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Electricity Generation from Solar Energy: A Contemporary Study Integrating Physical Applications and Islamic Sharia Guidelines

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ABSTRACT

Maintaining the natural environment and striking a balance when using its resources is one of the main goals of Islamic law. The Kingdom of Saudi Arabia has been a leader in the search for alternative energy sources in order to meet life's demands and attain economic progress. It is working hard to generate renewable energy, the majority of which is derived from solar radiation. The Almighty God spoke the truth when He declared: "And He has subjected to you the night and the day and the sun and the moon, and the stars are subjected by His command. Surely , in this are proofs for a people who understand." (An-Nahl, (12)) . Allah has created the sun obedient to humans, and people have realized this and sought to take use of it. It is an amazing energy source whose significance stems from its enormous potential, which may be applied wherever. When utilized in numerous fields, it is regarded as clean energy since it is a free and limitless fuel supply. As a result, it need to be researched and used since it is a valid goal, particularly given the limited supply of conventional energy sources. To participate The Kingdom has prioritized investing in the field of solar energy for electricity production, working to reduce gas emissions, and paying attention to developing renewable energy sources, the most important of which is solar energy, which is something that Sharia calls for and urges, in order to achieve the goals of the Kingdom's Vision 2030 in diversifying the economy and transforming the Kingdom from an advanced oil-exporting country to an exporter of sustainable energy. The Kingdom of Saudi Arabia is blessed by God with an abundance of solar radiation in the Arab world. The intensity of solar radiation in the Arab region reaches 1000 watts/square meter at midday and an average of 250 to 300 watts/square meter per day, which is equivalent to 6 kilowatt-hours/square meter per day. Additionally, the Kingdom receives approximately 2200 kilowatts of photovoltaic energy annually. The King Abdullah University of Science and Technology's solar power generation project, the solar village project, the National Initiative for the Production of Water and Electricity Using Solar Energy under the auspices of King Abdulaziz City for Science and Technology, and other initiatives have been proposed by the government to capitalize on this. We must overcome some obstacles in order for the Kingdom to profit from solar energy. In addition to encouraging research in solar energy and scientific exchange with other nations, the government has offered material and spiritual support. As we shall discuss the function of solar energy in sustainable development, its significance and components, and how to take advantage of it as a clean energy source, the significance of this research is clear. The benefits of employing solar cells as a source of energy will also be discussed, along with how photovoltaic cells can be used to generate power. All of this will be connected to the specific scientific miracles stated in the Holy Quran and the Prophetic Sunnah, which demand advancement and modernization. In order to promote and realize Vision 2030, which the beloved Kingdom has called for, this research closes by showcasing advancements in solar energy technologies and applications.

Keywords: -Solar energy - Applications - Challenges - Islamic law - Initiatives - Photocells – Electrical energy

INTRODUCTION

The sun and moon were made by Allah to serve as symbols of His omnipotence and majesty of might. He created light on Earth from the sun's rays and light from the moon's surface reflected rays. And He responded, "He is

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exalted.": "It is He who made the sun a shining thing and the moon as a light and measured out for it stages that you might know the number of years and the reckoning .Allah did not create this but in truth. He explains the Ayat (proofs ,evidences, verses, lessons , signs, revelations ,etc.) in detail for people who have knowledge." (Yunus, (5)). The sun moves through outer space according to precise calculation, as the Almighty says in (Surah Ar-Rahman (5)): "The sun and the moon run on their fixed courses (exactly) calculated with measured out stages for each (for reckoning). This indicates that the Earth's orbit around the sun is fixed, and any departure would cause abrupt changes in the planet's temperature, structure, and atmosphere. God Almighty alone has the ability to transform the searing sun into a source of warmth, mercy, and vitality. The sun is comparable to Physically, it emits electromagnetic waves with energy spread throughout a spectrum, much like blackbody radiation. The nature of the energy that the sun emits into space can be ascertained by examining its structure and composition. Eighty percent hydrogen, nineteen percent helium, and one percent other elements make up the sun, a flaming ball of gas. It is situated about 1.5×10^2 kilometers from the Earth's surface and has a diameter of 1.39×10^1 kilometers. It is thought to have a density that is 80–100 times that of water. Because of this, the sun produces massive amounts of energy every day that are sufficient to supply all of humankind's demands. Electromagnetic waves that contain visible and ultraviolet light are how the Earth obtains solar energy. Geographical position is one of several elements that affect how much solar energy is received at a certain area. The spherical form of the Earth, the tilt of its axis, the latitude and longitude angles, the time of day, the seasons, and the degree of transparency or clarity all affect how much solar radiation reaches the surface. The air's natural condition, as well as variations in temperature, humidity, wind speed, and altitude above sea level. [1-5]

