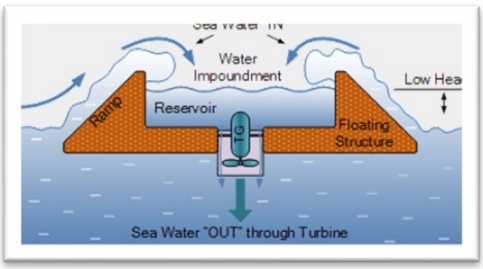

Figure 4: Overtopping device

Terminators : The trapped water column moves up and down like a piston, forcing air through an aperture connected to a turbine and generating electricity (Figure 5) [5].As above, electricity can be generated by ocean waves in a number of ways.

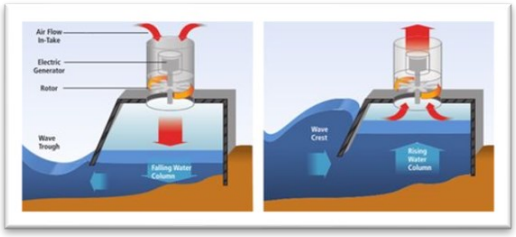

Figure 5: Terminators

B. The Pyramid Electric Generator :

There is evidence that the ancient Egyptians used wireless electricity as a source of energy An electric generator can draw power from the Earth's electric field. pyramid proposed a novel theory of space, energy, and matter based on the assumption that "electromagnetic interaction" spreading through a carrier medium known as the "space lattice". The lattice is composed of pulsing, phi-based spiral vortices, the stimulation of which results in sinusoidal lines of force running across it. A method for producing electricity has been discovered by placing a capacitor into a natural pressure drop. This is believed to have occurred in the pyramids. A "pyramid-shaped" capacitors are an advantageously formed device for exploiting the space lattice's energy gradient, which manifests as an electrical potential gradient in Earth's atmosphere. Also discovered that a "pyramid-shaped" capacitor design should be based on "pi" and "phi" ratios because electrical energy propagates in a "phi-based" spiral. The Earth's solid mass and atmosphere form a linked resonant system. Acoustic waves are also electrical and can be captured. As a result, the pyramid electric generator could catch the energy emitted by both telluric and atmospheric atomic oscillators [6].

Measurements and scientific research have been carried out to demonstrate that the pyramids were built to operate as "Electrical Generators" and wirelessly distribute this electric energy Covering all of Egypt. The Massachusetts Institute of Technology has acquired the capability of transmitting 60W over a distance of two meters by exploiting resonant magnetic coupling between two coils, by the reason researchers did by them. inside the queen's chamber's walls had remaining salt. that means it has been used in some chemical reactions used to light these places [7].

When quartz crystals are mechanically vibrated or pressured, it can generate electron flow. By using this theory, they generated electricity inside the pyramids. queen's chamber host a chemical reaction to generate hydrogen. after that hydrogen flows to passages and chambers of the pyramid. between the king's chamber and five granite beams distance will be adjusted according to the resonance frequency of the earth. after generating resonance, coupling the earth's vibration energy to flow through the pyramid [8].

As early as 3000 BC, the pyramids were built in places where the magnetic fields were at their maximum. It seems that the experts of mechanical sciences, chemical sciences, and electronic sciences of that time have contributed to making these. It appears that the pyramids located in various places around the world have been used for the generation and distribution of electricity as well as for the exchange of messages in addition to the burial of mummies. There is evidence that batteries and lights were first used in Egypt. Although there was artificial lighting inside the pyramids, no torches were lit and no torch grates or carbon were deposited on the walls. There is evidence that electricity was used in Egypt for the torch that produced the light used in the Lighthouse of Alexandria. To generate electricity inside the pyramid, a method of generating electricity from crystal oscillators has been used. Here it is imperative that the pyramid vibrates all the time. Therefore, they worked to establish pyramids in the most electromagnetic waves. Unlike today, back then electricity was transmitted wirelessly, and no step-down transformers was required. Evidence has also been found that it was possible to directly communicate or communicate with other pyramids in the world [9].

The exchange of electrons takes place between the atmosphere and the Earth's surface. It continues. Here the Earth's surface is negatively charged and the atmosphere is considered positively charged. This creates a potential gap. This potential gradient has been found to vary with tropospheric activity. Tests are conducted to harness that potential. Without being able to calculate the power of a lightning bolt. The approximate size can be seen as below[10].

- Medium-sized thunderstorm (approximately 200 km in diameter) with intra-cloud can generate at least 6.28x1010 W.
- With 2,300 operational thunderstorms at any given time, the overall power output is estimated to be 1.44x1014 W.
- The world's total power generation capacity is only 3.625x1012 W.

This makes the atmosphere very suitable for meeting human needs if it is possible to harness electrical activity [11] .

