K.L.E. SOCIETY's

S. NIJALINGAPPA COLLEGE

II Block, Rajajinagara, Bengaluru-560010

Re-accredited by NAAC at 'A+' grade with 3.53 CGPA

College with UGC-STRIDE Component –I

Proceedings of

Department of Chemistry

Organized

IQAC Initiated UGC-STRIDE Sponsored

Online One Day National Level Conference

On

"ADVANCEMENTS IN RENEWABLE SOURCES OF ENERGY"

In Association with Physical & Life Science Departments

AN APPROACH FOR TRANS-DISCIPLINARY RESEARCH

25th October 2021

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Address: 1040, 28th Cross Road, 2nd Block, Rajajinagar, Bengaluru,

Karnataka-560010

Tel: +9180 2352 6055

Email :klesncchem1963@gmail.com,

Website: http://www.klesnc.org

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PROCEEDINGS

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25th October 2021

Organized By

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About Society

The KLE Society, Belagavi, since its inception 1916, has been a model in parting quality education and upliftment of socio-economic status. The KLE Society disseminates the knowledge in all spheres of education from pre nursery to PG, for overall personality development of the students. It promotes and encourages the student's community to opt for programmes like Medicine, Dentistry, Pharmacy, Nursing, Agriculture, Law, Business management, and Hotel management, Engineering & Technology, Basic Arts, Science, Commerce and Education. Under the leadership of Visionary Chairman Dr. Prabhakar B. Kore, Ex. M.P. The number of institutions has elevated up to 272 in various fields of education including research in India & abroad with equality concept. The dynamism of our chairman has motivated the faculty & students in the process of exploring the knowledge for the welfare of the society at large.

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About our College

KLE‟s S. Nijalingappa College, established in the year 1963, is one of the premier institutions under KLE Society, and has been included under 2(f) and 12(b) of UGC. The college has seen phenomenal growth in terms of courses offered, quality enhancement, student and staff strength besides development in infrastructure. The college offers higher education to 3,685 students from all sections of the society. Over its glorious service of more than half a century to the community, the college has earned many significant laurels. The crowning one of these are the rare distinction of having been re-accredited at **A**$^{+}$grade with CGPA of 3.53 on a 4 point scale in 2016 it has received the status of the college with Potential Excellenc Phase – 2 and STRIDE Component – 1 by UGC in2019. The college conducts a range of UG courses in BA, B.Sc., B.Com, BCA, BBA, BHM and PG Courses in M.Sc., M.Com. MCA and Ph.D in Commerce to cater to the diverse needs of the evolving higher educational scenario at the national as well as global level. The college is also recognized as research center in commerce by Bengaluru Central University.

About the Department

The Department of Chemistry was started in the year 1963 with an objective of giving a practical and substantial shape to the vision of the founders of the institution. The department has been engaged in imparting the best quality of academic education inculcating practical reasoning among students. The department is recognized as one of the high rated departments by Expert committee of UGC CPE and is equipped with five laboratories for UG & PG sections to enable performing modern day chemistry Practicals

About Conference

Our Country is under energy crisis. The need of hour is less polluting fuels from renewable sources. The existing energy sources are depleting due to their indiscriminate use from several decades. It is the time for alternating fuels like bio- fuels, fuel cells and alternative methods of energy storage. Bio-fuels are also known as Green fuels. This fuel is distilled from plant and animal materials. It has evolved as a possible fuel option as world drains its fossil fuel resources. Hydrogen is the most common fuel; it is used for primary and backup power for commercial, industrial and residential buildings. In order to achieve the economic improvement,

ecological balance, sustainable development and nature friendly environment, it is inevitable to use non-conventional sources of energy. The main objective of this conference is to provide platform for young researchers, academicians and industrialists to disseminate the recent advancements in renewable sources of energy

Subthemes

- New Trends and Technologies for Renewable Sources of Energy
- Renewable Energy Research and Applications
- Artificial Intelligence and Renewable Sources of Energy
- Public Awareness and Education for Renewable Energy and Systems
- Renewable Energy Systems in smart and metropolitan cities
- Challenges for Renewable Sources of Energy
- Renewable Sources of Energy for global sustainable environment
- Policies and Strategies for Renewable Sources of Energy

Participants/Beneficiaries:

Delegates Academicians, Research scholars, UG and PG students.

Awards: Two best papers have been awarded to Faculty and UG/PG students (One each)respectively, along with a certificate to be conferred at the valedictory.

Sri. R. A Yadahalli
Associate Professor, Organizing Secretary

rayadahalli1963@gmail.com, klechemconf@gmail.com,Mobile No +91 9480430756

PROGRAMME SCHEDULE

Inauguration and Key Note Address	:	9.30 am to 10.30 am Dr. Hoysala N. Chanakya Chief Research Scientist, Centre for Sustainable Technologies Indian Institute of Science, Bengaluru.
Technical Session I Resource Person Topic	: :	10.30 am to 11.45 am Dr. Hoysala N. Chanakya Chief Research Scientist, Centre for Sustainable Technologies Indian Institute of Science, Bengaluru. INDIA Advancements in Bioenergy
Technical Session II Resource Person Topic	: :	12.00 noon to 1.30 pm Dr. G. Chakrapani Scientist, H+. Formerly Head Chemistry Division, AMD Department of Atomic Energy, Hyderabad, INDIA Latest Innovations in Renewable Source of Energy
Paper Presentation	:	2.00 pm Onwards 1. Students 2. Research Scholars 3. Faculty 4. Industry Experts
Valedictory	:	4.00 pm to 4.30 pm

Sri. R. A. Yadahalli
Organising Secretor

Dr. M. B Chittawadagi
IQAC & UGC STRIDE
Co-ordinator

Sri. Rajaiah B
Convener

Dr. A. B Sonappanavar
Principal

Message by

Chief Patron Dr. Prabhakar D Kore Chairman KLE's Society Belagavi

I am happy to learn that IQAC of KLE Society's S Nijalingappa College, Bengaluru is organizing UGC-STRIDE Sponsored One Day Online National Level Conference on "**Advancements in Renewable Sources of Energy" held on 25th October 2021** and invited eminent resource personalities. I am sure that the conference will enrich the knowledge of academicians and administrators of higher education institutions across the nation Congratulations to the organizers and I wish the conference a grand success.

Message by

Shri. Mahantesh M. Kavatagimath
Chief Whip, Government of Karnataka
Member of Legislative Council, Govt of Karnataka.

Board of Management KLE Society Belagavi

Greetings!

As a part of this National Level Conference, I take great pride in welcoming Resource persons and all the delegates of the conference on entitled "**Advancement's in Renewable Sources of Energy".** This national level online conference organized by the department of chemistry to share the novel scientific thoughts and research findings of the academician, administrators, research scholars and students. In the present scenario the entire globe is facing energy crises and consumption of death energy so the attempts for the perpetual solution of the energycrises to create awareness of the advancements in renewable sources of energy. The department of chemistry has been striving to contribute forward the enrichment of advancements in renewable sources of energy by offering a forum for generating innovative ideas in National level Conference.

I congratulate Principal and organizing committee of the National Level conference forthe grand success.

Message by

Sri.**Shankaranna I Munavalli**
Member, Board of Management
KLE Society Belagavi

KLE Society's S Nijalingappa College
Rajajinagar,

Bengaluru 560 010

This is my privilege and I am very happy to welcome you all for UGC- STRIDE Sponsored One Day National Level Conference on **"Advancements in Renewable Sources of Energy"** held on 25th October 2021 organized by Department of Chemistry KLE Society's S Nijalingappa College, Bengaluru. It is worth mentioning that the topic of the conference is related to the Renewable sources of Energy. The conference will help in understanding the Advancements in Renewable sources of Energy. I am sure that the one day key note address, special talk and academic/research work presentations will be helpful for the participants.

Message by

Dr.Arunkumar B Sonappanavar

Principal
KLE Society's S Nijalingappa College
Rajajinagar,

Bengaluru-560010

It gives me immense pleasure to welcome all the eminent speakers and delegates to the UGC-STRIDE Sponsored One Day Online NationalConference on **"Advancements in Renewable Sources of Energy" heldon 25th October 2021** organized by Department of Chemistry KLE Society's S Nijalingappa College, Bengaluru.

The Conference covers a key note address followed by two technical sessions by eminent speaker and Paper presentation by Faculty and Students, Research scholars across the country .The one day academic deliberations in the conference enlighten the faculty, researchers andstudents to bring awareness about Advancements in Renewable Sourceof Energy. On this occasion, I extend a heartfelt welcome to all the delegates, students and research scholars to KLE Society's S Nijalingappa College, Bengaluru. The college will bring out proceedings of the conference. I congratulate the organizing committee members of conference in conducting such an event to boost the knowledge of faculty, researchers and students.

Dr. ArunKumar B Sonappanavar

PRINCIPAL

Sri. Ramappa. A.Yadahalli

Organising Secretary

Report of National Conference

It gives me immense pleasure to present a brief report on IQAC initiated UGC Stride sponsored One Day Online National Conference "**Advancements in Renewable Sources of Energy"** held on 25th October 2021. Our College has been awarded A^+ grade by NAAC on third cycle with 3.53 CGPA and College with UGC stride component-1 and has been offering quality education since its inception in 1963. In the present scenario the entire globe is facing energy crises and consumption of fossil energy so the attempts for the perpetual solution of the energy crises to create awareness of the advancements in renewable sources of energy. Our College has been striving to contribute forward the enrichment of advancements in renewable sources of energy by offering a forum for sharing innovative ideas in National level Conferences.

The present UGC Stride sponsored National Level Conference on **"Advancements in Renewable Sources of Energy" is** contributing towards the applications of Recent Trends in Renewable Sources of Energy. As a result the papers presented during the technical sessions have been brought into the document form and this conference proceeding with ISBN is likely to motivate the research scholars in the field of Trans-Disciplinary Research to go in for further and greater research for contributing forwards towards Renewable Sources of Energy. I am very much thankful to the Keynote addressee, Technical Resource person, Jury member, and Research scholars and students for taking interest in enlightening the knowledge on Renewable Source of Energy. This proceeding contains the papers received from teachers, research scholars and students of enrichment of trans-disciplinary research in the era of Renewable Sources of Energy.

This proceeding has been prepared on a valuable document for guiding the young researchers and students to develop passion in research.

I take this opportunity to thank UGC-STRIDE for providing financial support for organizing one day National Conference. I thank our honorable chairman Dr. Prabhakar B Kore K L E societies Belagavi, all the members of Board of management, the secretary and life members for extending their full support and valuable guidance in successfully organizing this academic event. I also thank our beloved Principal, my colleagues and all others who have directly and indirectly extended their support in making this One Day Online National Level Conference a grand success.

AUTHOR INDEX

1: A STUDY ON THE CHALLENGES IN THE PRODUCTION AND USAGE OF BIOFUEL IN INDIA

Louisena Vinoth Priya L*, Dhanush S, and Cinthiya D
Sri Bhagawan Mahaveer Jain first Grade College, Geetha road, Robertsonpet, KGF
Author for Correspondence: E-mail: louisenapriya@gmail.com

Abstract

Renewable energy are a source that cannot be depleted and inexhaustive which supplies a continuous clean energy which can be regenerated. Renewable energy sources, biomass can be directly converted into liquid fuels, called "biofuels. Scientists are continually addressing these challenges, working to improve viability and reliability of renewable resources. The objective of the study is to study on the challenges on the production and utilization of biofuel in India. The methodology of the paper was done by review of literature and the secondary datafrom the current literature on the study on the challenges on the production and utilization of biofuel in India. The finding of the study was that a high power quality is needed to ensure stability and high efficiency power for production of biofuels. Loss of natural habitat can change the hydrology and reduces the wildlife areas. It depends on weather, climate and geographical location; therefore one type of energy generation is not appropriate for that particular region. There is a lack of information and awareness about the benefits and need of renewable energy. Investment and capital allowances have been made available for the implementation. Future research endeavours in biofuel production should be placed on the search of novel biofuel production species, optimization and improvement of culture conditions, genetic engineering of biofuel-producing species. In recent years, governments and private companies around the globe have ramped up the production of biofuels; the supply is so lesser than demand so companies are scaling back their long-term investments.

Key Words: Renewable resource, Biodiesel, Biofuel, Environment, pollution, fossil fuel

Introduction

Renewable resources of energy are a source that cannot be depleted and inexhaustive which supplies a continuous clean energy which can be regenerated. When we talk about energy resources, there is always a question of sustainability. It's mandatory that resources provide enough energy to meet our requirements such as electricity, run our vehicles and machines working regularly . However, it is also important to consider how these resources can be used long term. Some resources will practically never run out these are known as renewable resources. Renewable resources produces energy, which causes less pollution and greenhouse gas emissions, which is in favor to climate and temperature some of the sources of energy are wind energy, biomass energy, tidal energy , hydropower, biofuels ,solar energy etc. The solar energy is generated when sunshine is available and turns off at night; wind energy also depends on the availability of wind, so if the wind speed is very low, the turbine will not turn, and this result in zero power flow to the grid. On the other hand, too much wind can damage the generator and therefore a delicate balance needs to be maintained in order to keep a consistent generation of energy. The uncertainty in energy production in renewable energy technologies is making integration more complex.

Biofuel is also a source of renewable energy which are derived from biomass such as plants, algae or animal wastes. Unlike other renewable energy sources, biomass can be directly converted into liquid fuels, called "biofuels the best example for Biofuel in India is biogas and biodiesel. Biodiesel is produced from edible and non-edible vegetable oils such as cooking oils and animal fats. Most vegetable oils are potential renewable resource that is available in daily life. Fuel from these oil emits very less pollution than diesel fuels. Most common type of biofuels that are used in our daily life are ethanol and biodiesel these are first generation of biofuel technology, biodiesel is sustainable, eco-friendly, that can be used in diesel engines. biodiesel decreases greenhouse gas emissions .Many critics express concerns about the scope of the expansion of certain biofuels .There are some challenges associated with using renewable resources. One of the biggest concerns in the field of renewable energy is power generation depending on natural resources that are uncontrollable by humans.

For instance, renewable energy can be less reliable than non-renewable energy, with seasonal or even daily changes in the amount produced economicand environmental costs associated with refining process However, scientists are continually addressing these challenges, working to improve viability and reliability of renewable resources.

Objective

To study on the challenges on the production and usage of biofuel in India

Methodology

This paper reviews the current literature on the study on the challenges on the production and usage of biofuel in India. The scope of the study on the challenges on the production and usage of biofuel in India is done by review of literature. Biodiesel is not only sustainable, it's a more environmentally-friendly, cleaner-burning option that can be used in diesel engines without modification .The most important challenge for further scaling up renewables in India is the poor financial condition of power distribution companies and lack of awareness and less productivity.

Analysis of the study

The biofuels can be a viable source of renewable energy in contrast to the finite nature, geopolitical instability and deleterious global effects of fossil fuel energy. Biofuels can be classified into two categories: primary and secondary biofuels. The primary biofuels are directly produced from burning woody or cellulosic plant material and dry animal waste. The secondary biofuels can be classified into three generations that are each indirectly generated from plant and animal material. The first generation of biofuels is ethanol derived from food crops rich in starch or biodiesel taken from waste animal fats such as cooking grease. The second generation is bioethanol derived from non-food cellulosic biomass and biodiesel taken from oil-rich plant seed such as soybean or jatropha. The third generation is the biofuels generated from cyanobacterial, microalgae and other microbes, which is the most promising approach to meet the global energy demands.

The major problems with renewable energy production and supplies are far more variant than other means of energy production. Changes in sunlight levels and wind means that supplies are less consistent than those derived from fossil fuels. Renewable energy is slowly becoming a significant part of the mix energy production in different parts of India. In evaluating the economic benefits of biofuels, the energy required in the production of the biofuel has to be taken into consideration. Plant based biofuels is beneficial as they contribute to the environment releasing "carbon neutral" to the polluted air that is produced by the combustion of fuels. For example, in India the process of growing corn required for the production of ethanol we find some drawbacks like the farming process, equipment, manufacturing process and transportation costs which relatively represents small energy gain than the economic process. In this aspect the energy gained from the sugarcane is much greater than the cellulosic ethanol or algal biodiesel that could be even greater than the use of biofuel. Predominantly, biofuels are also produced from photosynthetic organisms such as photosynthetic bacteria, micro- and macro-algae. The primary products of biofuel may be in a gas, liquid, or solid form. These products can be further converted by biochemical, physical, and thermochemical methods. The major impact of biofuel brings safe environment and the drawback as a renewable energy source is how they are manufactured and processed.

The industrial production of agricultural biofuels can result in additional emissions of greenhouse gases that may be a drawback for the benefits of using a renewable fuel. This emission includes carbon dioxide from the burning of fossil fuels during the production process and from that has been treated with fertilizer. In addition, energy crops grown for biofuel can compete for the world's natural, in diverting arable land and feedstock from the human, biofuel production can affect the food price and availability as there are taken for the production of biofuels. It emphasis that the land used for the corn production is shifting grasslands and brush lands to corn monocultures and biodiesel is bringing down ancient tropical forests to make way for oil palm plantations. Loss of natural habitat can change the hydrology, increase and generally reduce of wildlife areas. The clearing of land can also result in the sudden release of a large amount of carbon dioxide as the plant matter that it contains is burned or allowed to decay.

The most important challenges for further scaling up renewable resources in India is the poor financial condition of power distribution companies (discoms). Almost all renewable energy is purchased by such discoms, resulting in very long and unsustainable payment cycles, the percentage of RE power increases, and the variability in its generation due to weather conditions makes operating the transmission grid a technically demanding task.

Findings of the study

- Consistently high power quality is needed to ensure stability and high efficiency power for production of biofuels. . The quality of the power supply allows the system to work well with high reliability and lower costs.
- Most renewable energy plants that share their energy with the grid require large areas of space. Loss of natural habitat can change the hydrology, increase and generally reduce of wildlife areas. In addition to this, renewable energy sources depend on weather, climate and geographical location, therefore meaning that one type of energy generation is not appropriate for the region.
- There is a lack of information and awareness about the benefits and need of renewable energy. Investment and capital allowances have been made available for the implementation of renewable energies. There is a clear need for government agencies to assist and advice applicants and potential recipients how to go about applying for renewable energy incentives. The storage system of the generated energy is expensive and represents a real challenge in terms of Transmission. To sufficiently leverage renewable sources, a great deal of new transmission infrastructure is required.
- With non-renewable energy being well-established, the utilities behind these legacy systems hold immense market, renewable sources of energy have to establish infrastructure, decades of experience and policy.