Research Problem: How Employing Electricity energy generation technologies based on physical principles, considering Islamic legal restrictions and current issues?

This research will address the following topics: -

- The concept of solar energy and its environmental challenges

- Advantages and disadvantages of solar energy

- Some problems and solutions for using solar energy

- Solar energy technologies

- Employing Electricity energy generation technologies based on physical principles

- The current state of solar energy in Arab countries

- The importance of solar energy for the Kingdom of Saudi Arabia

- Solar energy resources in the Kingdom of Saudi Arabia

- Initiatives to utilize solar energy in the Kingdom of Saudi Arabia

- Opinion of Contemporary jurists regarding renewable energy challenges

1- Solar Energy and Environmental Challenges:

The substantial increase in temperatures brought on by pollution created by humans is one of the most challenging issues facing the people of Earth today. Heat-absorbing gases such carbon dioxide (CO2), methane, nitrous oxide, and halocarbons are released into the atmosphere as a result of various human activities .The energy balance gradually shifts as a result of these gases absorbing infrared radiation from the Earth and then reemitting it to its surface. The average temperature rose by half a degree Celsius throughout the 20th century. The Intergovernmental Panel on Climate Change (IPCC) states that fossil fuels account for 75% of CO2 emissions, with the remaining 25% coming from changes caused by humans on land.

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2- Advantages and Disadvantages of Solar Energy:

Benefits of Solar Energy: Solar energy has several benefits that promote its use and adoption. Among the most significant of these benefits are: - It is a renewable energy source; - Sunlight is limitless and constantly accessible everywhere. It can be utilized for a number of purposes, including the generation of heat and energy, the desalination and distillation of water, particularly in places where clean water is scarce, and the powering of satellites.

- Low maintenance costs: Despite the large initial outlay, upkeep is easily accessible and reasonably priced. It can endure for many years with the right maintenance and hygiene.

- Ongoing developments in solar energy technology, especially in quantum physics and nanotechnology, with the goal of enhancing future solar power generation systems' efficacy and efficiency.

3- Disadvantages of Solar Energy: Despite its advantages, solar energy also has some disadvantages, including:

Weather variations: Its efficacy is diminished by the differences in summer and winter weather. - Because it cannot be used in the evening, a battery or other energy-storing device must be used.

- For maximal solar energy collection and optimal utilization, large regions are needed.

- The requirement for cutting-edge technologies to create solar power producing systems is the reason for its high cost. The cost of producing power from solar energy is five times higher than that of producing electricity from fossil sources.

4- Solar Energy Technologies:-

In recent years, solar energy technology has advanced remarkably, not only in terms of the kind and form of solar panels but also in terms of the materials and energy storage techniques that are employed. Up until recently, photovoltaic cells—which are distinguished by their black color and are frequently found in various calculators, watches, and other gadgets—were the most common method of utilizing solar energy. For these uses, photovoltaic cells are advantageous since the sun's energy is stored as electricity in tiny batteries, giving us power in the absence of sunlight.

- The Technology of Photovoltaic Cells Is Unsuitable for Large-Scale Projects However, it is difficult to generate substantial amounts of energy for use in houses and enterprises using photovoltaic cells. vast battery electricity storage systems still need a lot of work because batteries are costly and cannot hold vast amounts of electricity. As a result, we discover that alternative energy firms have recently adopted a new method of utilizing solar energy: heating water or other liquids with the sun's heat so they may be stored and used when sunshine is scarce.