C. Wind Power Electric Generation :

Wind energy is used as an alternative energy and can be classified as large and small scale depending on the scale. Large-scale wind turbines are combined to form wind farms, while small-scale wind turbines are used by households or small businesses to meet daily electricity needs. Small-scale wind farms are used both off-grid and on-grid.

Wind speed is directly considered in the construction of wind farms. These power plants are built in areas with high wind speed. This is not ideal in countries like Malaysia where there are no strong winds. But how a power plant was built in such a situation is described here. Its

average wind speed is about 4 meters per second. It is not a suitable situation to build a wind farm. But many small wind turbines were built on the east coast of Malaysia to produce 153.4Kwh of electricity per year[12].

The information obtained by sensors installed at a height of about 15 meters on this coast is collected annually and the data is analyzed. Accordingly, the annual average maximum wind speed is 2.2 meters per second, and the average minimum is 1.2 meters per second. Below is an equation that determines the wind speed according to the height of the sea level [13].

$V_x =$ V_r [Z_x / Z_r]
$V_z =$ Wind speed
$V_r =$ Reference Wind velocity (ms^{-1})
$Z_x =$ Target Height (m)
$Z_r =$ Share Factor

Up to now which made wind turbines have fixed control systems for getting maximum efficiency. currently use two types of wind turbines. there are Horizontal axis wind turbine (HAWT) and Vertical axis wind turbine (VAWT). VAWT type turbine's "main rotor shaft" runs vertically and HAWT type turbine's "main rotor shaft" runs horizontally. VAWT type turbine's main advantages are its simple design and no need to control speed. This turbine is driven by wind blowing from any direction. Under the "VAWT" type turbines have two main types. There are "Darrieus" and "Savonius". We can summarize both of turbine

Darrieus wind turbine	Savonius wind turbine
High speed, low torque	Slow rotation, high torque
Difficult to self-start.	It can start with low wind speeds
Easily integrated into buildings	Tough to integrated into buildings
Generator can be placed on the ground	Generator can be placed on the ground
Comparably High efficiency	Low efficiency

Also, as a by-product of solar heat, winds blow. That is, air particles that have absorbed the energy of solar radiation move up and come back down. Then the turbulence in the air can be called wind [14].
Two factors primarily affect the production of electricity by a turbine.

1. Wind speed
2. Swept Area of turbine

Through the below equation, we can calculate the swep Area(A). In this equation, "r" is the length of the turbine wing[15].

$$A = \pi r^2$$

Considering the raw materials for the production of rotary blades between aluminum, zinc and acrylic, blades made of acrylic can rotate at the highest speed. Also, considering the places where the wind turbines are installed, it has been found that the highest efficiency is in the field area, beach area, high area. The two-bladed wind turbine produced the highest volt-amperes among the two-bladed wind turbines, three-bladed wind turbines, and four-bladed wind turbines [16].

D. Power Generation And Storage Using Gravity :

People are turning to renewable energy to reduce fossil fuel burning. But the problem is that this only exists in a limited time or area. Problems have arisen regarding the storage and consumption of renewable energy. Storage effectiveness depends on how much is stored and how quickly it is available when demand changes.

Energy storage methods have been used since before 1800 AD. Electricity from renewable sources is sometimes at a peak and at other times at a minimum. Energy storage is used to overcome this problem. in power peak time store the electricity and when comes to minimum time power going to release from the store. we should have to choose a store method very important to according our requirements. Below are some methods of energy storage. [17]

- Pumped-storage Hydro : Water is pumped to a high potential, stored and released when needed to generate electricity.
- Compressed Air store : During peak electricity periods, compressed gas is sent to an underground chamber to produce thermal energy and is released when needed to convert it into electricity.
- Thermal: The heat is stored in the rock or lava and sent for later use.
- Lithium-ion / Solid state: This is the most famous and used battery in the world.
- Hydrogen: During peak electricity periods, going to make O_2 and H_2. Hydrogen is burned to generate electricity when electricity demand is at its peak.
- Fly-Wheel: Mechanical energy can be stored for short periods of time.

Scientists have innovated renewable energy stores like pumped hydro stores, electric batteries, electromagnetic energy stores and etc. but when stored in renewable energy (RE) it has few limitations. when using electric batteries is expensive. also, it hasn't a long lifetime. As well as when using pumped hydro stores has geographical limitations.

To avoid this problem currently using "gravity energy storage system" (GESS). This can be done to reduce the gap between high electricity demand and production during peak hours. Two main methods have been found using gravity to store electrical energy as potential energy and convert it back into electricity during times of low demand.