Conclusion:

In this review, we present the recent progresses including challenges and opportunities in biofuel production. Over the course of the 20th century, power transmission infrastructure was built with

large fossil fuel plants and nuclear plants in mind. This raises issues for renewable energy sources not located near existing infrastructure. Start-ups must show an ability to scale, as investors typically demand large amounts of energy production, which can be challenging. Future research endeavors in biofuel production should be placed on the search of novel biofuel production species, optimization and improvement of culture conditions, genetic engineering of biofuel-producing species. In recent years, governments and private companies around the globe have ramped up the production biofuels, since the supply is currently so lesser than demand, companies are scaling back their long-term investments and even going out of business.

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2: CHALLENGES FOR RENEWABLE SOURCES OF ENERGY

Amrutha R.A*, Sagari Gowda L and Nikhil Vamshi N.

K.L.E's S. Nijalingappa College, Rajajinagar Bangalore-560010.

Abstract: In the present – day scenario, global warming harms the environment and the human race. The power systems energy production sector contributes nearly 75% of total CO2 emissions in the world which is contribution for greenhouse gas emissions as well as global warming. Thus clean and environment-friendly energy harvesting are the prime interest today as it one of the key enablers in achieving the sustainable development goals as well as it accelerates social progress and enhances living standards. Renewable energy is one such type of sources that enables to achieve above goals. This paper encompasses the information about the usage of renewable energy sources and the constrains that are hindering these resources from becoming a global solution for sustainable energy resources.

Introduction: Sustainable energy supply remains a main requirement of modern society in order to respond to the increased demand caused by the larger consumption and population growth. So the development of renewable energy technologies is now widely as a crucial component, since the energy boom was based on fossil fuels. Not only that supply of oil, coal, and natural gas is limited, but there are also major pollution and environmental concerns associated with such energy sources. Renewable energy technologies range from solar power, wind power, hydroelectricity/micro hydro, biomass etc., are the most important solutions for the future and they need to be further developed in this century in order to take over most of the energy production. But, most of the renewable technologies have challenges in different aspects. Some of the challenges are discussed below;

Generalized challenges regarding policy, economy, technology, information and human resource aspects:

- Lack of incentives for private sector involvement and inconsistent policies.
- Fossil fuel subsidies.
- Small economies of scale, high initial capital costs, and long payback periods.
- Lack of access to credit and insufficient government financial support, priority given to renewable energy in national planning and weak implementation framework.
- High installation costs at the end user level.
- Limited technical capacity to design, install, operate, manage and maintain renewable based modern energy.
- Lack of standardized technology, energy services.
- Lack of quality information about RE resources and technologies, EE, equipment suppliers, and potential finance.
- Insufficient expertise in business management and marketing skills.

- Lack of expertise and services in system design, installation, operation and maintenance of renewable energy and energy efficiency technologies.[1]

Methodology:

1. **Biomass:**

 **[6]**

Biomass pyrolysis is a promising technology for producing renewable fuels and chemicals from lignocellulose feed stocks. This process utilizes moderate temperatures (400–600 C) to depolymerize biomass to a mixture of oxygenates (or 'bio-oil') that are liquid at room temperature. The major benefit of this ''next-generation'' biofuel production process over traditional enzymatic approaches is that solid biomass is converted in only a few seconds (compared to hours or days for biological conversion). Despite the potential for pyrolysis as a future biofuel production platform, there is currently a lack of understanding of the fundamental processes which govern pyrolysis. [2]

Efficient utilization of bio-oils is non-trivial since transportation to regional bio refineries or immediate consumption in boilers/turbines is hindered by the poor fuel characteristics (highly oxygen content), chemical complexity (hundreds of compounds) and instability (due to oxygen content and acidity). It is generally believed that commercialization of pyrolytic biofuels hinges on improving bio oil quality and stability. Significant research has focused on the development of catalytic hydrogenation processes capable of upgrading bio-oil to fuels or chemicals. [2]

Production of H2 from renewable sources derived from agricultural or other waste streams offers the possibility to contribute to the production capacity with lower or no net greenhouse gas emissions without carbon sequestration technologies, increasing the flexibility and improving the economics of distributed and semi-centralized reforming. [3]

Steam reforming of aqueous phase oxygenated hydrocarbons has excellent potential for renewable hydrogen production from organic molecules (glycerol, polyols, alcohols, sugars, and

organic acids) derived from agricultural and food-process industries. The major challenge for hydrogen production by steam reforming of oxygenated hydrocarbons is the development of inexpensive catalysts with high conversion efficiencies. This is also the case for alkaline enhanced reforming, with the added challenge that the carbon generated by the reforming processes is sequestered as a sodium carbonate precipitate, which creates problems with respect to catalyst fouling. [3]

The purification and storage issue: The combustion of one kilogram of hydrogen can release up to 120 MJ of energy, not-with-standing an amount of 20 MJ/kg contained in the residual water vapour. The equivalent of energy released by combustion of oil and natural gas would require 2.5–2.75 kg of fuel. Thus, hydrogen is one of the most efficient fuels on a gravimetric basis. Hydrogen, however, is also the lightest element. Methane gas is 8 times heavier than hydrogen gas, and gasoline is 10 times heavier than liquid hydrogen. Thus, despite having the largest heat of combustion per unit of mass, hydrogen exhibits a very low volumetric energy density.[3]

2. Hydropower:

[6]

Hydroelectricity is the form of energy that harnesses the power of water in motion such as water flowing over a waterfall to generate electricity. Hydropower facilities have a wide range of constraints on their operation because of their participation in both electric power systems and water systems, with each placing a set of requirements on hydropower facilities. As electricity generators, hydropower facilities have constraints similar to those of traditional power generators, including the maximum capacity of the system, maintenance requirements, ability to provide reserves, and contracts on power provision. As hydrological reservoirs, hydropower facilities are also faced with environmental and regulatory constraints, including spillage limitations, reservoir level constraints, seasonal water releases, water quality concerns, and downstream impacts. [5]

Operational Constraints Hydropower generators also face many of the same operational constraints as thermal generators, including ramping and minimum generation levels; however, hydropower generators are also limited by constraints particularly related to water. These constraints limit the operation of hydropower by the amount of energy that can be produced, maximum and minimum amount of power that can be produced, and upward and downward ramping rates. Although hydropower is among the most flexible dispatchable resources, these constraints limit the ability of hydropower facilities to absorb the variability and uncertainty of variable energy sources. [5]

Regulatory Constraints Regulations and agreements on water use often dictate the output and storage of a given hydropower facility. These include water rights, use of the water, flood control, and power regulations. Negotiations among several parties—which may include government agencies, private entities, or even countries—specify water releases in terms of total water flow during a certain time period, usually for a given month. These regulations and release terms determine the operation of hydropower facilities from one year to another. [5]

Hydropower and Climate Change: Hydropower, being a renewable energy, is among technologies that are known to produce electricity with least impacts on global climate change. However, large scale storage hydropower stations have been known to emit some greenhouse gases (GHGs), especially methane (CH4) and carbon dioxide (CO2) as a result of the buried organic matter decomposition in the absence of enough oxygen. Because methane is the predominant gas in the total hydropower gaseous emission, and also a main cause for global warming. [4]

3. **Solar energy:**

[]p[][]

[6]

Solar energy is the transformation of heat, the energy that comes from the sun. It has been used for thousands of years in many different ways by people all over the world. The oldest uses of

solar energy are for heating, cooking, and drying. Today, it is also used to make electricity where other power supplies are not there, such as in places far away from where people live, and in outer space.

Solar energy is used today in a number of ways:

- As heat for making hot water, heating buildings and cooking.
- To generate electricity with solar cells or heat engines.
- To take the salt away from sea water.
- To use sun rays for drying clothes and towels.
- It is used by plants for the process of photosynthesis.
- To use in cooking (Solar cookers).

Inspite of all these uses, there are constraints for the utilisation of solar energy completely;

- Cost and T&D Losses: Solar PV is some years away from true cost competitiveness and from being able to compete on the same scale as other energy generation technologies. Adding to the cost are T&D losses that at approximately 40 percent make generation through solar energy sources highly unfeasible. Manufacturers are mostly focused on export markets that buy Solar PV cells and modules at higher prices thereby increasing their profits. Many new suppliers have tie-ups with foreign players in Europe and United States thereby prioritizing export demand. This could result in reduced supplies for the fast-growing local market.
- Land Scarcity: Per capita land availability is very low in India, and land is a scarce resource. Dedication of land area near substations for exclusive installation of solar cells might have to compete with other necessities that require land.
- Low voltage grid connectivity: Development of off-grid systems that are ‘Grid ready’ for rural and remote areas, and making by-laws for new buildings for grid connected as ‘Rooftop ready’ should be the suggested goals for the future. If these initiative works are executed as envisaged, it is only a matter before India becomes one of the world leaders in Solar Energy.

4. **Wind energy:**

[6]

Wind power or wind energy describes the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water), or can be converted into electricity by a generator. Wind power is a popular sustainable, renewable energy source that has a much smaller impact on the environment compared to burning fossil fuels. The wind has a wide range of benefits and has been used by man for thousands of years in sailing and milling. Nowadays, one of the main uses of wind is for the production of clean and renewable electricity. Let's jump right in and take a look at the different advantages that wind energy has wind energy is one of the most environmentally friendly energy sources known to man. This is based on the simple fact that wind turbines don't create pollution whilst generating electricity. Most non-renewable energy sources need to be burnt. This process releases gases such as carbon dioxide (CO2) and methane (CH4) into the atmosphere. These gases are known to contribute to climate change. In contrast, wind turbines produce no greenhouse gases when generating electricity.

Generating electricity from wind energy reduces the need for us to burn fossil fuels. This not only reduces carbon emissions but also helps to conserve dwindling supplies of the earth's natural resources. As a result, reserves of fossil fuels like coal, oil, and natural gas will last much longer. Wind energy are all around us making it widely accessible. Wind turbines do require significant wind speeds to be efficient and therefore the placement of a turbine is important. However, most regions contain locations suitable for wind turbines and wind farm. Wind energy has a number of drawbacks with the NIMBY (not in my backyard) factor playing a key role.

- The Wind Fluctuates: Wind energy has a similar drawback to solar energy in that it is not constant. Although the wind is sustainable and will never run out, wind speed does change. This can cause serious problems for the efficiency of a wind turbine. Utility companies invest a significant amount of time and money in researching which locations are suitable for wind power.
- Wind Turbines Pose a Threat to Wildlife: We often hear that wind turbines pose a threat to wildlife – primarily birds and bats. However, researchers now believe that they pose less of a threat to wildlife than other manmade structures do.
  Installations such as cell phone masts and radio towers are far more dangerous to birds than wind turbines. Nevertheless, wind turbines still contribute to mortality rates among bird and bat populations.
- Wind Turbines Are Noisy: One of the main disadvantages of wind turbines is the noise pollution they generate. You can sometimes hear them from hundreds of meters away depending on the wind direction. Combine multiple wind turbines with the right wind direction and the audible effects can be much greater. This issue is one of the biggest impacts of wind energy.

Conclusion:

In order to ensure the sustainability of energy supply and subsequently of the country's sustainable economic development, the government has to intensify further the implementation of renewable energy and energy efficiency programs.

As explained in this paper, many factors cause challenges for the renewable resources protection. For this reason, a novel scheme for solving such problems should be provided in a wide-area manner rather than operation in a stand-alone manner.

It is our hope that the soon-to-be RE Policy will introduce effective pricing-law and enabling environment that will lead towards a sustainable market and encourage production of RE for the country.

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3: CHALLENGES IN MAKING GREENER METROPOLITAN CITIES

GOWRI M. BHAT[1] and KISHORE. G[2]

1. Department of Chemistry, Bengaluru City University, B'luru-01.
2. Department of Zoology, Nruapatunga University, B'luru-01.

Abstract:

Understanding the need for renewable energy has been a larger part of the challenge in the recent years. The current crisis of nonrenewable sources increases the need for a smarter and more efficient method to employ the renewable resources in metropolitan cities. In the last few years, India has achieved new levels in developing modern methods of transportation, communication, power supply and other important aspects of modern man. Starting from the solar heaters to most preferred metros renewable source is making a faster move towards all the major parts of today's life, which is the most welcoming part. Challenges still remain as the government has now adapted new method to improve public awareness, apart from the greater need to of public awareness; there are new challenges which arise for diligent functioning of newer technologies under renewable technologies. It is more costly, difficulties in transmission, barriers to entry and politics. The article emphasis on the various challenges during a successful application of renewable resources in metropolitan cities. It also focuses on the different tests India as a new global leader will face if it decides to make the metropolitan cites greener.

Key words: Renewable energy, metropolitan cities, challenges, sustainable development, transmission, costs, awareness, application, availability

Author for Correspondence: gowribhatm@gmail.com

Introduction:

In the aim of developing new technologies in a fast developing city, application of renewable energy is very important. This is because for a sustainable development the metropolitan cities of

today's time are needed to be more efficient in using their resources. The emergency for renewable resources is because the current alternative being coal deposits, petroleum products are fasting depleting. Awareness on green technology and the pressing need for innovative techniques and tools is important for their integration into new projects with a way which is less polluting and that can serve for sustainable development. . Relationship between the sustainable and comfortable built environment with intelligent lifestyle, can be ensured through the adopted technologies.

As the saying, a sea is not always smooth; the application of green technology in a sustainable development is not as easy it sounds. By 2040, the India will face a whole new challenge: changing demographics with a minimum doubling of the urban population. The energy demand alone is estimated to go up by nearly 60% and associated is the climate change due to an increase in greenhouse gas emissions in the order of 50%. Thus, our country has to place the spotlight on building greener technology, environmental preservation, sustainable development and scientific research applied to developing technologies in metropolitan cities.

This can occur through a process which needs us to identify the challenges and address them within time. Challenges include population growth, emerging economies, new and expanded usage, and limited natural resources. In this article we will now focus on each challenge one by one:

Cost of Energy:

The most critical factors in determining whether it is financially worthwhile to install renewable energy systems are:

(1) Initial cost of the installation

(2) The net annual energy production.

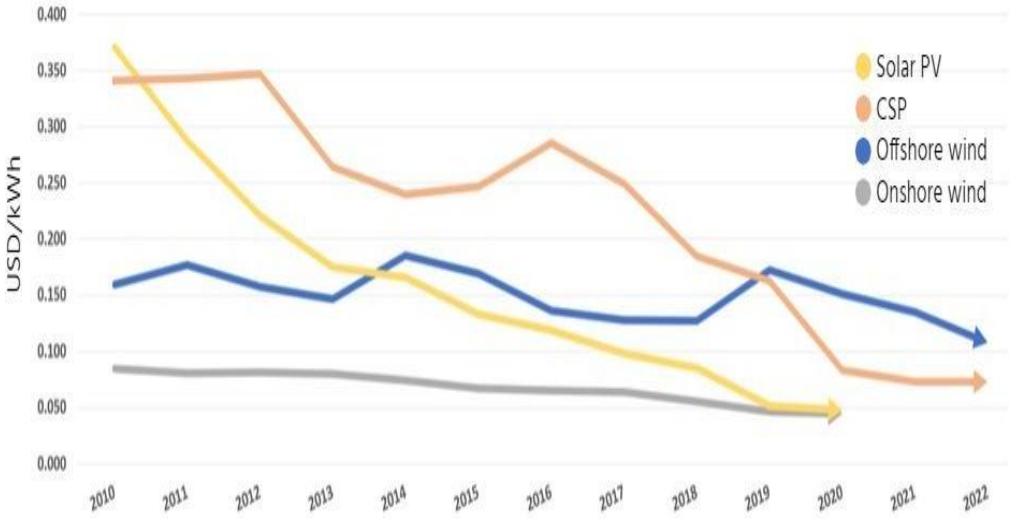
This problem can be explained by studying the world's largest solar park in Gujarat.

CASE STUDY:

The solar park is approximately 30 kilometres in the Rann of Kutch, an area roughly the size of Singapore — 72,600 hectares or 726 square kilometres which has been set aside for the world's largest hybrid solar-wind power park. This remote desert area has no human resides, the sun beats down relentlessly and temperatures soar to 35 degrees Celsius during the day. In December 2020, Prime Minister Narendra Modi laid the foundation stone for the project, which is expected to produce 30 gigawatts (GW), or 30,000 megawatts (MW) of power. The park, needs an investment of Rs 1.5 lakh crore. The average cost of 1MW solar plant is about Rs. 4 Crore. For such a huge project there is a greater need for funds, for a developing country like India it is rather difficult to adjust such funds in short term. Therefore, it takes a larger time to make a fully functional project which gives back the invested money. The project of solar park in Gujarat is thus being constructed in multiple stages.

A similar condition arises in establishing solar power plants in metropolitan cities. The acute shortage of funds is making it difficult to improve the access of renewable energy. But this problem is now being addressed due to greater competition in the market. The average cost of 1MW solar plant was about Rs. 10-12 Crore which has now come down by about 60%.

This can be seen in the below graph,



Transmission:

To sufficiently leverage renewable sources, a great deal of new transmission infrastructure is required. In the past century, power transmission infrastructure was built keeping in mind the large fossil fuel plants and nuclear plants. This makes it difficult for renewable energy sources not located near existing infrastructure. The metropolitan cities have already been facing the problem of shortage of area. The excess need of place for construction of renewable sources makes it impossible for the locating greener resources in an easily accessible place.

For instance, If the renewable energy system produces electrical energy and is connected to the grid, the important factor is the value of that energy. For large systems, it is easier to transmit because the cost of transmission can be eventually covered with time. For a smaller system, the initial cost of installment is itself a larger in many cases. Thus, the transmission cost makes it much more disadvantageous.

Usually, transmission and distribution loss in the form of heat in conductors accounts for about 20.66 per cent in 2018-19, 21.04 per cent in 2017-18, and 21.42 per cent in 2016-17 in India alone. As compared to USA, faces T&D loss of about 5%.

Thus, Some of the options to reduce this technical losses include: replacing incorrectly sized transformers, improving the connection quality of conductors (power lines), and increasing the availability of reactive power by installing capacitor banks along transmission lines.

But, in the near future the metropolitan cities and smart cities are to be designed in such a way that the renewable resources could be easily adapted when needed.

Barrier to entry:

With non-renewable energy being well-established, the utilities behind these legacy systems hold immense market power, and this presents a powerful barrier for renewable energy. Solar, wind, and other renewable sources of energy have to vie with deeper pockets, established infrastructure, and decades of experience and policy.