-Solar Thermal Power Plants: A new class of power plants known as solar thermal power plants makes advantage of this innovative technology. These plants are distinguished by their affordability and ease of use. The majority of the new generation of solar thermal power plants use reflective mirrors at a central location to concentrate sunlight. High temperatures allow, for instance, the melting of salt at 565 degrees Celsius, which is then kept in special tanks and used to heat water when sunshine is scarce, or the conversion of saltwater into steam to power turbines. In many regions of the world, this new kind of power plant will become common. For instance, this kind of facility will be necessary to provide electricity to the proposed Masdar City near Abu Dhabi. In a similar vein, these factories are being built in numerous parts of the United States. Plans for a huge solar power project in Arizona with a 280 megawatt producing capacity were revealed in February 2008. In contrast, the biggest solar power plant on the market now only generates 20 megawatts.[6-8]

5- Employing Electricity energy generation technologies based on physical principles

Solar power production systems use specific scientific principles that control the behavior of electromagnetic

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radiation and its interaction with materials to capture solar radiation and transform it into electrical energy. Designing solar systems and maximizing their efficiency and safe, sustainable operation require a physical grasp of these concepts. The internal photovoltaic effect, which occurs when semiconductors (like silicon) absorb photons, electrons shift from the valence band to the conduction band, and a potential difference is produced at a p-n junction, is what powers solar cells.

6- The Reality of Solar Energy in Arab Countries

- The Arab world has unrealized potential for solar energy. In Syria, for instance, solar energy produces 2,300 kWh per square kilometer, whereas in Germany, it only produces 1,000 kWh. In addition, Syria has the second-highest sun irradiance of any Arab nation.

- Some Gulf nations, like Kuwait, are situated in regions at latitude 28 that have been recognized by international assessments as ideal places for solar energy. With a total area of 863 square kilometers, or roughly 5% of Kuwait, Bubiyan Island has the capacity to generate more than twice as much electricity as Kuwait. In Kuwait, the first projected cost of building a 100 megawatt concentrated solar power facility is [amount missing].

- Numerous Arab nations have made investments in solar energy after realizing its benefits. Among them is the United Arab Emirates, which has contributed to a thin-film solar power facility and the $15 billion Masdar project. A 200 megawatt solar power facility was developed in Morocco, and a 150 megawatt plant was completed in Egypt. Libya and Algeria were among the other nations that did the same. Saudi Arabia built the solar hamlet in Al-Uyaynah, making it one of the first Arab nations to use solar energy.

One of the most significant nations in the Middle East for encouraging the use of solar energy and for creating, manufacturing, and developing solar water heaters is the Hashemite Kingdom of Jordan. According to official figures, they are used in 40% of residential dwellings, with about 15,000 units added each year. They are also utilized in many industrial, service, and agricultural settings, including hospitals, schools, hotels, and swimming pools. Solar water heaters can be placed as an independent, permanent system or as an addition to central heating and water heating systems. They are appropriate for all applications, regardless of size.

7- The Importance of Solar Energy for the Kingdom of Saudi Arabia:

Extending the life of oil-based energy and creating a new energy source to supplement the existing oil supply are two significant advantages of using alternative energy sources. The Kingdom of Saudi Arabia's electricity usage is rising at a pace of five percent every year. Over the next 25 years, $117 billion is anticipated to be invested in the Saudi energy sector. By 2023, the Kingdom's 25,000 megawatt power generation capacity is projected to increase to 66,400 megawatts.

- lowering Saudi Arabia's carbon emissions.

-Increasing the capacity to export oil since it can be sold at the world price rather than being used in manufacturing.

- Preventing the Kingdom of Saudi Arabia's budget from being heavily burdened by the use of oil-based electricity. Additionally, this requires a large amount of excavation work, which may impact ongoing projects like roads and the installation of lengthy power lines, raising the cost of this energy. According to estimates, producing power in the Kingdom with solar energy costs $0.12 per kWh.

- lowering reliance on oil and turning the Kingdom of Saudi Arabia into a source of electricity.

8- **Solar Energy Resources in the Kingdom of Saudi Arabia: -**

Abundant desert regions with year-round sunshine. About 7,000 watts of energy per square meter are produced by sunlight every day for 12 hours. Because the Kingdom's landmass stretches from east to west rather than north to south, it is exposed to sunlight for longer periods of time, allowing for the creation of more energy.