1. Pumped hydro store(PHS)
2. Advanced Rail Energy Storage (ARES)

In PHS water is stored in an upper tank and then its potential energy is used to generate electricity. But it has limitations. Such a system cannot be followed in every place. Only a place with geographically high and low land can do something like this. ARES uses a six-arm crane to lift up to 5,000 concrete blocks (35 tons) and store the potential energy of the concrete blocks. It produces electricity when needed. In this type of system with a capacity of 20 - 80 MWH, 6-8 hours can be obtained continuously. this system has been developed to reduce the ratio between demand and supply during peak energy demand. Here, when the electricity demand is minimal, the excess is stored as potential energy[18],[19].

The Table 1 summarizes the characteristics of energy storage systems.

TABLE I. CHARACTERISTICS OF ENERG STORAGE SYSTEMS

	Max Power Rattin g (MW)	**Typical Discharg e time**	**Max cycles or lifetime Energy density**	**Energy density (watt-hour per liter)**	**Efficiency**
Pumped hydro	3000	4h - 16h	30 - 60 years	0.2 - 2	70 - 85 %
Compresse d air	1000	2h - 30h	20 - 40 years	2 - 6	40 - 70%
Thermal	150	1h	30 years	70 - 210	80 - 90%
Li-ion battery	100	1min - 8h	10000 - 12000	200 - 400	85 - 95%
Hydrogen	100	Mins - week	5 - 30 years	600	25 - 45%
Flywheel	20	Sec - mins	20000 - 100000	20 - 80	70 - 95%

E. Electrical Energy via Vibration Energy :

This method is already used for electronic devices that work under low power. Walls, roads, vehicles, and people walking can be seen as pathways through which vibrational energy can be absorbed. Staircases, vehicle shock absorbers and crowded places have been developed to generate electricity through these methods. Every object vibrates at a specific frequency. These are high frequencies that are not in the range of human sensitivity. Such vibrations in the environment can generate electricity.

Vibration is converted into electricity mainly in two ways. As a piezoelectric and electromagnetic transducer.by using vibrations, the piezoelectric and electric motors can generate electricity. Electricity is generated from vibrations using piezoelectric stresses and a motor speed induced transducer. when generating electricity by using pizoplate it has two steps. first mechanical energy has to convert to AC voltage. as a second step AC voltage converts to DC voltage. in another hand, we can use "spring Vibration ". when vibrating spring it can generate an electric flux. it's sensitive to small vibrations also. that is a method for generating electricity by magnetic flux [20].

III. METHODOLOGY

This chapter tells about how the literature survey was done. First, related to the research topic, what are the current non-popular power generation methods in the world. Research papers were searched (IEEE, Research Gateway) using keywords related to unknown power generation methods found on the Internet. A total of 400 results were obtained as the search results, and 40 papers were selected by reading the abstracts of those papers.

Out of these 40 papers, at least 5 research papers have been selected under one power generation method. After reading the entire 40 papers and summarizing the contents, 15 of the most clear and appropriate papers have been selected and presented here. Here, attention has been given to the renewable energies that have been used and are currently being used in the world, their weaknesses, advantages and disadvantages and to what extent they are suitable for a country like Sri Lanka. Based on the above-mentioned research papers have been selected as the basis for this literature survey. Below is the flowchart for the literature survey. (Figure shows the methodology for creating the literature survey using a flow chart)