As it can be seen the increasing population of vehicles, also increases the demand for fuels. Metropolitan cities are greatly facing this problem. However the increasing demand of fossil fuel is not being met by their adequate supply, leading to a greater surge in fuel price. But this astoundingly does not decrease the popularity of fossil fuel making it difficult for the entry for renewable resources.

The easier solutions are now being coming up as convertible engines are being rapidly developed which can run both by using fossil fuel or renewable source.

Also, Start-ups must deal with even bigger barriers to entry as they must contend with massive market players. To show their value, start-ups must show an ability to scale, as investors typically demand large amounts of energy production, which can be challenging.

Higher investment in clean energy from governments, via subsidies and other measures, could level the playing field.

Politics:

Multi-billion-dollar industries tend to wield massive political influence, and the renewable energy industry is no exception. The political influences in the project committees and the repetitive changes in ruling party in a democracy, the effective construction of a fully functional renewable resource dependent project in a metropolitan city becomes a much difficult task. This also significantly reduces the quality of the project.

In most situations, the power industry is backed by subsidies, tax breaks, incentives and regulatory loopholes in the clauses. Though these advantages have probably elevated production, thus reducing the cost but they've also diverted resources that may have helped the expansion of renewable energy.

Also, the bigger industries, are mostly owned by the politicians, this makes the green project rather a money making deal than a cleaner initiative to improve the condition of environment.

Making the condition more challenging, the fossil fuel industry has been actively lobbied against the greater adoption of renewable energy and undermined climate change science, a strong driver for the adoption of clean energy.

Oversupply:

In recent years, governments and private companies around the globe have ramped up the production of solar panels which can be seen more often in metropolitan cities. However, even with a growing industry, the large supply is not being met by a equal demand. This is due to following reasons:

1. Lack of public awareness
2. Installation cost
3. Lack of space in modern day homes.

Thus, the supply currently being so much higher than demand, companies are scaling back their long-term investments and eventually going out of business. This gives an unpleasant environment to the upcoming projects. Also Investors have lost millions as a result of this situation.

Thus, the oversupply situation of today could significantly restrain the green technology of tomorrow. This could have the knock-on effect of disrupting its long-term adoption.

Public Awareness:

The public awareness is most common challenge in the green technology. In a well-established field dominated by the fossil fuel which is more effective and cheaper, replacing it with a much costlier and lower technology is more difficult. Though the green solutions are environment friendly, the mere difficultly in lack of availability makes it uneasy to increase awareness.

Thus, there is an urgent need for campaigns which can increase public awareness. In a metropolitan city it much more required because of the larger population and greater chances of harming environment.

CASE STUDY: Georgetown capital city of Guyana, South America.

The Ministry of Public Infrastructure launched a public awareness campaign to promote the benefits of renewable energy technologies and energy efficiency in Guyana. The campaign is part of a broader energy programme which is the "Sustainable Energy Programme for Guyana".

The objectives of campaign are

- To improve knowledge and understanding of renewable energy technologies among the target audience.
- To improve public understanding of the principles and need for energy conservation and substitution.
- To create awareness and support for Government's vision of transitioning towards renewable energy in the power sector.
- To create a favourable environment for achievement of energy policy targets as well as changes in attitudes and behaviour of energy consumers in Guyana.

Conclusion:

The need for green energy now being already established, the challenges which arise are need to be answered for an effective and cleaner drive. The major challenges have been discussed above, with the increasing population in a metropolitan city making them more significant with time. Thus, for greener and cleaner cities with modern technologies we have to face the challenges with new and innovative solutions.

In the next five years, the greener solutions will definitely increase by leaps and bounds if planned properly, government-backed auctions or other incentives such as tax credits, rebates to establish new projects in the developing cities will definitely increase the chances to make the cities more environment friendly.

But, The Covid-19 crisis poses challenges to the timely implementation of previously announced government plans. For instance, the implementation of projects under government-backed auctions will critically depend on whether India maintains its planned schedule of tenders. This can be clearly experienced in the now developing Smart cities. Though the committees planned

to develop the multiple cities in India into smart cities the Covid-19 drastically slowed down the process due to lack of labor and diversion of funds into the medical emergency.

Planned renewable electricity projects with long-term contracts will be mostly shielded from these kinds of situations. But, in the short term, governments may have to delay scheduling new renewable resource projects and turn to existing fossil fuels to meet new demand. In the medium and long term plans the energy projects are also supported by economics. Thus, reducing the risk of new challenges.

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4: A STUDY ON PUBLIC AWARENESSAND ACCEPTANCETOWARDS SOLAR AND WIND ENERGY IN KGF.

Jennifer Joy I*, Cinthiya D, Louisena Vinoth Priya L and Ramadevi N

Sri Bhagawan Mahaveer Jain first Grade College,Department of Life Science Geetha road, Robertsonpet, KGF

Author for correspondence: E-mail: louisenapriya@gmail.com

Abstract

Energy is essential to our society to ensure our quality of life. Renewable energy gathered from self-renewing resources such as the sun, wind, earth and plants would serve the need. The objective is to analyze the awareness and acceptance of public regarding RE. The questionnaire was designed and distributed in the month of October 2021 through Google form and emails to the public in KGF. A total of one hundred and fifty valid responses were collected and analyzed. The participants were questioned regarding their awareness and acceptance of renewable energy. The data analysis shows that the majority (92.7%) of the respondents are aware about renewable energy while 7.3% are not. This data canbe used by the government to enhance people awareness towards renewable energy to ensure people understanding on the importance of renewable energy. In addition, 95.3% of the respondents accepted to set up solar panels and 76.7% accepted to set up wind turbines as renewable energy in generating electricity. This data demonstrates that people are ready to implement renewable energy in their activities. The government should focus on the idea to increase RE awareness to achieve 50% usage of renewable energy is attained. The government should maximize the advertisement in organizing events related to renewable energy in the future. Besides that, early education at the school level is also important in providing knowledge on the importance of RE. This step is crucial to ensure the sustainability of nature and the preservation of the environment for future generations.

Keywords: Public Awareness, Acceptance, Renewable energy, solar energy and Wind energy.

INTRODUCTION

The Kolar Gold Fields (KGF), located in the Kolar district of the state of Karnataka,India, It lies on the Deccan Plateau of Central and South India and is roughly 3000feetabovethesealevel.Itwasone of India's earliest industrialized towns, which had electricity supplied to it from a captive power plant, good water supply, well-equipped hospitals, schools, etc. Energy is essential to our society to ensure our quality of life and to underpin all other elements of our economy. Renewable energy technologies offer the promise of clean, abundant energy gathered from self-renewing resources such as the sun, wind, earth, and plants.Wind, solar biomass, and geothermal technologies are cost-effective today in an increasing number of markets, and are making important steps to broader commercialization.

Renewable energy is useful energy that is collected from renewable resources, which are naturally replenished on a human time scale, including carbon neutral sources like sunlight, wind, rain, tides, waves, and geothermal heat. Renewable energy often provides energy in four important areas: electricity generation, air and water heating/cooling, transportation, and rural energy services. Renewable energy is derived from natural processes that are replenished constantly. In its various forms, it derives directly from the sun, or from heat generated deep within the earth. Solar energy is the most demanding energy source due to fact that it is the most abundant and most effective energy source on earth. Solar energy is derived from sun, and this energy is not only environment free but also costless. Latest technology allows the harnessing of solar energy through cells known as solar cells or photovoltaic cells. Photovoltaic cells are placed in direct sunlight, when the direct sunlight hits these cells chemical reaction takes place which produce electric current. These electric currents are later on converted into electricity which are used to power everyday items like street lights, schools and households. In most of the areas streetlights in India receive electrical energy from national grid, so we need to look for another alternative source of electrical power. For this purpose we use solar energy. LED

based lightning system is used which received charge from lead batteries charged by solar panels. Solar system and LED lightning combination enables its interest in governing authorities to lighten street lights and schools in remote areas without setting up any external infrastructure in a meager traditional way.

Solar panels are designed to absorb sun rays as a source of energy for generating electricity and heating. It is also called photo voltaic a sit convert slight energy directly into electrical energy. Solar panel is made up of solar cells. A large number of small solar cells are spread over a large surface area which can work together for provision of sufficient power to be used. Larger the amount of light that falls on a cell, larger is the amount of electricity generated. Two forms of solar panels are used to achieve electricity. The most common is the solar electricity cells. Different design of solar panels which are increasing in popularity are the solar water heating panels which can provide all part of homes hot water supply, heat swimming pools and for other purposes.Usingsolarelectricitypanelssomeformofbatterystorageisattached to the system. This allows the storage of electricity produced through the day which is used at night.

Wind power or wind energy is the use of wind to provide mechanical power through wind turbines to turn electric generators for electrical power. Wind power is a popular sustainable, renewable energy source that has a much smaller impact on the environment compared to burning fossil fuels. Areas where winds are stronger and more constant, such as offshore and high-altitude sites are preferred locations for wind farms. Typically, full load hours of wind turbines vary between 16 and 57 percent annually but might be higher in particularly favourable off shore sites.

Wind-generated electricity met nearly 4% of global electricity demand globally, the long-term technical potential of wind energy is believed to be five times total current global energy production, or 40 times current electricity demand, assuming all practical barriers needed were overcome. This would require wind turbines to be installed over large areas, particularly in areas of higher wind resources, such as high-altitude places.

Objective

The objective of the study is to analyze the awareness on public regarding renewable energy and the level of acceptance.

Methodology

The questionnaire was designed based on public concern on the existence of renewable energy. The questions in the questionnaire is discussed briefly on the knowledge on renewable energy and technology which covered the impact of renewable energy, opinion on the implementation of renewable technology, concern on government initiatives and knowledge of renewable energy**.** Thus, a set of questionnaires was prepared to determine the level of public awareness about renewable energy based on their educational level and residential area. The questionnaire was distributed within the months of October 2021. The survey questionnaires were distributed through Google Form, emails and social media to family, neighbor's, students, academicians, and senior citizens. A total of one hundred and fifty valid responses were collected and analyzed. The respondents who answered the survey were the citizens of KOLAR GOLD FIELD.

Result and Discussion

The survey participants were asked several questions regarding their awareness and acceptance of renewable energy. The respondents were between the age of 16 and 65 years old from various levels of educational qualifications with approximately 62% female and 38% male. The percentage of respondents according to age range is as follows: 16–25 (92.7%), 26–35 (6%), 36–45 (0.3%), 46–55 (0.7%) and 56-65 (0.3%).

The information obtained includes the respondents' living address whether in the urban or rural area, which affected their knowledge and information about renewable energy. From the collected data, most of the respondents were degree holders, indicating that they might be exposed to the current issues on green energy.

The data analysis shows that the majority (92.7%) of the respondents has heard and knew about renewable energy while 7.3% have not. As shown in Figure 1.

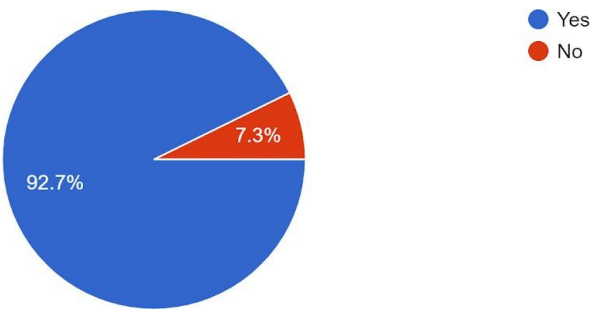

Fig 1: Awareness on renewable energy

This result shows that public concern on renewable energy is high and information about renewable energy was received by the people who live in KGF. This data can be used by the government to enhance people awareness towards renewable energy to ensure people understanding on the importance of renewable energy. In addition, the survey found that 95.3% of the respondents accepted to set up solar panels and 76.7% of the respondents accepted to set up wind turbines as renewable energy in generating electricity in their town. This data demonstrates that people are ready to implement renewable energy in their daily life activities in order to create a sustainable country. The majority of the respondents support the idea of replacing conventional energy sources with renewable energy sources as they realized the benefits that the citizens and country could gain from the renewable energy implementation. Even though most of them supported the use of renewable energy, 4.7% of respondents disagreed to set up solar panels and 23.3% of the respondents disagreed to set up wind turbines as their energy source to generate energy, as shown in Figure 2(a) and 2(b).

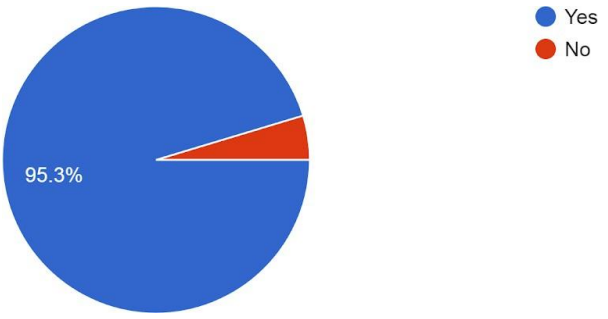

Fig 2(a): Acceptance for solar panels

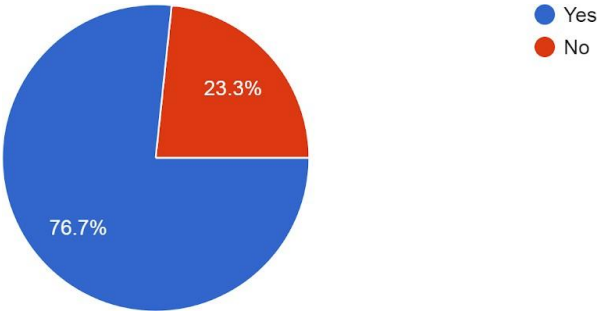

Fig 2(b): Acceptance for wind turbines

Early education at the school level is also very important in providing knowledge on the importance of renewable energy. This step is crucial to ensure the sustainability of nature and the preservation of the environment for future generations.

Public Support on Government initiative in another question, the respondents were asked if they would support the government's initiative to implement renewable energy. A majority of them supported the government effort in emphasizing the implementation of renewable energy both through solar and wind energy as compared to minority who was not supportive. This result shows positive feedback and the support from the public to enhance the renewable energy

technology. Additionally, people are ready to face and use renewable energy technology. The government should organize many related activities to introduce and educate the public on renewable energy in order to ensure the community is willing to pursue renewable energy.

Conclusion:

This study was conducted to determine public opinions about renewable energy and to determine the level of acceptance benefits of renewable energy. Data were collected throughout Kolar Gold Field that included almost all age ranges. This study shows that public was adequately informed about renewable energy. Even though most of the respondents prefer to use renewable energy, the price of renewable energy technology is high, which reduces its affordability for moderate and poor families. The government has to discuss with the relevant ministries and researchers on ways to develop a high-quality technology at an affordable price. Thus, people will be able to afford the price of technology, and the government's goal can be accomplished by 2050. In addition, this study showed that the public's knowledge on the government's initiative on renewable energy is low either due to less exposure or simply being ignored by the people. However, a majority of the people are keen to support the government's efforts to emphasize the deployment of renewable energy. The finding also suggests that the government should act aggressively in enhancing public awareness through social media as it is easily accessible by the people especially teenagers. Meanwhile, the government can include the benefits and importance of renewable energy through advertisements and campaigns. Events and programmes on the application of the latest RE technology and how it can save cost and the environment can be organized for the public including through demonstrations. Thus, the government should focus on the idea to increase RE awareness to ensure that the aim of achieving 50% usage of renewable energy is attained. The government should maximize the advertisement in organizing an event related to renewable energy in the future. Besides that, renewable energy should be included in the syllabus for the young minds to study and practice since kindergarten appropriate with their thinking level. Learning from kids will enhance brain development in critical thinking. It will influence their mind for more challenging future in developing sophisticated technology.

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5: RENEWABLE SOURCES OF ENERGY FOR GLOBAL SUSTAINABLE ENVIRONMENT

YAMUNA.C
Department of chemistry, KLE'S Nijalingappa Degree College, 2nd Block, Rajajinagar, Bengaluru-10

Abstract
Renewable energy sources used to produce energy from natural processes, are nowadays used to meet the ever increasing energy requirements worldwide, Conventional energy sources are finite and under depletion. Renewable energy sources are continually replenished by cosmic forces and can be used to produce sustainable and useful forms of energy with minimum environment impact .The main forms of Renewable energy sources are solar energy, wind energy, hydro electric energy, geothermal energy and biomass. Solar energy is the most renewable energy source; this is because energy from the sun can be used directly for electricity generation and heating applications. Hydropower is a source of energy that comes from falling water. By adopting the application of renewable energy source the world can become energy independent. Renewable Energy techniques provide an excellent opportunity for mitigation of greenhouse gas emission and reducing global warming through substituting conventional energy sources

KEYWORDS:-Renewable energy sources (RES), sustainability, usage of resources, climate change mitigation.

Introduction

Modern life style means much more energy, with the goal to achieve higher effectiveness and comfort. Nowadays, most energy needs are settled using extremely harmful fossil fuels, which in the future should be replaced with cleaner energy resources, like renewable or nuclear energy.
Renewable energy sources supply 14% of the total world energy demand. RES includes biomass, hydropower, geothermal, solar, wind and clean or inexhaustible marine energies. Solar energy is the most renewable energy source; this is because energy from the sun can be used directly for electricity generation and heating applications. Hydropower is a source of energy that comes from falling water. This is synonymous to a situation where energy from the sun evaporates water at low altitudes and later rains from high altitudes. Through differential heating of the earth's surface, the sun creates wind. Biomass comes from plants which are results of photosynthesis powdered by the sun.
The renewable are the primary, domestic and energy resources is dramatically increasing along with improvements in the quality of life, industrialization of developing nations, and increase of the world population. It has long been recognized that this excessive fossil fuel consumption not only leads to an increase in the rate of diminishing fossil fuel reserves, but it also has a significant adverse impact on the environment, resulting in increased health risks and the threat of global climate change. Society is slowly moving towards seeking more sustainable production methods, waste minimization, reduced air pollution from vehicles, distributed energy generation, conservation of native forests, and reduction of greenhouse gas emissions. The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Govt of India for all matters relatingto new and renewable energy.