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According to some research, the Kingdom has more solar energy potential than it now produces from oil. This is because of the Kingdom's large size and ongoing exposure to intense light and solar electromagnetic radiation. The Kingdom receives 2,200 kilowatt-hours of solar energy per square meter on average each year.

-At the Copenhagen Climate Conference, several nations, including Saudi Arabia, pledged to lessen the adverse effects of energy production. Consequently, the Kingdom's solar power plant expansion will aid in lowering harmful emissions that fuel climate change and global warming.

- The Kingdom's rural settlements are small, dispersed, and isolated. It might not be viable or affordable to connect these settlements to the main electrical grid. Therefore, using solar energy is a sensible alternative in these isolated villages. [9-13]

9- Solar Energy Utilization Initiatives in the Kingdom of Saudi Arabia:

King Abdulaziz City for Science and Technology announced a national initiative to use solar energy to produce water and electricity at a cost of less than one riyal per cubic meter of water and three halalas per kilowatt-hour of electricity. The cost of producing water and power is predicted to drop by 40% as a result.

King Abdullah University of Science and Technology's Solar Power Generation Project: This project intends to use photovoltaic cells connected to the Saudi power grid to generate two megawatts of electricity. An yearly production of 3,300 megawatt-hours of clean energy is anticipated.

One of the Kingdom's earliest solar energy initiatives is the Solar Village Project. The Solar Village project, which was founded in Al-Uyaynah in 1980 to generate 350 kilowatts of power, is regarded as the first solar energy research station.

In the Al-Jawf region of Saudi Arabia, the Sakaka Solar Power Plant is a 300 MW photovoltaic solar farm built on a 6-square-kilometer plot of land close to Sakaka. Sakaka Solar Energy Company (SSEC), a joint venture between ACWA Power (70%) and Al-Jazirah (30%), created and runs it. As part of Saudi Vision 2030, which aims to meet the Kingdom's renewable energy targets of producing 58.7 GW of renewable energy by 2030, the National Renewable Energy Program launched a number of renewable energy projects, the first of which is a utility-scale solar power project in Saudi Arabi

The Al-Jawf area is home to the Dumat Al-Jandal wind power project. It is a ground-breaking project that embodies the Kingdom's dedication to realizing its lofty objectives in the development of renewable energy. The goal of the 400 megawatt Dumat Al-Jandal wind power project is to provide electricity to 70,000 dwellings. [14-15]

Opinion of Contemporary jurists regarding renewable energy challenges.

The permissibility of utilizing renewable energy: According to jurists, Islamic law permits the use of renewable energy sources, such as solar energy, since these are among the resources that God Almighty has made available to humanity, as stated in the Quran: ”And He has subjected to you whatever is in the heavens and whatever is on the earth - all from Him. Indeed in that are signs for a people who give thought’’ Surah Al-Jaathiyah : 13 .

Achieving the public interest: According to jurists, increasing the use of renewable energy promotes public interests including protecting the environment, lowering pollution, and achieving energy security, all of which are consistent with the idea of bringing about benefits and preventing harms.

Conformity with the goals of Islamic law: Because renewable energy is a sustainable and safe energy source, scholars confirm that it is in line with the goals of Islamic law, especially the preservation of life, property, progeny, and the environment.

The duty to preserve the environment: jurists concur that employing clean energy sources is a part of improving the planet rather than polluting it, and that conserving the environment is a religious duty.

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METHODOLOGY:

Solar thermal energy conversion is based on the use of thermal materials and solar collectors (dishes) to transform solar radiation into thermal energy. When an insulated, dark-colored object is exposed to sunlight, it absorbs the radiation and becomes hotter. This heat is utilized for energy production, water heating, heating, and cooling. The most common application of solar thermal energy conversion is solar water heaters.