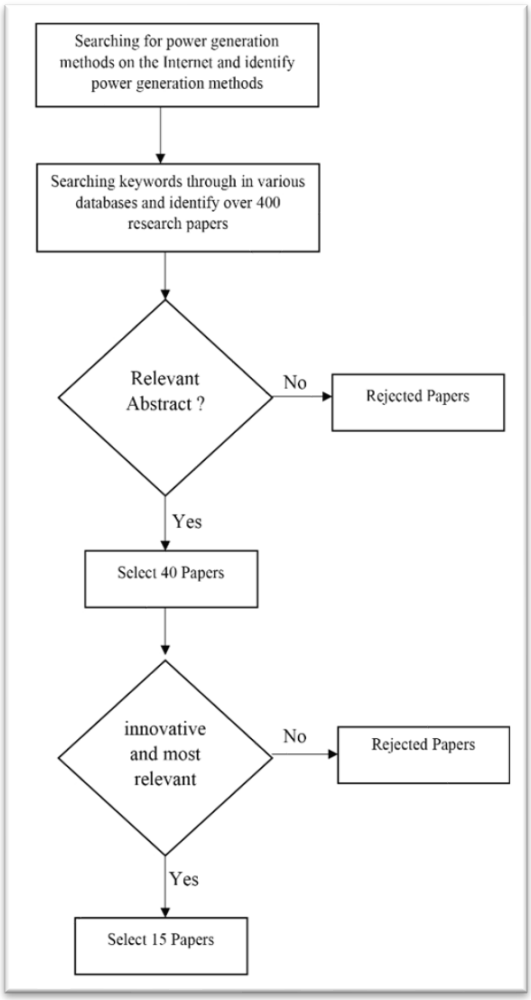

Figure 6: Methodology

IV. DISCUSSION

Considering the renewable energies available in the world now, hydropower can be considered the most profitable. In Sri Lanka, 30% of the power is generated through hydropower. But it has limitations. It depends on the geometric background and Annual rainfall in the area. So everywhere cant install hydropower plantations. According to geometric view and annual rainfall, Kegalle, Rathnapura, Nuwara-Eliya, Badulla, Kandy, Kaluthara, Galle and Matara districts are suitable for setting up Hydropower plants . Even now, Sri Lanka is producing hydroelectric power at its maximum capacity. Therefore, it is essential to turn to other renewable energies to meet the energy requirement. This is a common power generation method.

Considering the two types of wind power generation, VAWT and HAWT, VAWT can be of great benefit. The attractive benefits of VAWT are small tower size, no need for yaw mechanism, overall very simple to make, low noise generation, can be generated on the ground floor and more than 70% efficiency. When considering the wind condition of countries, it has internal and external wind power. In Sri Lanka like Kandy, Matale, Kurunegala, Anuradapura, and Polonnaruwa district has internal wind power. These power plants are suitable for installation in coastal areas where sea breezes are prevalent such as Hambantota, Jaffna and Puttalam. But most of these are still rarely used.

Solar energy has become the most widely used renewable energy in the world. So this is not an uncommon way. But this type of renewable energy cant is used at night time. Because we have to store and use it. When using batteries it's very costly also batteries have a short life cycle. To avoid this problem few of country have used "Gravity Batteries" as we are known as mechanical batteries.

Although the generation of electricity from sea waves seems to be more profitable, there are still very few power plants that generate electricity from ocean waves. But tidal power generation can be seen significantly. The sea around Hambantota in Sri Lanka is considered suitable for generating electricity from ocean waves [21].

Using geothermal heat is now being produced at significantly lower costs in several regions of the world. But there are few places where this geothermal energy is available.

Vibrations are currently being used to generate electricity on a very small scale, such as powering street lights. Also, hybrid vehicles charge the batteries of the same vehicle using the vibrations produced by it when moving. In the past, the pyramids also used vibration and gravity to generate electricity, but they have been buried with the past.

Table II is the summary of uncommon power generation methods.

TABLE II. SUMMARY OF UNCOMMON POWER GENERATION METHODS.

Type of Energy	The largest power plant in existence	Advantage	Disadvantage
Solar Energy	Tengger Desert Solar Park, China - 1,547MW	Infinite & 100% free source.	Storage cost is high. Taking Large Space. A uniform sunshine is required throughout the year
Wind Power	China – installed wind capacity of 342GW	Low operational cost. Rapid Growth.	A uniform wind power is required throughout the year. Noise Problem.
Geothermal	Geysers Geothermal Complex (USA) capacity of 900 MW.	24 Hours 365 days can use continuously.	Limited Area.
Sea Wave Power	Agucadoura Wave Farm from Portugal (Surface-following attenuator) - 2.25MW	24 Hours 365 days can use continuously free source. Ideal for island.	Limited Area. Technical Problem. Using High Technology & High cost to build this structure.
Tidal Energy	Sihwa Lake Tidal Power Station, South Korea – 254MW	24 Hours 365 days can use continuously free source. Long Life cycle.	Limited Environment. Expensive. Taking Large Space
Vibration Energy	-	Long time can use. 100% free .	Not suitable for a large project. High cost for build.
Gravity Battery	Energy Vault 60 meter prototype in Castione-Arbedo - 10MWh	Long life cycle. Very cheap than electrical battery.	Using High technology.

V. CONCLUSION

Although most people in the world use renewable energies such as solar power, wind power and hydroelectricity, the use of ocean waves and tidal waves is at a very low level. Although ocean waves are available 24 hours a day, this has become difficult to use due to the high cost of producing these power plants and the constant damage to the machines due to sea erosion. Otherwise, there is a possibility of harvesting electricity 24 hours a day by sea waves. Currently, solar power stores energy in batteries for use at night. But this can be stored more efficiently and cheaply in gravity batteries.

However, if it is possible to produce energy all the time, it is advantageous renewable energy because there is no need to store it. A very large cost has to be applied to store electricity. But still less attention seems to have been paid to generating electricity from ocean waves. And in the past, less attention has been paid to the generation of electricity by hidden vibrational and gravitational fields.

VI. FUTURE WORK

Analyzing suitable methods for human and environmentally friendly energy generation and storage from renewable energies that are discarded without use in the environment to reduce the current increasing energy demand. And to analyze a system of electricity production using the unlimited wave energy produced in the ocean.

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