Solar energy

Solar energy is a type of energy generated by the sun. Solar energy is created by nuclear fusion that takes place in the sun. Fusion occurs when protons of hydrogen atoms violently collide in the sun's core and fuse to create a helium atom. Solar energy is an energy resource that comes from the sun and varies between the values of 0-1100 W/m2 on earth. Solar energy is clean, costless and limitless. Firstly, solar energy was used as heat energy but in recent years, it is also being used as an electric energy source together with developed technology. Solar energy resources are massive and widespread, and they can be harnessed anywhere that receives sunlight. The amount of solar radiation, also known as insolation, reaching the Earth's surface every hour is more than all the energy currently consumed by all human activities each year. A number of factors, including geographic location, time of day, and weather conditions, all affect the amount of energy that can be harnessed for electricity production or heating purposes. Solar photovoltaics are the fastest growing electricity source. In 2018, around 100 GW of global capacity was added, bringing the total to about 505 GW and producing a bit more than 2 percent of the world's electricity. Solar energy can be captured for electricity production using: A solar or photovoltaic cell, which converts sunlight into electricity using the photoelectric effect.

Typically, photovoltaics are found on the roofs of residential and commercial buildings. Additionally, utilities have constructed large (greater than 100 MW) photovoltaic facilities that require anywhere from 5 to 13 acres per MW, depending on the technologies used.

Concentrating solar power, which uses lenses or mirrors to concentrate sunlight into a narrow beam that heats a fluid, producing steam to drive a turbine that generates electricity.

Concentrating solar power projects are larger-scale than residential or commercial PV and are often owned and operated by electric utilities. Solar hot water heaters, typically found on the roofs of homes and apartments, provide residential hot water by using a solar collector, which absorbs solar energy that in turn heats a conductive fluid, and transfers the heat to a water tank. Modern collectors are designed to be functional even in cold climates and on overcast days.

Electricity generated from solar energy emits no greenhouse gases. The main environmental impacts of solar energy come from the use of some hazardous materials (arsenic and cadmium) in the manufacturing of PV and the large amount of land required, hundreds of acres, for a utility-scale solar project

Applications of solar energy

1. Solar energy for battery charging. Solar light have become ubiquitous and can be found everywhere from home landscaping and security lights to road signs and street lights**.** These solar lighting technologies for your home are inexpensive and readily available from basic to high-end designs everywhere from your local hardware store to online shopping websites.

2. Solar ventilation solutions such as solar attic fans can reduce the burden of your HVAC by helping to cool your home during the summer. This may be a good option if you are not able to install a solar PV system that offsets your home's entire electricity use. One innovative product is the Solar tube solar attic fan

Advantages of Solar Energy

1. The energy from the Sun is free, its renewable energy source

2. Solar energy will last forever whereas it is estimated that the world's oil reserves will last for 30 to 40years.

3. It prevents unnecessary and excessive commercial energy consumptions of buildings by using the natural heating and cooling systems.
It meets the energy need in areas without electric network.

Wind energy

Wind is caused by the uneven heating of the atmosphere by the sun, variations in the earth's surface, and rotation of the earth. Mountains, bodies of water, and vegetation all influence wind flow patterns .Wind turbines convert the energy in wind to electricity by rotating propeller-like blades around a rotor. Wind energy is a form of solar energy. Wind energy describes the process by which wind is used to generate electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. A generator can convert mechanical power into electricity. Mechanical power can also be utilized directly for specific tasks such as pumping water. Wind power is one of the fastest-growing renewable energy technologies. Usage is on the rise worldwide, in part because costs are falling. Global installed wind-generation capacity onshore and offshore has increased by a factor of almost 75 in the past two decades, jumping from 7.5 gigawatts (GW) in 1997 to some 564 GW by 2018, Production of wind electricity doubled between 2009 and 2013, and in 2016 wind energy accounted for 16% of the electricity generated by renewables. Many parts of the world have strong wind speeds, but the best locations for generating wind power are sometimes remote ones. Offshore wind power offers tremendous potential.

Wind turbines first emerged more than a century ago. Following the invention of the electric generator in the 1830s, engineers started attempting to harness wind energy to produce electricity. Wind power generation took place in the United Kingdom and the United States in 1887 and 1888, but modern wind power is considered to have been first developed in Denmark, where horizontal-axis wind turbines were built in 1891 and a 22.8-metre wind turbine began operation in 1897.Wind is used to produce electricity using the kinetic energy created by air in motion. This is transformed into electrical energy using wind turbines or wind energy conversion systems. Wind first hits a turbine’s blades, causing them to rotate and turn the turbine connected to them. That changes the kinetic energy to rotational energy, by moving a shaft which is connected to a generator, and thereby producing electrical energy through electromagnetism. The amount of power that can be harvested from wind depends on the size of the turbine and the length of its blades. The output is proportional to the
dimensions of the rotor and to the cube of the wind speed. Theoretically, when wind speed doubles, wind power potential increases by a factor of eight. Wind-turbine capacity has increased over time. In 1985, typical turbines had a rated capacity of 0.05 megawatts (MW) and a rotor diameter of 15 metres. Today’s new wind power projects have turbine capacities of about 2 MW onshore and 3–5 MW offshore. Commercially available wind turbines have reached 8 MW capacity, with rotor diameters of up to 164 metres. The average capacity of wind turbines increased from 1.6 MW in 2009 to 2 MW in 2014.

Applications of wind energy

1. Mechanical application: Multi-blade windmill used for water pumping.
2. Wind turbines vary in size and type. They are commercially available for electricity generation. Size of wind turbines (400 Watt-5 MW).Advantages of wind
1. Use of an indigenous resource without producing greenhouse gases or other pollution.
2. Wind energy contributes to the power supply diversification, Wind energy projects can developlocal resources in terms of labour, capital and materials,

3. Wind Energy can be used directly as mechanical energy. In remote areas, wind turbines can beused as great resource to generate energy. Land around wind turbines can be used for other uses.

Hydropower

Hydropower also known as **water power**, is the use of falling or fast-running water to produce electricity or to power machines. This is achieved by converting the gravitational potential or kinetic energy of a water source to produce power. Hydropower is a method of sustainable energy production. Since ancient times, hydropower from watermills has been used as a renewable energy source for irrigation and the operation of mechanical devices, such as gristmills, sawmills textile mills, trip hammers, dock cranes, domestic lifts, and ore mills. A trompe, which produces compressed air from falling water, is sometimes used to power other machinery at a distance. Hydropower is now used principally for hydroelectric power generation, and is also applied as one half of an energy storage system known as pumped-storage hydroelectricity. Hydropower is an attractive alternative to fossil fuels as it does not directly produce carbon dioxide or other atmospheric pollutants and it provides a relatively consistent source of power. Nonetheless, it has economic, sociological, and environmental downsides and requires a sufficiently energetic source of water, such as a river or elevated lake. International institutions such as the World Bank view hydropower as a low-carbon means for economic development. Hydroelectric power is the largest source of renewable electricity in the United States, producing about 6.3% of the nation's total electricity throughout the last decade. Even after a century of proven experience with this reliable renewable resource, significant opportunities still exist to expand the nation's hydropower resources through non-powered dams, water conveyance systems, pumped storage hydropower, and new site development. The Water Power Program supports the hydropower industry and complements existing investments through the development and deployment of new technologies and key components, as well as by identifying key opportunity areas through which hydropower generation can be enhanced. With more than 2,500 U.S. companies supporting the hydropower industry, adding additional hydropower

Generation will create a large and enduring economic benefit by revitalizing the domestic manufacturing and hydropower industry, example of the early use of hydropower is seen in hushing. Hushing is the use of the power of a wave of water released from a tank in the extraction of metal ores. The method was first used at the Dolaucothi Gold Mines in Wales from 75 AD onwards. This method was further developed in Spain in mines such as Las Médulas. Hushing was also widely used in Britain in the Medieval and later periods to extract lead and tin ores. It later evolved into hydraulic mining when used during the California Gold Rush in the 19th century. **Applications of hydropower** 1. Electricity – Hydroelectricity is one of the most important sources of energy in the world. Hydroelectricity is one of the cheapest and non-polluting sources of power. Many countries in the Nordic region and South America are almost completely dependent on hydro power for their energy needs. 2. Energy Storage – There is 90 GW of Global Pumped Hydro Storage already existing in the world and with increasing Solar and Wind Energy this Capacity is only going to grow. The main use of Pumped Hydro Storage is for Grid Energy Storage.

Geothermal energy

Geothermal energy is heat within the earth. The word geothermal comes from the Greek words *geo* (earth) and *therme* (heat). Geothermal energy is a renewable energy source because heat is continuously produced inside the earth. People use geothermal heat for bathing, to heat buildings, and to generate electricity. Geothermal energy is a type of energy taken from the Earth's core. It comes from heat generated during the original formation of the planet and the radioactive decay of materials. This thermal energy is stored in rocks and fluids in the centre of the earth. The difference between the temperature in the earth's core and the surface drives a continuous conduction of thermal energy from the centre to the exterior of the planet. High temperatures of over 4000°C cause some of the rock in the centre of the Earth to melt and form hot molten rocks called magma. These heats also cause
The mantle to behave plastically and portions of it to connect upwards, since it is lighter than the surrounding rock. The rock and water in the Earth's crust can reach heats of around 370°C.Thermal energy contained in the rocks and fluids can be found from shallow depths right down to several miles below the Earth's surface.
This energy is a clean renewable energy and is used for electricity generation .27%of total electric production in Philippines and 7% in California State are being covered from geothermal plants and 56MW capacity geothermal electric energy production is made in Papua New Guinea.75% of energy need of gold mining is covered from geothermal.86%of total heat energy in Iceland is covered from geothermal. In 2018, 27 countries, including the United States, generated a total of about 83 billion kWh of electricity from geothermal energy. Indonesia was the second-largest geothermal electricity producer after the United States, at nearly 14 billion kWh of electricity, which was equal to about 5% of Indonesia's total electricity generation. Kenya was the eighth-largest geothermal electricity producer at about 5 billion kWh, but it had the largest share of its total annual electricity generation from geothermal energy at 46%.
Environmental Effects of Geothermal Energy As many countries that use geothermal energy apply reinjection, geothermal energy is considered the most positive energy resource in respect to environment. When geothermal energy is used in electric production, it comes before fossil fuels with its almost zero waste even though it is only evaluated with sulphide emissions. In geothermal power plants, azoth oxide emissions have much lower values than the power plants that use fossil fuels. For this reason, geothermal power plants are considered as a clean energy resource as they are classified risk free in respect to its effect on ozone layer and health.
Applications of Geothermal energy 1.Geothermal Energy for Houses: The use of geothermal energy enables you to cool down the temperature in your house during hot periods. The technology takes the hot air from your house and transfers it down to the ground, where the air naturally cools down. After that, the chilled air will be sent back to your house through the pipes. The reverse geothermal
heating process will take place during the cold winter months when warmer temperatures are generated in your house by tapping into an underground heat exchange. 2.Geothermal Energy for Farms: Geothermal energy is widely used among farmers to heat their green houses, it is even possible to grow tropical plants such as citrus trees in the middle of the winter. Countries such as Hungary and Italy have been using geothermal energy for many decades to grow vegetables regardless of the weather conditions**.** Another field where geothermal energy is necessary is in fish farms. Tropical fish and other aquatic animals need warm water to survive and geothermal energy system is a suitable way to provide it. 3. Geothermal Energy for Industries: Geothermal energy is used for drying different kinds of foods – mostly fruits and vegetables. It can also be

used in the process of extracting precious metals from ore. **BIOMASS ENERGY** Biomass is plant or animal material used as fuel to produce electricity or heat. Examples are wood, energy crops and waste from forests, yards, or farms. Since biomass technically can be used as a fuel directly (e.g. wood logs), some people use the terms biomass and biofuel interchangeably. The word biofuel is usually reserved for *liquid* or *gaseous* fuels, used for transportation. Biomass power is the largest source of renewable energy worldwide. Biomass comes from both human and natural activities. By-products from most industries, including timber, agriculture, naturally occurring forest residues, household wastes and landfills, are all viable sources of biomass energy materials. Agricultural products like corn kernels, corn stalks, soybean and canola oils, animal fats, prairie grasses, hardwoods and even algae can be converted to energy. The largest source of energy from wood is pulping liquor or black liquor, a waste product from the pulp and paper industry. Wood and wood waste is a major source of biomass energy, particularly in the Northwest. Wood waste from thinning young timber stands and harvesting older stands for timber or pulp yield tops and branches suitable for bio-energy production. Timber stands damaged by insects, disease or fire is also potential sources of biomass fuels. Transporting wood waste and biomass materials is often costly. The use of smaller, lower-cost power plants located near the biomass source minimizes those costs and improves the viability of bio-energy projects. The IPCC (Intergovernmental Panel on Climate Change) defines bioenergy as a renewable form of energy. In 2017 the IEA (International Energy Agency) described bioenergy as the most important source of renewable energy. IEA also argue that the current rate of bioenergy deployment is well below the levels required in low carbon scenarios, and that accelerated deployment is urgently needed. Researchers have disputed that the use of forest biomass for energy is carbon neutral. Biomass is converted to energy through various processes, including: Direct combustion (burning) to produce heat, Thermochemical conversion to produce solid, gaseous, and liquid fuels, Chemical conversion to produce liquid fuels, Biological conversion to produce liquid and gaseous fuels. Direct combustion is the most common method for converting biomass to useful energy. Thermochemical conversion of biomass includes *pyrolysis* and *gasification.*

Wood, forestry residue, animal dung, human excrement, and agricultural residues in the form of crop waste like stalks and coconut husks are used. Though these are renewable energy sources, the stoves used for burning these fuels are the inefficient 'three stone stoves'. These stoves have an energy efficiency of only 10%, so 90% of the biomass burnt is wasted. Most of the biomass is used as the primary energy source by people for heating and cooking, ranging from 65% in Haiti, 72% in Kenya, 78% in Democratic Republic of Congo, 81.5% in

Nigeria, 85% in Tanzania, to 89% in Kenya and Niger. In all the countries, rural households are more dependent on biomass than peri-urban and urban areas for cooking. Its use in rural households varies in different countries, from 99% of the population in Ethiopia, to 95% in Mozambique. While in urban Ethiopia biomass is used by 84% of the population. In addition, 12% and 6% of the biomass is used for transportation in Haiti and Nepal, respectively. Industrial use of biomass for heating is prevalent in Haiti (4%), Nepal (6%), Myanmar (20%) and Sudan (20%). These are usually small scale industries like sugar mills, sawmills, brick production, and tobacco curing. Other users of biomass are commercial services like restaurants, and baking, as well as arts and crafts. Nepal also uses 1% of its wood in agriculture.

Applications of biomass energy **1. Biomass is always and widely available as a renewable source of energy**:-The organic materials used to produce biomass are infinite, since our society

consistently produces waste such as garbage, wood and manure. **2. It is carbon neutral:-**As a natural part of photosynthesis, biomass fuels only release the same amount of carbon into the atmosphere as was absorbed by plants in the course of their life cycle. **3. It reduces the overreliance of fossil fuels:-**Not only is there is a limited supply of fossil fuels, but fossil fuels come with environmental baggage, including the release of large amounts of carbon dioxide into the atmosphere and the pollutants that result from removal, transportation and production. **4. Is less expensive than fossil fuels:-**While fossil fuel production requires a heavy outlay of capital, such as oil drills, gas pipelines and fuel collection, biomass technology is much cheaper. Manufacturers and producers are able to generate higher profits from a lower output.

Conclusion:

Human development can be achieved through the use of energy. Considering climate change, we can see that the energy needs of future generations can be met on the basis of renewable resources. But, making full use of the potential offered by renewable resources can be hindered by market and political conditions, as well as cost. At the level of local communities, due to the possibilities of producing renewable energy, electricity consumers have an important role in the use of renewable energy sources .The analysis shows that renewable energy sources are increasingly used and at European level the proposals for the coming years are very ambitious. And in the field of transport, measures can be implemented to reduce total energy consumption in transport as well as increase energy efficiency of transport. These include increasing the shareof electric cars and transport planning. Measures leading to the implementation of low-carbon technologies or even technologies leading to the removal of carbon dioxide from the atmosphereare necessary, It is believed that in the coming years the proportion of electricity in the final energy demand will increase. Energy is a requirement in our everyday life as a way of improvinghuman development leading to economic growth and productivity.

6: ILLUSTRATIVE REVIEW ON CHALLENGES OF RENEWABLE ENERGY

Kavyasri PS, Tanushree BM, Vidayashree MS, Mangala Gowri SA, Jayapriya s.

KLE‘s Nijalingappa college Rajajinagar B’lore-560010

ABSTRACT: The nation that leads the renewable energy [RE] will lead the world. The renewable source of energy is a feasible source of energy that our Mother Earth has gifted us. Utilization of Renewable resources is a step towards Green Technology. It has been lifeblood for Economic growth. RE source is optimistic contribution to environment. Many projects are undertaken by Indian government as well as the world to overcome the barriers of RE. Schemes have played significant role in development of Mankind. The usual challenges of RE are availability of resources, expenditure, resources location and conservation. There are crucial projects managed by Indian government and world for sources of RE. Developing and under developing countries face financial issues for implementing RE sources. Developed countries should fascinate other countries and lead them the path of renewable energy source. Tolerance capacity should be inbuilt in order to safe guard our biodiversity. Obstacles of RE have been resolving through policy and programs. Inadequate information is root of problems. We should be heading our self towards sustainable development by RE. This paper encompasses the barriers of utilization of Renewable energy. It throws light on struggles and solutions for consumption renewable resources. This paper also has many statistical and data analysis of usage of RE. Action plans for resolving the challenges. Start replacing energy start developing.

Keywords: Feasible, Green Technology, Environment, Mankind, Financial, Biodiversity, Policy.

Introduction:

Renewable energy usually refers to those energies that do not pollute environment and could be recycled in nature. A **renewable resource** is a resource which can be used repeatedly and replaced naturally. Energy is a critical foundation for economic growth and social progress. The need for energy and its related services to satisfy human social and economic development, welfare and health is increasing. All societies call for the services of energy to meet basic human needs such as: health, lighting, cooking, space comfort, mobility and communication and serve as generative processes. Sustainable development of Renewable energy systems are rapidly becoming more efficient and cheaper and their share of total energy consumption is increasing as become the centre of recent national policies, strategies and development plans of many countries. Rapid deployment of renewable energy and energy efficiency technologies is resulting in significant energy security, climate change mitigation, and economic benefits. Renewable energy almost never runs out, for example: solar energy is powered by heat from the sun and never runs out. Other examples include oxygen, geothermal power, fresh water, solar energy and biomass. Coming to power generation in the country, India has increased installed power capacity from 1362MW to over 112,058MWsince independence & electrified more than 50,000 villages**.The Government of India has set a target of installing of installing 175 GW of renewable energy capacity by the year 2022, which includes 100 GW from solar, 60 GW from wind, 10 GW from bio-power and 5 GW from small hydro-power**. The aim of this paper is to identify the key barriers of RE development in Malaysia and explore the broad strategies and action plans implemented by the government which will be the catalyst for RE penetration in power generation. In addition, the paper will also highlight the impact of strategic improvements that have been made by the government so far. India is the only country in the world to have an exclusive ministry for renewable energy development, The Ministry of NonConventional Energy Sources (MNES).