How a Photovoltaic Cell Works:

An electric current flows as a result of electrons being knocked off a metal's surface by light (or electromagnetic radiation). The wave-particle duality of light was verified by this phenomena, known as the photoelectric effect, which is based on light being made up of small energy packets called photons or light quanta . There are numerous uses for the photoelectric effect. The photocell, which is utilized in the construction of solar cells, is arguably the most important application. By generating voltage, a photocell converts light into electrical energy. They can therefore be employed as light-detecting sensors .Silicon is one type of semiconductor material found in solar cells. An electric current, or electricity, flows when light strikes the solar cell because it removes electrons from the atoms of the semiconductor material. Photovoltaic modules are created by soldering several solar cells onto circuit boards; these modules are then connected to create solar cell arrays, which produce a larger quantity of electricity . Image sensors, photomultipliers, photoelectron spectroscopy, photocopiers, photodiodes, phototransistors, and astronomy are some further uses for photoelectric current. The phototube, a vacuum tube having a metal cathode with a modest work function to facilitate the easy emission of electrons, was the first device to use the photoelectric effect. An anode maintained at a high positive voltage in relation to the cathode would collect the current discharged by the plate .In spectroscopic research, the photomultiplier tube—an extension of the phototube that increases photocurrent—is quite helpful. Measuring weak light sources is frequently required. The semiconductor-based photodiode, which can detect light and convert it into electrical energy, took the place of the phototube. Imaging methods employ both phototubes and photodiodes . Other uses for the photoelectric effect include astronomy and scintillators. When the scintillator draws radiation from a cosmic or laboratory source, it releases light. The photoelectric effect is utilized in astronomy applications to measure star temperatures and intensities [17- 25].

Photovoltaic modules are created by soldering several solar cells onto circuit boards. You can utilize each module separately. However, a number of modules can be linked together to create arrays that produce more electricity (see figure 4) . The electrical grid system is linked to the arrays. PV systems can be constructed to satisfy nearly any electric power requirement, regardless of size, thanks to their modular design. There are roughly thirty modules in a typical home rooftop solar system installation. Refer to figure 5. Additionally, the system contains an inverter that transforms the DC electric current generated by the modules into the AC needed to run all of the household appliances.

The Photoelectric Effect:-

Heinrich Hertz, a German physicist, discovered in 1887 that he could use UV light to make sparking more sensitive. Later, in 1897, J.J. Thompson discovered the electron and ascribed the enhanced sensitivity to light driving electrons . Nevertheless, the aforementioned conclusion—that light acted like transverse waves—did not align with the classical theory of electromagnetic radiation. Until Albert Einstein said that light is

a distinct quanta of energy, or photons, it was unclear. Planck's formula states that photon energy is proportional to their frequencies :

$$E = \hbar\nu = \hbar c/\lambda$$

where v is the electromagnetic radiation's frequency, c is the speed of light (3*108 m/s), E is the electromagnetic radiation's energy, and $\hbar$ is the Planck's constant, which has a value of 1.055*10-34 J.s. As a result, light (or electromagnetic radiation) can only be emitted or absorbed as discrete elements, but it propagates according to linear wave equations. As a result, it simultaneously behaves as a particle and a wave. Therefore, when incident light strikes a metal's surface, photons smash with the atoms and, if the photon's frequency is high enough, knock

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electrons out of the metal atom. As shown in figure (1)

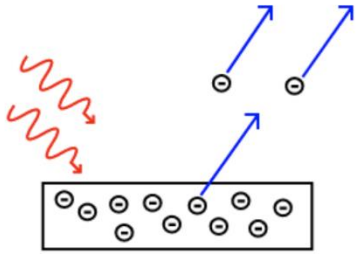
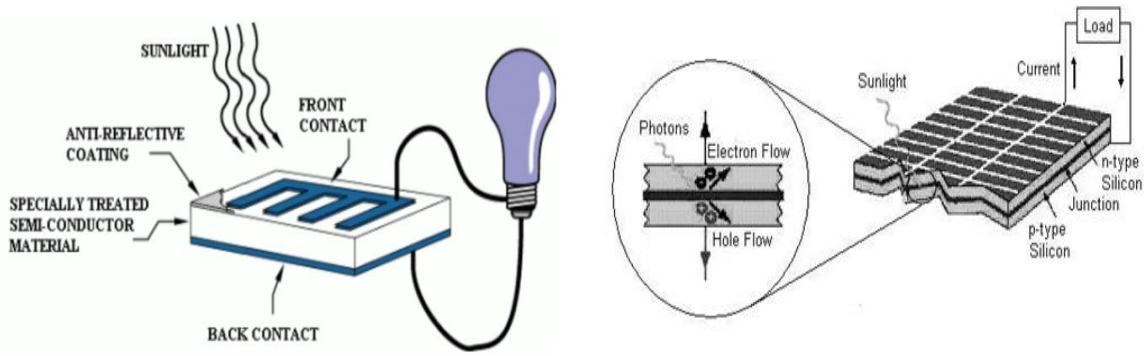