1. Barriers of renewable energy

The RE development in INDIA could be hampered by several barriers which are financial, technical, regulatory/institutional and informational in nature that needs to be addresses for the viability of RE development in the country.

1.1 Information barriers

There is a lack of information and awareness on the benefits of renewable energy. Investment allowances and capital allowances were made available for RE implementation since 2008. However, not many companies are aware of the special incentives. There is a clear need for government agencies to help and advice applicants and potential recipients how to go about

applying for RE incentives and the need for more channels for dissemination of information. Because of lack of trained personnel to train, demonstrate, maintain and operate renewable energy structures, especially in regions with low education levels, people are unwilling to import the technologies for fear of failure On the other hand, lack of physical facilities for transmission and distribution networks, as well as equipment and services necessary for power companies is a major infrastructural challenge for renewable energy development in most developing countries.

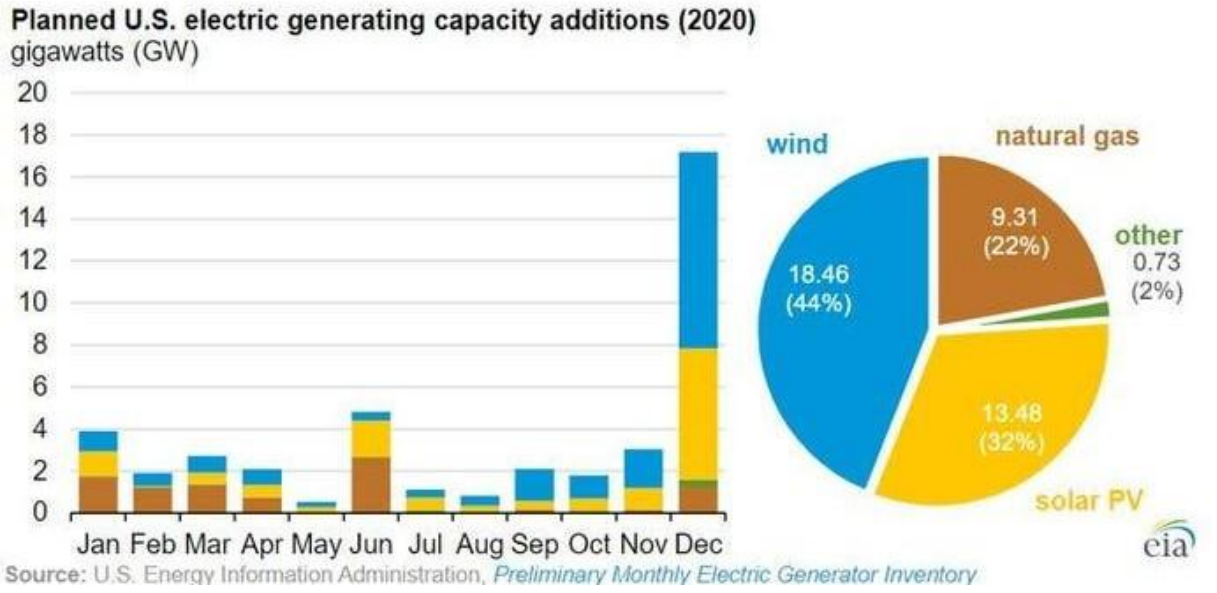

Figure: 1 Technology information on Renewable energy.

1.2 Financial barriers

The financial barriers are the single major barriers to the expansion of green renewable energy, although they are not the only barriers. While these barriers may vary from country to country, by and large, they stem from the Asian bank-dominated financial system. Given that this system lacks a well-developed capital market and thus the availability of venture capital is limited in many Asian countries, banks are the main source of funding for major projects, including green renewable energy ones. Presently, many green energy projects are implemented With the assistance of grants. This is because new technologies bear a certain amount of uncertainty, thus it creates a barrier for its development. This uncertainty results in high financing costs for research, development and deployment. This in turn artificially raises the price of clean energy options, delaying their full integration into the energy marketplace. Frequently, the initial cost for efficient equipment is substantially higher than the standard alternative and the payback period or economic return may be unacceptable. Renewable or green energy projects generally face

Difficulty in getting financing and bank loan approval due to the high risk .

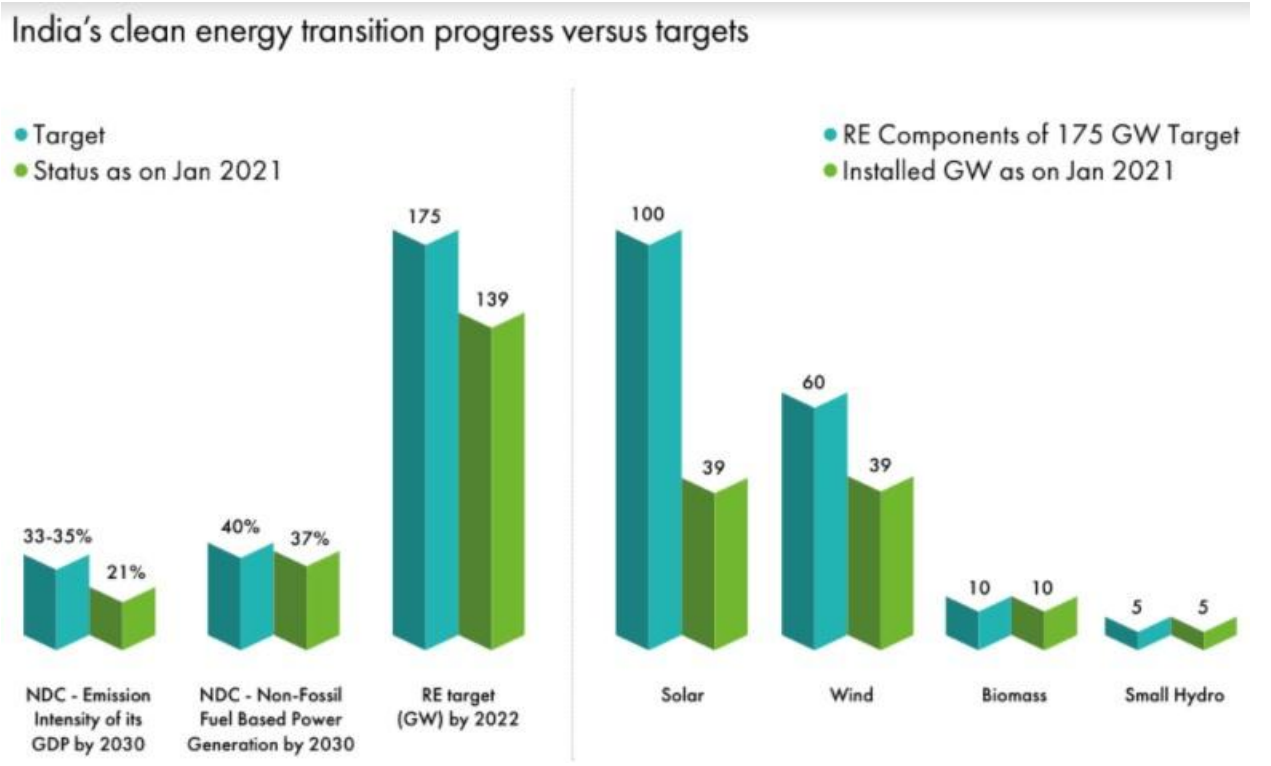

Figure 2: Renewable energy progress in INDIA by 2022.

1.3 Social and cultural barriers

Socio-cultural barriers, for example, households' unwillingness to adopt renewable energy for fear of unreliability form one of the bases for failure to adopt renewable energy technologies in some countries People do not accept changes easily. The change of RE needs effort. The people's way of thinking should be renowned. Tribal communities are unable to replace themselves for usage of RE due to lack of information and cultural ethics.

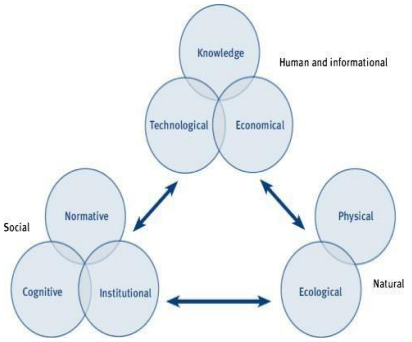

Figure: 3 Problems of cultural ethics.

2. Policy advice on renewable energy development in INDIA

The few important steps taken by the Ministry of India for development of renewable Energy sources are recapitulated below:-

Realizing the need for concentrated efforts in this sector, The Government of India.

- Established a Commission for Additional Sources of Energy (CASE) in the Renewable Energy Sources – Policies in India 295 Department of Science and Technology, in 1981. The mandate of CASE is to promote research and development activities in the field of renewable energy. CASE was formally incorporated in 1982, in the newly created Department of Nonconventional Energy Sources (DNES).
- In 1992 DNES became the Ministry for Nonconventional Energy Sources, commonly known as MNES. India has a vast supply of renewable energy resources, and it has one of the largest programs in the world for deploying renewable energy products and systems.
- Indeed, it is the only country in the world to have an exclusive ministry for renewable energy development, the Ministry of Non-Conventional Energy Sources (MNES).
- MNES was renamed the Ministry of New and Renewable Energy. India has pioneered in the world in many administrative actions of renewable energy promotion such as:
- Electricity regulatory commission within liberalized market1991
- Mandatory environmental audits for power projects -1992
- Energy conservation bill -2000
- Renewable Energy promotion bill- 2005.
- The Ministry is encouraging the setting up of grid-interactive power projects basedon renewable energy through private investment route.
- The State Nodal Agencies are responsible for promotion and development of private sector projects by way of providing necessary clearances, allotment of land, allotment of potential sites in case of SHP projects and facilitating power purchase agreements etc.

State Electricity Regulatory Commissions (SERCs) are determining tariffs by taking into account the submissions of all stakeholders, including consumers.

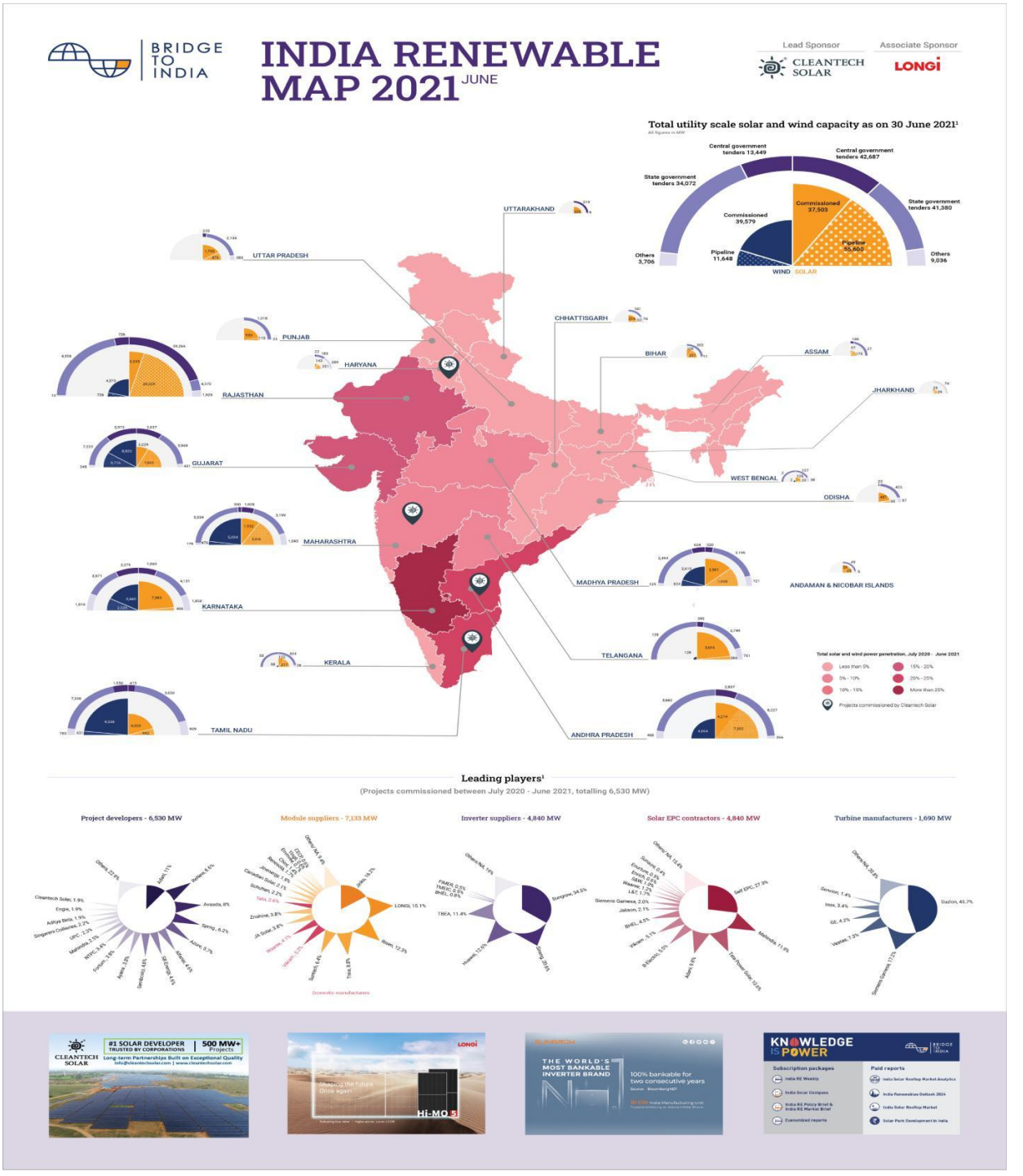

Figure:4 Growth of Renewable energy through policies

2.1 Solar energy

ROOFTOP PV AND SMALL SCALE GENERATION PROGRAME {RPSSGP}

Under Phase I, the Rooftop PV and Small Scale Generation Programe (RPSSGP) aims to encourage the development of rooftop and ground-mounted solar systems. The Indian government revised the Solar Mission in 2014. It targets for 100 GW installed capacity of solar electricity **by 2022**.

2.2 Wind energy

National wind solar hybrid policy {2018}

The main objective of the Policy is to provide a framework for promotion of large grid connected wind-solar PV hybrid system for optimal and efficient utilization of transmission infrastructure and land, reducing the variability in renewable power generation and achieving better grid stability.

2.3 Bioenergy

National policy on biofuels {2018}

The policy is aimed at taking forward the indicative target of achieving 20% blending of bio fuels with fossil-based fuels by 2030. The strategy involves increasing domestic production, adopting bio fuels and renewable, energy efficiency norms, improvement in refinery processes.

Conclusion

Renewable energy is the inevitable choice for sustainable economic growth, for the harmonious coexistence of human and environment as well as for the sustainable development. In order to promote and ensure the rapid, effective and sustainable development of renewable energy .India can meet all energy needs with Renewable Energy Sources. Solution to long-term energy problems will come only through research, development & implementation of such developments & recherché in the field of renewable energy sources. The total estimated potential of renewable Energy is around 152,000 MW, which is much greater than the current total installed energy generating capacity of India. To overcome energy crises, Government has developed many projects & programs for proper utilization of renewable energy resources. Energy problem is global problem. Only the government cannot do everything. However individual & co-operative efforts can do a lot. Seeking high end technology in RE-generation from developed countries and harnessing the huge solar potential of India is an appropriate step towards development of R.E. in India. Though, the path is difficult during the initial stages, with the full support of Indian Govt. the development of 'Renewable Energy' in India would certainly turn out to be a 'success story'. India has instituted various efforts and initiatives to promote renewable energy. The progress on RE generation has been slow but over time the growth rate of RE in India has shown an upward trend as more energy users took advantage of the incentives provided by the government. In line with any radical change, the way India perceives its energy development must be on a gradual basis. The foundations have to be firmly set so that while external environment may change, our direction remains the same. India has taken a step forward towards a more proactive approach and the soon to be introduced national RE policy will hopefully create a level playing field for RE technologies providers or investors and provide conducive regulatory framework that would allow more participation from the government agencies, non-government organizations as well as the general public. It is our hope that the soon-to-be RE Policy will introduce effective pricing-law and enabling environment that will lead towards a sustainable market and encourage production of RE for the country.

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7: IMPLEMENTATION OF RENEWABLE ENERGY SOURCES TO HYDROPONICS

Kalicharan HCK[1], Prasanna Kumar SG[1], Vidya M[*1]

[1]Department of Chemistry and Biochemistry, MS Ramaiah College of Arts, Science and Commerce, Bangalore.

Author for correspondence Dr.M.Vidya,Bangalore -54, E-mail: mvidyaz@gmail.com

Abstract:

Hydroponics is a type of horticulture that involves cultivating plants without soil, using nutrient solution in water preferably under controlled settings. Nutrients used in hydroponics systems may come from natural or artificial sources. Hydroponics offers numerous advantages over traditional/classical agriculture-low water requirements, almost zero-nutrient losses, less carbon footprint, high yield per unit space due to stacking and many more. But it has high power consumption which could offset the 'less carbon footprint advantage'. Thus, integrating hydroponic system with renewable energy sources might offer a greater benefit to the environment and well as our economy. In hydroponics, majority of the power is utilized for lighting and constant or periodic water circulation. In addition to using renewable sources of energy, the entire system can be boosted to work at highest potential with usage of minimal resources. Optimizing manageable settings such as light, temperature, humidity and composition nutrient solution is significantly valuable. Herein we discuss about the importance and improvements in incorporation of renewable energy sources in hydroponic technique and optimization of the technical properties.

Introduction

Hydroponics (Gr. Hydro-water; ponos-labour) is a technique of growing plants in nutrient solution with or without the use of an inert medium to provide mechanical support. The word 'hydroponics' was coined by Professor William Gericke in the early 1930s; describing the growing of plants with their roots suspended in water containing mineral nutrients. Most hydroponic systems operate automatically to control the amount of water, nutrients and photoperiod based on the requirements of different plants, which makes it more reliable on electricity. Due to population growth, rapid urbanization, and industrialization, not only the cultivable land is decreasing but also conventional agricultural practices are causing a wide range

of negative impacts on the environment including high water usage, methane emissions, leaching out of fertilizers, and endangerment of indigenous natural flora and fauna [1]. Studies showed that by the year 2050, our growing global population would require an estimate of 60 percent more food than we produce today. Agricultural land covers only 38%, while arable land covers around 11% of the total land area. The data shows that there will only be a meager 2% increase in agricultural land by the year 2040[2, 3].