Figure (1) : illustrate photo electric effect

The Photocells :- A sensor is a photocell. Its resistor's resistance varies with the amount of light it receives. We refer to this phenomena as photoconductivity. They are employed in circuits for light-sensitive detectors. Thus, light can be detected by a photocell. functions on the basis of the photoelectric effect, also known as semiconductor photoconductivity, in which electrons are knocked off the surface of the semiconductor by photon energy from incident light. As a result, there is less resistance and current flows since the electrons are moving. The amount of incident light affects its sensitivity. Thus, it can function as a switch that is controlled by light . Light meters have been using photocells since the middle of the 20th century. They are utilized as safety sensors in factories, fire and burglar alarms, counting devices, cameras, camcorders, and city street lights .

The Solar Cells:- When light strikes a solar cell, an electric circuit is created. They consist of two layers of silicon and other semiconductor materials. One is negatively charged, and the other is positively charged. Electrons are released from the semiconductor material's atoms when photons from light hit the solar cell. The DC electric current is produced by the motion of electrons . Refer to figure 2.

Photovoltaic modules are created by soldering several solar cells onto circuit boards. You can utilize each module separately. However, a number of modules can be linked together to create arrays that produce more electricity (see figure 3). The electrical grid system is linked to the arrays. PV systems can be constructed to satisfy nearly any electric power requirement, regardless of size, thanks to their modular design. There are roughly thirty modules in a typical home rooftop solar system installation. Refer to figure 4 a. Additionally, the system contains an inverter that transforms the DC electric current generated by the modules into the AC needed to run all of the household appliances. Calculators, keyboards, lighting, notebooks, and garbage compacting bins are all powered by solar cells. Battery charging is another usage for them. Mobile phone chargers, public power sources in parks and streets, and fold-out car battery chargers are examples of portable solar-powered battery chargers . Numerous solar panels at solar farms capture solar radiation to generate electricity that is subsequently sent to the electrical grid. Refer to figure 4b .[26-30]



(a) (b)

Figure (2): illustrate the operation of solar cell

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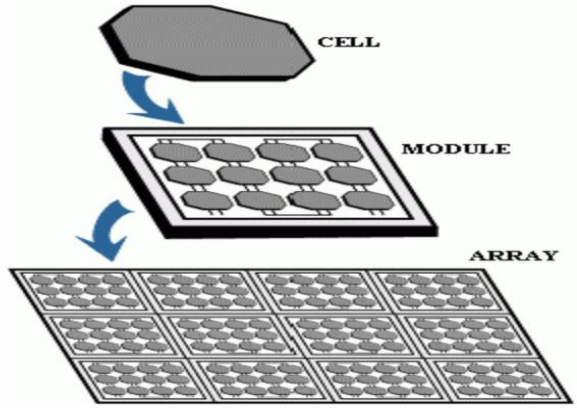

Figure 3. illustrate the multiple photovoltaic

(a) (b)

Figure (4): Solar cell illustration

Previous Studies:-

Dr. Sevan Omrani's paper, "The Reality and Future of Renewable Energy in the Kingom of Saudi Arabia in Light of Vision 2030." This study uses a descriptive and analytical technique to support the study's topic in order to highlight the reality and future of renewable energy in the Kingdom of Saudi Arabia in light of the Vision. According to the study's findings, Saudi Arabia has a lot of potential in the field of renewable energy and hopes to create a competitive industry within it. The National Renewable Energy Program's Vision 2030 announcement demonstrated this. Nevertheless, the policies implemented to promote the use of renewable energy sources are still dependent on their capacity to meet the desired quantitative goals.