Traditional agriculture is one of the most climate-sensitive industries. Outdoor production processes largely depend upon precipitation and temperature [4]. Adverse weather patterns like heat waves, cold waves, droughts and floods have severely affected many parts of the world and also have caused numerous famines in the course of history [5]. Increased water logging due to poor drainage is increasing the salinity of soil all over the world particularly in dry and hot regions. Plants absorb all the essential nutrients from the soil mineral pool in form of soluble salts, but salinity suppresses plant growth.[6]

Conventionally, soil has been the only and thus most ubiquitous medium for growing plants while providing the dual role of anchorage as well as supplying water and nutrients to the plants allowing for successful plant growth. This dependency on soil, however, causes inherent problems such as the constant presence of disease-causing organisms and nematodes. There has been a constant increase in fertility of soil until now, currently; this soil fertility increase has stagnated due to a saturation effect, where further application of fertilizers only produces a marginal and diminished return in productivity. Soils pose serious limitations for plant growth in general causing farmers to face inconvenience due to the trade-off between large space requirement or reduction in plant growth and thus productivity [7].

The objectives of this article are,

1. To discuss available techniques for hydroponics
2. To discuss advantages and disadvantages of hydroponics
3. To discuss the implementation of renewable energy sources to hydroponics

Benefits of Hydroponics over conventional agriculture several different techniques can be employed depending on resource availability I the region [8]. During the last few years, the hydroponics of vegetables has been increasingly shifted to closed systems. The main advantage provided by closed systems is the restriction of surface and ground water pollution through harmful discharges, which are abundant in nitrates and phosphates. Moreover, recycling the excess nutrient solution, which runs off after each watering application, results in substantial fertilizer savings. An efficient hydroponic farm uses only around 25% of fertilizers in comparison with conventional agricultural structure. The recycling of nutrient solution also diminishes water usage [9].

Hydroponic farms are not affected by the external environment and thus plants can grow at any part of the year, in any climatic region and even within metropolitan cities. Using optimal nutrient solutions, simulated LED lights, temperature settings and additional cutting-edge, sophisticated equipment, plants can be formulated to develop faster, produce higher yields and grow all year round. They can be cultivated closer to consumers, reducing transport emissions and providing people with fresher produce. Less occurrence of pests and diseases in hydroponic systems and easy treatment makes it much more yielding. There are no soil-borne insect pests, disease attack and weed infestation. Soil pests are almost non-existent and in enclosed greenhouses natural predators can be used to control insect pests and thus no pesticides are essential. Healthiest crops can be produced free from pesticides and heavy metals with high yields per unit area. Nutrients are fed directly to the roots; as a result, plants grow faster with smaller roots. [10].

Hydroponic systems are used for bioremediation (use of biological interventions for mitigation of the toxic effects caused by pollutants in the environment including wastewater and sewage) of treated water. Treated waste water contains large quantities of Phosphorous and Nitrate which accelerates the eutrophication of lakes, but can be highly beneficial to plants, when used correctly. Bioremediation using hydroponics is green and environmentally sustainable approach that offers promising alternative for wastewater treatment in developing countries [11]. Vertical farming or high-rise farming is a proposed indoor, urban farming technology involving large-scale agricultural production at several vertical stages in multi-story buildings using hydroponics.

Soilless culture methods offer unique benefits such as capabilities to control water availability, pH, and nutrient concentrations in the root zone. At the same time, there are higher risks because of the smaller root system and low buffering capacity for water and nutrients and because of the increased risk of exposure to extreme ambient temperatures[12].

Even though the hydroponic systems can be highly efficient, at conserving water and nutrient utilization, they require large and continuous supply of power to function smoothly. Most of the energy is consumed for water recirculation and lighting arrangements. In most of the developing countries, this energy comes from burning the fossil fuels which is a large downside. Thus, renewable sources can be used as the source of energy to mitigate the negative effects of hydroponics [13]. Most tropical countries receive abundant year-round solar energy. In-grid solar energy to electrical energy conversion systems can be used for exploiting the profuse solar energy. This could be put into proficient usage by harvesting it efficiently and using it for hydroponic systems [14]. This solar energy is used to circulate water and to energize the complete system. Other renewable energy sources can also be used depending on their abundance and year-round availability. One must make sure that the energy source is at the least distance from the set-up to prevent energy losses in the grid, as transporting electricity over very long distances could result in high energy losses.

Alongside using renewable energy sources, the equipment that are used must be efficient and dissipate least amount of energy. The lighting systems must comprise of LEDs that utilizes less energy compared to conventional ones. Moreover, using LEDs gives us the option of controlling the wavelength of the light being used. Thus, it can be varied with the circadian rhythm of plants that are being cultivated.

Summary

Hydroponics is a viable method for cultivation of plants. This technique is ideal particularly in regions with diminished soil. Accomplishment of hydroponic systems at smaller, larger and commercial scale is greatly beneficial to the mankind and to the planet as a whole. Optimization of this technique using accessible resources and space is of the at most important in this swiftly developing world. This technique can also be used to fight the climate change by reducing our

net carbon emissions and consequently our carbon footprint. As the technology advances, it provides opportunity to deliver more efficient use of water, nutrients, space and energy, and to strengthen production sustainably. Exploiting renewable energy for this purpose can go a long way in the future.

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8: A STUDY ON THE ROLE OF ARTIFICIAL INTELLIGENCE TECHNOLOGY IN IMPROVING THE RENEWABLE ENERGY SECTOR

Sharulatha.M, Lavaneya.G**,** Divya Rebbeca.D and Roselin. K*

Dept of Life Sciences, Sri Bhagawan Mahaveer Jain College - Robertsonpet KGF

Author for Correspondence Email id: roselin.jgi@gmail.com

Abstract

A modern renewable energy forecasting system blends physical models with Artificial Intelligence to aid in system operation and grid integration. The growth of renewable energy generation capacity has triggered a paradigm shift in the energy industry with a move from traditional base load power generation sources of coal and nuclear energy to the lower cost renewable energy resources of wind and solar power. However, this fundamental shift has widespread consequences in the energy industry. Additionally, the industry is changing from a market based on commodity pricing to a market based on technology solutions in order to integrate renewable energy. As the energy industry continues to utilize more variable generation sources, accurate forecasts of power generation and net load are becoming essential to maintain system reliability, minimize carbon emissions, and maximize renewable energy resources. The basic objective of Artificial Intelligence in renewable sources of energy is to enable computers to perform intellectual tasks as decision making, problem solving, perception, understanding human communication. Artificial Intelligence approaches are developed to produce accurate predictions of renewable energy, including their generation and impacts on the electric grid such as net load forecasting, line loss predictions, maintaining system reliability, integrating hybrid solar, battery storage systems, and predicting equipment failure. Both fundamental and applied researches are supporting AI to revolutionize the energy industry to utilize the capabilities of renewable energy. This paper describes the methodology of the AI methods and provides a preliminary assessment.

Keywords: Artificial intelligence, renewable energy, machine learning, solar power, power grid, net load.

Introduction

What is Renewable Resources? A Renewable Resource is one that can be used repeatedly anddoes not run out because it is naturally replaced. Examples of Renewable Resources include solar, wind, hydro, geothermal, and biomass energy.

A Renewable Resource is a asset of which there is an unlimited and endless supply. Some resources, unlike the sun, wind, or water, are considered renewable even though some time or effort must go into their renewal. Most precious metals are renewable also. Although precious metals are not naturally replaced, they can be recycled because they are not destroyed during their extraction and use. Such renewable resources, once a nonrenewable resource is depleted, it cannot be recovered. As the human population continues to grow and finite resources become increasingly scarce, the demand for renewable resources increases.

Artificial intelligence is the counterfeit of human intelligence processes by robotic language processing, especially speech recognition and machine vision. It gives rise to smarter intelligence than human in the form of brain computer interfaces and neuroscience based human intelligence enhancement. Artificial Intelligence (AI) techniques play an essential role in modelling, analysis, and prediction of the performance and control of renewable energy. The algorithms used to model, control, or predict performances of the energy systems are complex, involving differential-equations, enormous robotic power, and time management. Instead of multiplex rules and mathematical routines, AI techniques can grasp critical information patterns within a multi-dimensional information domain. Design, control, and operation of renewable energy systems require a long-term series of meteorological data such as solar radiation, temperature, or wind data. Such long-term measurements are often non-existent for most of the interest locations or, wherever they are available, they suffer from several shortcomings, like inferior quality of data, and in-sufficient long series. AI techniques focus on overcoming these problems. It summarizes commonly used AI methodologies in renewal energy, with a particular emphasis on neural networks, fuzzy logic, and genetic algorithms. It outlines selected AI applications for renewable energy. In particular, it discusses methods using the AI approach for prediction and modelling of solar radiation, seizing performances and controls of the solar photovoltaic (PV) system.

There are numerous complex, nonlinear interactions among multiple parameters controlling the integration of renewable energy into the electric grid. Artificial Intelligence approaches are being developed to produce more accurate predictions of renewable energy, including their generation and impacts on the electric grid such as net load forecasting, line loss predictions, maintaining system reliability, integrating hybrid solar and battery storage systems, and predicting equipment failure. Both fundamental and applied research is leveraging artificial intelligence to revolutionize the energy industry to utilize the capabilities of renewable energy. This Special Issue seeks to contribute to advancing the generation capacity and integration of renewable energy into the electric grid with artificial intelligence. Artificial Intelligence is a widely spoken latest trend right now. It is the fastest growing branch of the high-tech industry. The central government sees AI as a key strategy for mastering some of the greatest challenges of our time, such as climate change and pollution.AI is often used in connection or sometimes even corresponding with machine learning. A central aspect of intelligence in AI is that it makes decisions based on information and carries out actions with regard to its goals. Under certain prospects, this includes collecting this information and reacting flexibly to changes and the environment. AI also aim and enables machines to perform task intelligently. Although computer science is very important in AI, which is applicable to other fields, such as statistics, robotics, linguistics, or philosophy.

Calls for government spending on grid infrastructure to update long transmission lines from a centralized power generation source attempts to solve today's problems using technology from the past. There is a better, more forward looking alternative already in existence. AI leverages decentralized renewable sources.The emerging role of AI for RE utilization may help to achieve some targets within the environment society and economic growth. AI has the ability to improve the operation and efficiency of RE sources and reduce the cost of operation and produced energy and minimize environmental impacts efficiently. This technology can help enhance energy management efficiency, transparency and use of RE sources. AI can cover different areas of RE system such as forecasting, emission reduction, and cost minimizing, robust and smooth control, high power quality without fluctuation.

Objective of the study:

The basic objective of Artificial Intelligence in renewable sources of energy is to enable computers to perform intellectual tasks as decision making, problem solving, perception, understanding human communication. The global transition to renewable energy will need artificial intelligence (AI) technology to manage decentralized grids. AI can balance electricity supply and demand needs in real-time, optimize energy use and storage to reduce rates. The emergence of artificial intelligence (AI) and its progressively wider impact on many sectors requires an assessment of its effect on the achievement of the Sustainable Development Goals.. The fast development of AI needs to be supported by the necessary regulatory insight and oversight for AI-based technologies to enable sustainable development

Features

AI Focuses on a significant area of concern to develop a foundation for the implementation of renewable energy system with intelligent techniques. The global transition to renewable energy will need artificial intelligence technology to manage decentralized grids

- Provides insights on solar cell, bio fuels, wind, and other renewable energy systems design and characterization, including the equipment for smart energy systems.
- Highlights international standards for intelligent renewable energy systems design, reliability, and maintenance.
- Balance of electricity supply- provides electricity through grids by Smart electricity generation.
- Attains needs in real time and executes reliability.
- Optimize energy use and storage to reduce rates.
- Produces more accurate predictions of renewable energy, including their generation and impacts on the electric grid such as net load forecasting, line loss predictions, maintaining system reliability, integrating hybrid solar and battery storage systems.
- Diversifying energy supply with perception of understanding human communication.

- Focuses on a significant area of concern to develop a foundation for the implementation of renewable energy system with intelligent techniques.
- Showcases how researchers working on renewable energy systems can correlate their work with intelligence and machine learning approaches.
- Highlights international standards for intelligent renewable energy systems design, reliability, and maintenance.
- Provides insights on solar cell, bio-fuels, wind, and other renewable energy systems design and characterization, including the equipment for smart energy systems.

Role of AI in renewable sources energy sector

Recent years have witnessed the evolution of Artificial Intelligence (AI) techniques and their revolutionary applications in energy systems. In this situation, AI provides smart and efficient tools for smart energy systems to perform smart electricity generation, emergency response, and delivery. The incorporation of renewable energy sources into the smart grid is made easier by using AI technologies to revolutionize the generation, transmission, and consumption of energy. It is known that the integration of AI in energy systems will deliver a wide range of potential research opportunities to the energy management community. Innovative Artificial Intelligence solutions can enhance the efficiency, stability, strength, and security of energy systems. The transformations of energy systems for a carbon-free future possess many technological, organizational, and socio-economic challenges. These originate from the electrification of existing heating and transport, understanding the impact of increased demand and intermittent generation on existing power and energy system assets, informing the business processes that obtain energy, and quantifying weather-related risks. The application of artificial intelligence spans these disciplines, offering powerful tools and methods for aiding the understanding of the new data streams that are now being generated from energy systems and unlocking their operational value.

Artificial Intelligence in Energy Efficiency

AI in energy efficiency is more interconnected as data collection, calculating power, storage capabilities are growing exponentially every year. AI makes it possible in the current industrial

revolution, and it binds with the possibility of delivering the next level of performance.AI is in its early stages of execution. AI is capping the sector's environmental impact when demand is gradually rising. The energy generation profile is branching out, and we see the consequences of fossil fuel utilization on quality of life and air quality. Some of the ways AI-powered software can aid with energy management, energy storage, and energy forecasting that affects sustainable development at the moment and in the future.

AI in Renewable Storage

According to Green-tech Media, the US energy storage market achieved a gigantic milestone in 2017's last quarter. The numbers were only projected to double, but increased faster than the optimistic authority had anticipated. Hence, a renewable solution was sought. With the increase in storage capacity and development of innovation, AI has come out to support efficiency and sustainability. Athena,an AI software, highlights energy utilization, thus enabling its clients to keep an eye on fluctuation in energy rates to allow an effective energy storage solution.

Accident Management

Failures in equipment and accidents are frequent occurrences within the energy sector. Human errors can cause massive instrument failures and unalterable losses. AI is now being used to identify flaws by observing the instruments. Timely detection of errors saves money, time, and lives.

Grid Management

Present-day grids collect energy from several energy sources. Running and supervising enormous power grids systems is getting more complex. An AI software increments efficiency and stability to these energy sources via its ability by evaluating massive data-bases in short durations. This has led to the rise of smart grids that are made to operate several sources simultaneously. For example, Active Network Management (ANM), developed by Siemens is an

AI-based computer program, which independently runs grids. ANM keeps an eye on a grid's interaction with specific loads of energy and alters the grid accordingly to increase efficiency.

Power Usage

Both developed and emerging economies are facing the same excessive energy consumption challenges. To understand sustainable energy consumption, AI is used to keep track of the power consumption behaviour of people and their enterprises. Numerous AI-based establishments are now giving logical solutions to enhance energy utilization. An example is Alphabet's Nest, an intelligent thermostat that lowers power usage by adjusting to user behaviour.

Energy Prediction

Renewable energy sources are equivalent with a continuous challenge of unreliability. Despite being sustainable, renewable sources often fluctuate in their energy, proving inefficient in powering companies in the long haul. Xcel utilizes AI-dependent data mining techniques to get weather reports with utmost precision and exhaustive details. The algorithms running these systems then point out motifs in the collected data sets to make significant forecasts.

The need to develop and integrate renewable sources of energy has been unnecessarily emphasized. Due to the reckless nature of renewable sources, power suppliers greatly depended on fossil fuels. Nonetheless, with the incorporation of AI in renewable energy sources, an increment in energy efficiency is not far off.

Artificial Intelligence (AI) in the Energy Industry

Artificial Intelligence becomes more and more important in the energy industry and is having great potential for the future design of the energy system. Typical areas of application are electricity trading, smart grids, or the sector coupling of electricity, heat and transport. Essentialities for an increased use of AI in the energy system are the digitalization of the energy sector and a correspondingly large set of data that is evaluable. AI helps make the energy industry more efficient and secure by analyzing and evaluating the data volumes.

Artificial Intelligence in the Power Grid - Smart Grids and Sector Coupling

AI is present in the field of intelligent networking of electricity consumers and generators across sector boundaries. With the increasing decentralization and digitalization of the power grid, it is becoming more complicated to manage the massive number of grid participants and keep the grid in balance. This requires evaluating and analyzing a torrent of data. Artificial Intelligence helps process this data as quickly and efficiently as possible. Smart grids are another area of application. These networks transport not only electricity but also data. Especially with an increasing number of volatile powers generation plants such as solar and wind, it is becoming more and more important for power generation to react intelligently to consumption simultaneously. AI can help evaluate, analyze, and control the data of the various participants (consumers, producers) connected to each other through grids. A particular focus of AI in the energy industry is on the integration of electro mobility. An increase in e-cars offers opportunities and challenges. The charging of electric cars must be synchronized, but at the same time, they offer the possibility of storing electricity and stabilizing the grid, for example by adjusting the charging demand to price signals and availability. AI can help with all these by monitoring and coordinating. In addition, the AI can stabilize the power grid by, detecting deviation in generation, consumption, or transmission in near real time, and then develop suitable solutions. Initial research projects in this field, such as at the Fraunhofer Institute, are already underway.

Therefore, AI can help coordinate maintenance work and determine optimal times for the maintenance of networks or individual systems. This helps minimize costs and loss of profit as well as disturbances of the network operation

Artificial Intelligence in Electricity Trading

Artificial Intelligence in power trading helps improve outlooks. With AI, it is simpler to evaluate systematically the large amount of data in electricity trading, such as weather data or historical data. Better forecasts also increase grid stability and thus supply security. Especially in the field of forecasts, AI can help facilitate and speed up the integration of renewable. Machine Learning and Neural Networks play an important role in improving forecasts in the energy industry.

Developments in forecasting quality in recent years have shown the potential of AI in this area: There is already a reduction in the demand for control reserve, even though the share of volatile power generators in the market has increased.

AI for Power Consumption

Consumers, smartly connected in the electricity system, can contribute to a stable and green electricity grid. Smart home solutions and smart meters already exist, but they are not yet widely used.

In a smart networked home, the networked devices react to prices on the electricity market and adapt to household usage patterns in order to save electricity and reduce costs. One example is smart networked air conditioning systems. They react to prices on the electricity market by boosting their output when electricity is eco-rich and economical. By analyzing user data, they can also include information about user friendly and time windows in their computations.

1. **Applications:**

- Cyber-physical systems for energy systems
- Intelligent optimal design, operation, and control of energy systems via artificial intelligence
- Modelling of energy production at different time scales, asset health monitoring, and the optimization of system operation and life cycle
- Optimization of distributed energy resources via artificial intelligence
- Advanced forecasting of variable renewable power generation
- Electric vehicle smart charging infrastructure
- Artificial Intelligence for the integration of distributed energy resources
- AI-enabled consumer-centric business models of energy systems
- Environmental pollution reduction for energy systems via artificial intelligence
- Solar home system, solar dryers, solar cookers, E- cars and bikes, power generation water heaters, windmills and water pumps are best known applications of this sector.

2. **Methodology**

This paper reviews the current literature on the role of artificial intelligence in renewable sources of energy. The methodology is done by data collection and review of literature.

3. Findings of the study

A detailed assessment of the Society, Economy, and Environment groups are discussed below. Asurvey on public perspective regarding Artificial Intelligence in renewable energy sources was conducted and a questionnaire was designed to assess the finding of the study. A total of 100 people whose age group varies from 15-45 were taken into consideration.

4. Result and Analysis

According to the survey, 95.3% are aware of AI and rest of the 4.7% weren't aware.

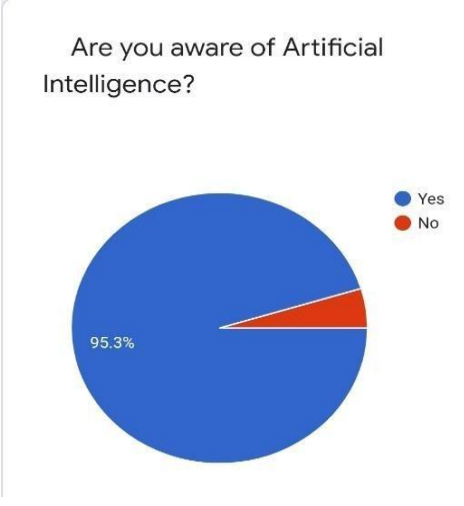
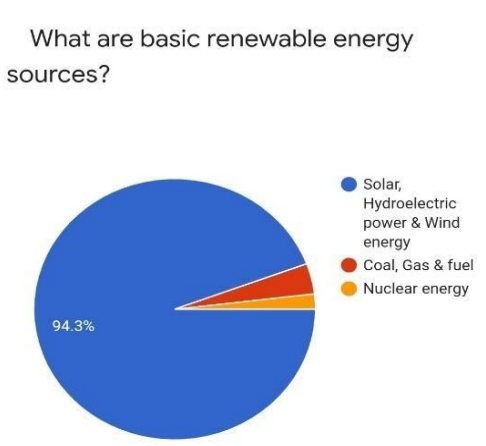


fig1.1

It was found that 94.3% of public were able to recognize the basic renewable sources of energy.



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82.1% of people were aware that AI plays an important role in renewable energy sources sector.

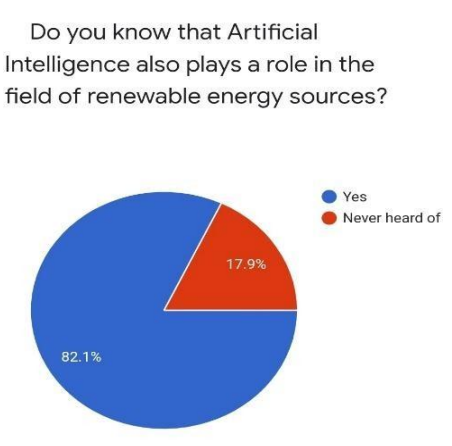

fig1.3

84.9% people agreed that AI is beneficial in RE sector that AI can help to balance electric supply and heat management.

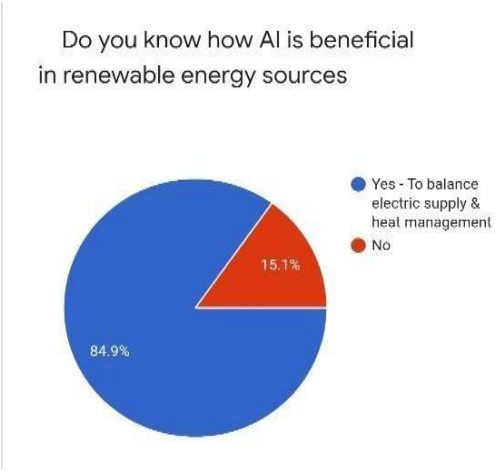

fig1.4

46.2% public have come across devices like solar panels, solar bikes and windmills. Whereas 35.8% have experienced solar cookers, solar bulbs, hydropower energy and 17.9% have not come across any of these.

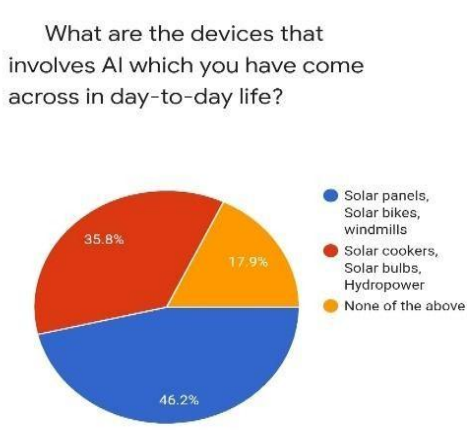

fig1.5

42.5% of the public know-how AI is helpful in building a Heat-Free environment by converting heat into energy, 20.8% by reducing combustion of fuels, 15.1% by reducing man power and 21.7% have never heard these given options.

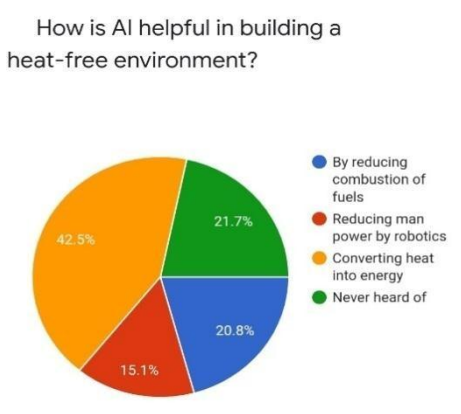

fig1.6

92.2% people believe that AI can make wonders in the field of renewable energy source.

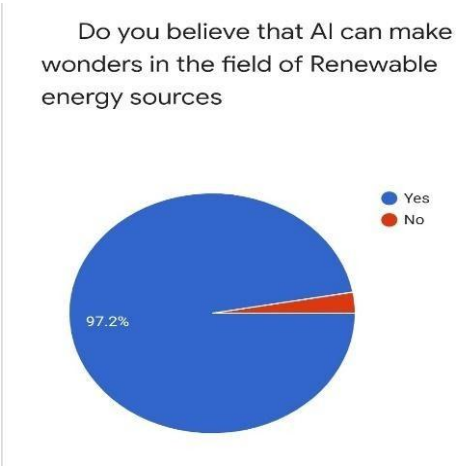

fig1.7

78.3% individuals think that AI in RE sector is more efficient than fossil fuels and bio-fuels, which received 9.4% and 12.3% respectively.

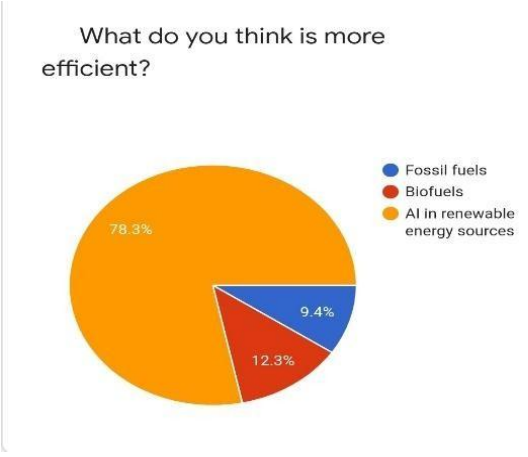

fig1.8

Suggestions:

People of all age groups believe that installation and set-up of the power grids are expensive and high cost of implementation. People have a wrong mindset on solar and wind-based devices. They assume that it reduces man-power which leads to unemployment due to which the

innovative ideas are compressed. They feel that there is lack of awareness among people regarding AI in the field of renewable energy sector.

As it consumes more of electrical energy it may have an impact and drawback in the usage of AI. It can be prevented if we reduce the amount of energy used by AI, it may be effective if energy is properly utilized to get a beneficial input on renewable sources and to conserve renewable energy.

Conclusion

We have described the major techniques of Artificial Intelligence in the renewable energy sources sector with a survey taken among public. As we move toward an increasingly electric world, more energy will be produced by decentralized, renewable sources. Think micro-grids, wind farms, private solar panels, and batteries. These will add complexity to energy grids across the globe. Over the next 10-15 years, the growing adoption of electric vehicles, the electrification of heating systems, and the proliferation of Distributed Energy Resources like wind turbines and solar panels will require a delicate balancing act to match supply with demand without collapsing the grid. With the help of AI software, decentralized energy sources can send any excess electricity they produce to the grid, while utilities direct that power to where it's needed. Similarly, energy storage in industrial facilities, office buildings, homes, and cars can hold excess energy when demand is low, while AI deploys that power when generation is inadequate or impossible Artificial Intelligence will change everything – We personally believe it will bring a new and better future for us. We are already using AI in our work today: the Future Energy Home without AI is not possible. We use data intelligence in Home Energy Management, E-Mobility, Solar, and Heating and comfort solutions. By using strong AI input we can build new business models, test new market approaches through growth hacking methodologies and much more. This is just the beginning. In the future everything will be intelligent and we need to be at the forefront. Artificial Intelligence is proving to be a key component in making our grids more efficient, smarter and able to tackle critical issues in the energy transition. Advanced forecasting methods are enabling our infrastructure to anticipate renewable energy feed-in and explore ways

of increasing the renewable footprint. We can combine machine learning and human evaluation to make it more efficient at less cost to reduce the risk of unemployment. Creative innovative experience in energy sectors "**TO MAKE OUR LIVING WORLD A BETTER PLACE."**

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9: NEW TRENDS AND TECHNOLOGIES FOR RENEWABLE SOURCES OF ENERGY

Suchitra Sahoo, Abhiraj P

K.L.E. Society's S. Nijalingappa college

Abstract

The global energy system has to be transformed. An energy supply system based largely on fossil fuels has to be based on renewable energy. Hence, recently, businesses with scientific research and development focus on nascent technology to solve the global energy crises, and results in innovative approaches for resource exploitation and sustainable disposition to improve energy generation and utilization. The deployment of renewables has been growing at a rapid pace in recent years, reaching record levels and outpacing annual conventional power capacity additions in many regions. Riding on the success of developing renewable energy projects, newer and more innovative technologies are looking to address the need for higher efficiencies, and generation and supply balance between peak and off-peak demands through energy storage and hybrid.Growth in renewable energy must nevertheless greatly accelerate.

Introduction

Around the world, the quantity of individuals lacking admittance to power dropped to 860 million (11% of the populace) in 2018, down from a detailed 1 billion (13%) in 2017. In the meantime, an expected 2.65 billion individuals (35% of the worldwide populace and 44% of the populace in emerging nations) were living without clean cooking offices in 2018, down from 2.7 billion of every 2017 (36% of the worldwide populace and 46% of the populace in non-industrial nations). In an era of accelerating change, the imperative to limit climate change and achieve sustainable growth is strengthening the momentum of the global energy transformation. The rapid decline in renewable energy costs, improving energy efficiency, widespread electrification, increasingly "smart" technologies, continual technological breakthroughs and well-informed policy making all drive this shift, bringing a sustainable energy future within reach. Many governments have strengthened efforts to reduce national emissions in the last years. However, this improvement is not yet reflected in current CO2 emissions which grew by around 1.4% in 2017

Many countries have started to install facilities that use renewable energy sources for power generation. Renewable energy-based mini-grids continued to gain momentum as more projects were developed across Africa and Asia. Countries in Asia – including Afghanistan, Myanmar, India and Nepal – installed the highest numbers of mini-grids in 2019. We expect to see increase

in developing countries, where a sizeable proportion of the population does not have access to electricity.

Solar Photovoltaic Trends

The energy from the sun which is abundant and limitless resource, The amount of solar power intersect only on earth is 173 thousand terawatts, which is 10 thousand times more than the people on earth uses. There are political factors and Businesses which is stopping from completely relying on solar power, leaving that physical challenges which we mainly face is solar energy is unevenly distributed across the planet. Some areas are sunnier than the other and also in consistent. Less solar energy is available during cloudy days or at night. The solar PV industry is changing rapidly, with innovations occurring along the entire value chain. In recent years, a major driver for innovation has been the push for higher efficiency. This is reflected by the development of Passivated emitter and rear cell/contact (PERC) technology, which offers more proficient sunlight, based cells and as such builds the execution of sunlight powered chargers. Expanding cell proficiency is key for cutthroat module producing, as it straight forwardly diminishes cell preparing costs by lessening amounts needed for a given yield.

About 82% of the global PV module production was from Asia in year 2010. It increased to about 92% of total global production in year 2020. The annual production has increased by a factor of 7 in this decade. Installed prices have declined by 5%–7% per year, on average, depending on the system size and the period over which historical data are available. Those price declines, however, have not occurred at a steady pace. Solar system pricing has fallen in all markets, including residential, non-residential, and utility. The decline is largely explained by shrinking hardware costs, oversupply of modules due to increasing production from China, and lockdown-driven decreases in global energy demand.

Wind Power

Wind-based capacities are growing rapidly, propelled by the proven track record and precedence of the previous decade. A number of emerging technologies need to be pioneered and supported. They include examples such as offshore wind. If the world starts working towards the energy transition today, it could achieve substantial emission reductions, including those necessary to keep the rise in average global temperate below 2°C. The installed capacity of wind power in India has increased from 2.2MW in 1990 to more than 38.789 GW in 2021. The country currently has the fourth highest wind installed capacity in the world. The global wind power market expanded 19% in 2019, with around 60 GW of new capacity added to the world’s electric grids (including more than 54 GW onshore and over 6 GW offshore).

The electrostatic wind energy converter (EWICON) in which wind energy is converted to electrical energy by letting the wind move charged particles against the direction of an electric field. In all of the methods, that are used to convert wind energy into electrical energy, some form of mechanical movement occurs, which is the primary reason for maintenance and usually the primary cause of failure. Therefore, a concept in which there is very little mechanical movement would be ideal with respect to system complexity and maintenance costs. This makes the turbine ideal for offshore installations or in the city, for instance on a high rooftop.

Skybrator / Bladeless wind turbine, it generates wind energy from a phenomenon called vortex shedding. Basically, bladeless technology consists of a cylinder fixed vertically with an elastic rod. The turbine is no longer dangerous to bird migration patterns, or wildlife, particularly if used in urban settings. For the people who is living or working nearby, the turbine noise is nearly undetectable by humans. This makes this tech profoundly serious not just against ages of option or environmentally friendly power, however even contrasted with traditional innovations. You can peruse a learn about cost-adequacy for bladeless turbines here.

Hydro Power

Salt is a characteristic asset with an undiscovered energy-creation potential. According to certain appraisals, by the year 2050 renewable energy will be the essential wellspring of power on the planet. However sun oriented energy and wind farms will be enhanced with new force sources that don't depend on climate conditions, for example osmotic force will enable us to exploit the salinity gradient among seawater and fresh water from river outlets in Reverse osmosis. A non permeable layer repulses the negative salt particles permitting just the progression of positive ions that travel to the opposite side to repay the salinity gradient, this converts into a potential difference that produces a voltage. The seas are ready to become one of the fundamental wellsprings of Renewable energy. In this regard wave power is becoming one of the most encouraging examination.

In contrast to wind and photovoltaic force, there is a wide scope of wave power advances. These are probably the most well-known wave energy converters (WECs):

Pelamis (attenuators). A kind of gliding snake—it is named after the ocean snake Pelamis platurus, this innovation involves a progression of chambers connected together that follow the sea surface waves. Its low upkeep is one of its principle benefits.

Salter's duck (eliminators). With a comparative guideline as the Pelamis, this innovation depends on a line of autonomously moving gadgets looking like duck heads, put confronting the waves and joined to the seabed. The waves move each piece, which acts like a cylinder.

wave

For this situation, a stage is laid on the seabed with an air chamber and films on the sides. The waves push the films, driving the air through a channel with a turbine at one of the closures.

Clam (wavering wave flood converters). An upward oscillator appended to a stage on the seabed, in near shore waters. This pivoted light fold moves to and fro with the waves, siphoning water to a hydroelectric plant in the central area.
Wavering water segment (OWC). This innovation is introduced on the beach, leaving an air chamber that gets the waves, which push the air inside and turn a turbine.
To be sure, a portion of these environmentally friendly power advancements could give a steady and effective wellspring of clean force later on, empowering the change to a more maintainable energy model.
The movement of the waves, causes the buoys hanging from a several arms associated with the primary stage to rise and fall then an electric turbine is activated. M wave is another innovation that tackles the dynamic energy of waves but with a design laying on the seabed, the waves push the air inside a bunch of films through a line, moving a turbine in the process. Natural waste is another potential source because of the action of living life forms. While feeding on wastes, microbes discharge electrons that can be utilized to deliver power. Biomass or even coffee waste could hence fuel these force stations, however maybe the future will bring considerably further developed arrangements, for example, harvesting energy from space, out there the sun never sets and orbital solar based force stations could ultimately transfer that energy to any area in the world through electromagnetic waves. All these choices bring us nearer to a fossil fuel free world.

Biomass energy

Biomass is a renewable organic source of energy made from animal and plant wastes. Some examples of biomass are wood, crops, manure etc. The primary issue with supplanting worldwide fuel supplies with bio fuels is that it requires a lot of land and horticultural creation to keep up with those assets. To put it plainly, it would require horticulture rates to twofold, which is difficult to anticipate in case there is sufficient land accessible for biomass cultivation.
Brazil gets the vast majority of their bio fuel energy assets from the sugarcane business as it is plentiful in their country. It has been liable for making occupations and work in the auto and flex-fuel vehicle organizations permitting more shoppers admittance to this new variety of energy. Although the development in utilization of bio fuels has all the earmarks of being stale, they anticipate that the demand should develop over the long haul as longer term speculations are put forth in the attempt to supplant low oil costs.
The most troublesome test in creating bio fuels for the following not many years is the expense for financial feed stocks.