According to a study by Dr. Khaled Mohammed Al-Mohammadi of Taibah University's College of Engineering, home solar energy is feasible in the Kingdom and the top cities are identified. According to the report, Hail, Sakaka, and Jeddah are the top three cities for residential solar energy investment, with a minimum solar energy production rate of 47% needed to attain competitive costs and a net cost of $18,000. Additionally, the survey found that Taif and Al-Ahsa placed fourth and fifth, respectively, for the best grid-connected solar energy system configurations in Saudi residential structures. Al-Ahsa outperformed Taif in terms of financial returns, with a minimal solar energy % needed to be competitive, whereas Taif showed economic viability at a lower cost. Makkah and Tabuk's net cost was $16,500; in order to attain competitive costs, a minimum energy production percentage of 43% was needed. The availability of smart meters in every Saudi home, the potential for a full grid connection to lower bills, achieve significant long-term financial savings, and reduce carbon emissions are the main factors that the study confirmed support the Kingdom's investment in residential solar energy.

"The Impact of Adopting Renewable Energy Sources on Sustainable Development in the Kingdom of Saudi Arabia: A Qualitative Study," a study by Dr. Hakim bin Hussein et al., looks at how employing renewable energy resources affects sustainable development in the Kingdom of Saudi Arabia. Partial least squares structural equation modeling (PLS-SEM) was used to assess the research model using data gathered from 180 respondents

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with knowledge of sustainability and energy utilizing a quantitative research approach. The findings show that wind and hydropower have a major impact on social, environmental, and economic aspects of sustainable development. However, Saudi Arabia's resource and physical limitations restrict hydropower's scalability. On the other hand, wind energy has emerged as a competitive option, especially along the Red Sea coast where reliable wind speeds are available. sun energy is frequently emphasized for its potential rather than its existing quantifiable influence, even though the Kingdom receives significant amounts of sun irradiation. It's interesting to note that the three renewable energy sources' contributions did not differ significantly from one another. This suggests that the results should be interpreted carefully and that each energy source's sustainability trade-offs should be understood. Given the Kingdom's geographic location and resource availability, hydropower is a good choice, but solar and wind energy are scalable and pertinent to the local environment. Thus, the study's conclusions highlight the strategic importance of a diversified and balanced renewable energy strategy, which will assist Saudi Arabia in achieving Vision 2030's objectives and advancing sustainable development. [30-33]

Results: In addition to being eco-friendly, renewable energy is essential for reducing climate change, and the One green energy source is solar power. Sunlight is limitless, constantly accessible, and useful for many purposes, The most plentiful energy source currently known is solar energy. Solar cells are used in photovoltaic conversion, which uses solar energy to produce electricity. The absence of air pollution is a distinguishing feature of solar cells, Applications involving solar radiation—that is, without concentrators or lenses—are where this technique works best. As a result, they can be mounted on building rooftops to produce power and light up buildings and roadways, And there are numerous uses for the photoelectric effect. It is frequently utilized in light detecting devices, such as "electric eye" door openers, because light triggers the electric current. Photocopiers, photomultiplier tubes, photodiodes, phototransistors, scintillators, light meters used in photography, measuring star intensities and temperatures in astronomy, and solar cell power production are some other uses for the photoelectric effect, and Photovoltaic (PV) or solar cells are its primary use. PV cells generate power for an electrical circuit and are composed of semiconductor materials such as silicon.

RECOMMENDATIONS:

Create a database of the temperature, dust levels, wind speed, solar radiation, and other periodic information required for the utilization of solar energy.

- Encourage scientific consultation and exchange across Arab nations by holding frequent conferences and seminars.

-Employees should receive solar energy training and equipment. Academics and researchers should be encouraged to attend regional and international conferences on solar and renewable energy by universities and specialized research institutes.

- It is necessary to update research on solar energy applications in the Arab world and to identify and assess current applications.

- Every energy-saving strategy should be put into practice, and the most effective ones should be researched. Citizens who use solar energy in their homes should also receive assistance.

CONCLUSION

There is a lot of interest in solar energy and alternative energy systems, particularly in light of the rising cost of fuel and the growing pollution that comes from the overuse of petroleum goods. Everyone is now thinking about creating alternate energy sources and techniques as a result. Building confidence in the usage and application of alternative energy concepts requires raising awareness through workshops and carrying out useful initiatives. As a result, the Kingdom's Vision 2030 objectives have made solar energy investment a top priority for producing electricity.

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