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10: BIODIESEL PRODUCTION FROM SIMAROUBA GLAUCA

Praveena B [1]**Ramya N.,** [2]**Harshitha D**

*Assistant Professor, Department of Chemistry, M.E.S. College of Arts, Commerce and Science, Bengaluru-03

[2, 3]B.Sc. Students, Department of Chemistry, M.E.S. College of Arts, Commerce and Science, Bengaluru-03

Author for Correspondence: Dr. Praveena B

Email: mes.praveenab@mesinstitutions.org.in

Abstract:

The world's expanding industrialisation and motorization has resulted in a sharp increase in demand for petroleum-based fuels. Petroleum-based fuels are restricted in supply. As a result, those countries lacking these resources are experiencing an energy/foreign exchange crisis, owing primarily to crude oil imports. As a result, it is vital to look for new fuels that can be created from local resources, such as alcohol, biodiesel, and vegetable oils. Biodiesel is a renewable, biodegradable, and nontoxic fatty acid alkyl ester that may be made from any edible or non-edible oil through the transesterification process. Efforts are being made all around the world to limit the use of liquid petroleum fuels in every way that is practical. Due of the status of the environment and the depletion of essential resources, biodiesel has recently gained popularity as an alternative for petroleum-based diesel. Simarouba oil methyl ester is a commonly used non-edible biodiesel in India (SOME). This study was conducted to determine the performance and emissions of simarouba biodiesel.

Keywords: Biodiesel, *Simarouba Glauca*, Transesterification,

Introduction:

Simarouba glauca Plant. Sukumaran Anil (2021).

Diesel, the developer of the famous engines that bear his name, showed the use of agriculturally produced seed oil (peanut oil) as a fuel at a world fair over a century ago. Petroleum-based diesel fuels, which became more widely available as a result of government subsidies in the 1920s, gradually phased out the use of these agriculturally generated oils as a fuel **[1]**. Global warming has accelerated in recent decades, owing primarily to the exhaustion of fossil fuel resources for human comfort. With the depletion of petroleum-based diesel, which formerly replaced agriculturally produced oil in engines, the demand for alternatives to petroleum-based fuels is growing **[2].** The popularity of these alternative biofuel is growing not only due to the depletion of fossil fuels, but also because they emit fewer pollutants than traditional fuels and are mostly derived from renewable energy sources. Biofuels are any type of fuel produced mostly from biomass or biological material derived from live or recently living resources **[3].** Biofuels have piqued the interest of the transportation industry because of the potential for rural development, the availability of feedstock, and the fact that, if done correctly, they can be renewable and sustainable. In the recent two decades, biodiesel production and use has grown in popularity **[4].** Because of its source and processing method, biodiesel is classified as a second-generation biofuel. Biodiesel can be made from a variety of renewable natural resources **[5].** Raw processed,or waste materials can be employed, and they can be sourced from a variety of

renewable resources such as plant and animal stocks **[6].** Soybean, sunflower, palm, rapeseed, cottonseed, and *Jatropha curcas* are the most commonly utilized feedstock oils for biodiesel synthesis today. Transesterification, a chemical process, is the most popular method for producing biodiesel **[7]**. The extracted oil is then split down into its constituents. The components of the oil that have qualities similar to ordinary diesel fuel are separated from the rest **[8].** The high viscosity and low volatility of these oils necessitate the transesterification procedure since they cause engine issues **[9].** There are various reasons why I choose *Simarouba glauca* for my research. First, the oil content of *Simarouba glauca* is similar to that of popular oil feedstocks used in biodiesel synthesis, such as *Jatropha curcas. Simarouba glauca,* unlike other oil-bearing crops like soybean or rapeseed, is not widely grown for food, pharmaceuticals, or industry **[10].** *Simarouba glauca,* commonly known as Laxmitaru and maruba in central America, has the ability to reduce the demand for diesel imports. Later, the *Simarouba glauca* plant was discovered in the wasteland of Karnataka, Tamil Nadu, Gujarat, Orissa, and Maharashtra, where its leaves were employed as cancer remedies, its seeds for biodiesel production, and its tree for crafting wood. *Simarouba glauca* has 0.06% FFA (free fatty acids) with a half-year shelf-life, according to India's national oilseeds and vegetable oil development board **[11].** The transesterification technique can be used to create biodiesel from *Simarouba glauca. Simarouba glauca* thrives in semi-arid climates and has the ability to thrive where other economically valuable crops cannot **[12].** Finally, because *Simarouba glauca* is endemic to South Florida, South America, and Central America, any noteworthy findings from my thesis research can help inform ongoing and future research and development on this feedstock in these areas **[13]**.

THE USE OF VEGETABLE OIL AS AN ALTERNATIVE TO CONVENTIONAL DIESEL FUEL

For several years, many researchers have agreed that vegetable oil might be used as an alternative to conventional fuels in these engines. Many studies have shown that under normal conditions, vegetable oil can be utilised to fuel a diesel-powder engine **[14]**. For example, they ran a tractor for a few hours on sunflower seed oil **[15]**, and another example showed that rapeseed oil had a similar energy output to diesel **[16]**. However, later research has shown that using vegetable oil has drawbacks, such as heavy wax and gum deposits in diesel engines and

carbon build up in the combustion chamber with sunflower oil **[17]**. Carbon deposits on piston rings, valves, and injectors were said to cause problems in engines running on rapeseed oil **[18]**. An even more viable study facilitating the use of vegetable oil looked at several physicochemical properties of various oils and discovered that carbon deposits were reduced when the oil was heated prior to combustion, and that carbon deposits were a function of oil composition, such as high viscosity **[19]**. Vegetable oil used with standard diesel fuel in various quantities has been shown in studies to reduce deposits and improve engine life **[20]**. Evaluators commonly mixed diesel with a range of oils, such as peanut, sunflower, rapeseed, and palm oil, in a mid-ratio **[21]**. It discovered that running the engines on a blend of vegetable oil and diesel had no immediate negative effects and had long-term lifecycle impacts similar to those shown in engines running on pure diesel. However, in many of the trials, the percentage of biodiesel in the blends was a significant variable; blends with a higher ratio of vegetable oil to diesel resulted in increased carbon deposits. The rise in carbon deposits could be a result of unusual atomization and injection properties, which are likely due to the high viscosity and low volatility of vegetable oils, according to studies on blending vegetable oil with conventional diesel fuel **[22]**.

The development of biodiesel from vegetable oil

Vegetable oil has the capability to be used as a diesel substitute; however it has drawbacks such as high viscosity, low volatility, poor cold flow characteristics, and carbon build-up in engines **[23]**. The disadvantages have prompted the exploration into several fuel derivatives, with biodiesel appearing to be the most popular. The National Soy Diesel Development Board, currently known as the National Biodiesel Board, was a pioneer in the commercialization of biodiesel in the United States, and introduced the term biodiesel to the mainstream in 1992. Biodiesel is defined chemically as mono alkyl esters of long chain fatty acids derived from a renewable resource or lipid. Lipids or oils, also known as triglycerides, are water insoluble, hydrophobic compounds made up of one mole of glycerol and three moles of fatty acids **[24]**. Triglycerides make up 90-98 percent of the oil's composition. The fatty acid composition of oil and fats produced and computed from various sources varies. The length of the carbon chain and the number of bonds present in fatty acids differ. Stearic, palmitic, oleic, linoleic, and linolenic acids are the most prevalent fatty acids found in vegetable oil. Stearic, palmitic, and dihydroxy

stearic fatty acids are frequent, as are oleic, linoleic, ricinolein, palmitoleic, and linolenic unsaturated fats **[25]**.

The fatty acid makeup of the feedstock oil has a significant impact on biodiesel characteristics **[26]**. As a result, the fatty acid profile of vegetable oils used to make biodiesel is a significant consideration. Biodiesel made from vegetable oils containing specific fatty acids is considered to have more properties in common with conventional fuels **[27]**. It's crucial to understand the ratio of unsaturated to saturated fatty acids, for example, because oil with more saturated fatty acids than unsaturated fatty acids is usually more viscous **[28]**. Oil containing more unsaturated fatty acids, on the other hand, is less viscous and has a greater cloud point and pour point. The fatty acid composition of the feedstock oil can also influence the duration of storage; for example, unsaturated fatty compounds have been demonstrated to have a significant impact on the long-term oxidative stability of biodiesels **[29]**.

Transesterification

Pyrolysis, micro emulsification, and transesterification are the three most common methods for producing biodiesel. Transesterification, on the other hand, has been shown to be the simplest and most efficient method of producing biodiesel. Transesterification is the process of converting free fatty acids and triglycerides into fatty acid esters and glycerine **[30]**. Because of its reversible nature, the transesterification process for biodiesel is the reversible sequential stepwise organic reaction of a triglyceride with an alcohol to produce glycerol and esters, where an excess of alcohol pushes the reaction towards the creation of esters. In other words, triglycerides are transformed from diglycerides to monoglycerides and ultimately glycerol throughout the transesterification process, with each step releasing or freeing a mole of ester **[31]**.

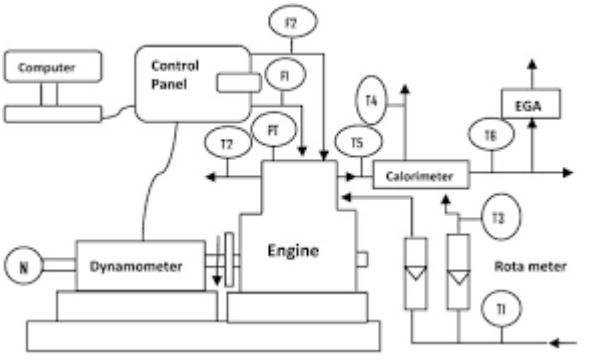
Edible oil feedstock transition into nonedible oil feedstock

There has recently been discussion about the harmful effects of biodiesel production. Biodiesel manufacturing using agricultural feedstock is causing deforestation and ecological degradation, according to environmentalists, while economists claim that the line between food and fuel economies is blurring as both sectors fight for the same oil supplies. While the output of vegetable oil continues to rise around the world, the amount of vegetable oil stocks continues to fall. The manufacturing of biodiesel has been a major reason for the decline of vegetable ending stock **[32]**.

Soybean, sunflower, palm, rapeseed, canola, cotton seed, and Jatropha are the most frequent types of feedstock vegetable oil used in biodiesel manufacturing around the world. The majority of these oils are considered edible. Soybean oil is the most popular biodiesel feedstock in the United States, whereas rapeseed oil is the most frequent in Europe and palm oil is the most common in tropical countries. As a result, it's safe to assume that the most common biodiesel feedstock is edible. Unlike the United States and Europe, India is not self-sufficient in edible oil production; it has been a significant importer of edible oil since 1965, when demand for edible oil began to surpass the country's supply of oilseeds and oils **[33]**. Low production cost and big production scale are two important factors to consider when choosing a feedstock. As a result, feedstock for biodiesel production should not compete with other applications such as food or pharmaceutical manufacture, as this would raise the price of raw materials for everyone, which is one of the major issues with present feedstock oils.

Non-edible oilseed crops are one type of feedstock that is showing promise because of its low production cost and the fact that it causes little to no conflict between food and energy. Non-edible vegetable oils have comparable oil content to edible oils, but they contain hazardous properties or have an unpleasant flavour. As previously said, oil composition is one of the most essential considerations when choosing a feedstock oil for biodiesel production. The biodiesel mentioned in this review is a mixture of fatty acid methyl esters (FAME) made from *Simarouba glauca* **[34]**.

***Simarouba glauca* in production of biofuel:**



*Simarouba glauca*biodiesel blends (S.R.Mishraet al. 2018).

Simarouba glauca is commonly cultivated in South and Central America, as well as India. The seed oil is the most economically valuable portion of the plant. The oil content of the Simarouba

seed ranges from 55 to 65 percent. The oil has a wide range of industrial applications, including the capacity to be converted into fat or margarine **[35]**. The pulp of the fruits is semi-sweet and excellent for consumption or use in beverages. Manure can be obtained from leaf litter and seed cake. Finally, the bark and leaves have been reported to have medical properties, and *Simarouba glauca* has been the subject of at least one patent application. It is popular because all of the tree's parts can be used in various operations **[36]**. Around 200 trees may be cultivated on one hectare of land. While the tree begins to produce seeds at around four to six years of age, and the tree begins to fruit at a young age, some plantations have not reached their full capacity of about 20kg-50kg of seed until the tenth year **[37]**. According to estimates, a one-hectare *Simarouba glauca* plantation can produce over 6000kg of seeds, enough to produce over a tonne of oil. With the exception of Oil Palm, which produces roughly 5 tonnes per hectare, the predicted output compares favourably to actual feedstock yields **[38]**? Table 1 gives a good comparison of *S. glauca* with other popular feedstock used for the production of biodiesel.

Table 1: Comparison of oil yields between common oilseed crop

Type of oil	Oil yield (kg oil/ha)	Oil yield (wt%)
Simarouba glauca	>100	55-65 (seed kernel)
Jatropha curcas	1590	50-60 (seed kernel)
Soybean	375	20
Oil palm	5000	20

In 1961, *Simarouba glauca* was introduced to India from El Salvador, and it has since been planted all over the country. It has demonstrated a wide range of adaptability to a variety of soil and climate conditions, as well as other desired characteristics such as drought tolerance, non-browsing by animals, and speedy shock recovery **[39]**. Furthermore, researchers have found that the fatty acid composition of seeds from different countries is not significantly different. The major fatty acid composition for *Simarouba glauca* is 52-54 percent oleic acid, 27-33 percent

stearic acid, and 11-12 percent palmitic acid, a composition that is very similar to that of several feedstocks already in use, such as *Jatropha curcas* and soybean **[40]**.

Comparison of Simarouba glaucaBiodisiel withSimarouba glaucaOil. [41]

PROPERTIES	***S.glauca* biodiesel**	***S.glauca* Oil**
Acid Value (mg KOH/g)	0.24905	2.2465
Viscosity at 40C (mm2/s)	12.609	60.535
Calorification (MJ/kg)	32.143	
Saponification	179.561	185.9317
Density	867	
Cloud Point (Celsius)	18	Room Temperature
Pour Point (Celsius)	15	
Iodine Number	56.03	54.28
Flash Point (Celsius)	160	
Ash Content (%)	0.00485	

Cautionary case of *Jatropha curcas*

In the early 1990s, there was a strong push to produce *Jatropha curcas*, a non-edible oil-bearing seed that, like Simarouba glauca, had a lot of potential for producing energy from marginal land without a lot of inputs. Many of these plantations, however, have been abandoned due to low productivity and/or higher labour costs than anticipated **[42]**. This sparked a scientific effort to learn more about *Jatropha curcas* potential yield under sub-optimal and marginal conditions, as well as study into additional positive features *Jatropha curcas* may have. The instance of

Jatropha curcas should serve as a warning lesson for any new feedstock used in biodiesel production **[43]**.

The amount of water and nutrients needed to create a high yield of seeds and oil use, root area required for proper growth, and output of plantations built on marginal soils are just a few of the fallacies linked with the *Jatropha curcas* boom **[44]**. While *Jatropha curcas* has high drought tolerance mechanisms, studies suggest that if given the opportunity, it would need a lot of water for growth, and there are only a few studies that show *Jatropha curcas* can generate a good oil output under drought conditions. Paradoxically, the majority of beneficial applications are typically found in semiarid and arid environments, which are the most analogous to its natural environment **[45]**. Furthermore, positive properties of *Jatropha curcas* can be enhanced with the right number of additives, and small-scale farming in rural regions shows potential. As with *Jatropha curcas*, much more research is needed before *Simarouba glauca* can be recommended as a feedstock for biodiesel synthesis without fear of failure **[46]**.

Conclusion

In latest days, studies have concentrated on the challenges associated with using vegetable oil as a diesel engine fuel and how they might be minimised, leading to the development of biodiesel and other fuels derived from their derivatives. Biodiesel [14] is defined as the mono alkyl esters of long chain fatty acids generated from a sustainable source. The amount of original oil in the feedstock has a big impact on the biodiesel quality. The most prevalent technique of producing biodiesel is transesterification, which involves utilising an alcohol and a catalyst to convert free fatty acids and triglycerides into fatty acid esters and glycerin.

Unlike other major biodiesel feedstocks such as soybean or rapeseed, *Simarouba glauca* is not widely produced for food, pharmaceuticals, or industry. *Simarouba glauca* grows well in semi-arid environments and can survive where other economically valued crops cannot. As a result, it would face little to no competition for food production from land. Finally, because Simarouba glauca is endemic to South Florida, South America, and Central America, any significant findings from my thesis research in India may be valuable in future research in these regions. To strengthen the system's ecological integrity, the UAS is using a community small-scale production model that takes advantage of the synergistic potential of many sectors of agriculture.

They are taking use of this synergy by cycling nutrients and energy using crops grown locally to meet the requirements of the community. According to the scientific community, small-scale biofuel production technologies have a variety of on-farm benefits as well as the potential for community development. Comparatively tiny biofuel production techniques have shown to be extremely beneficial in locations where petroleum fuels are expensive and scarce. By giving power to areas who could not otherwise afford it, these manufacturing techniques have the potential to boost sustainable development and alleviate poverty in places like India. Small-scale biofuel production has also been proposed as a way to promote farm markets, raise agricultural output, and minimise dangerous pollutants released into the atmosphere in developing countries. However, there are still a number of issues with small-scale biodiesel manufacturing.

Whilst *Simarouba glauca* shows promise as a feedstock for small-scale biodiesel production in India, the cautionary example of *Jatropha curcas* should not be forgotten. Despite the negative press, *Jatropha curcas* plantations are regaining popularity on a small scale. However, it's important to highlight what happened to the crop, signalling that much more research is needed before *Simarouba glauca* can be recommended as a biodiesel feedstock.

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11. PUBLIC ATTITUDE TOWARDS EDUCATION AND AWARENESS ON SUSTAINABLE DEVELOPMENT

K.L.E. S.NIJALINGAPPA COLLEGE, RAJAJINAGAR, BANGALORE – 560010 Authors: Mangala Gowri.SA, Jayapriya.S, Vidyashree.MS, Kavyasri.PS, Tanushree.BM.

ABSTRACT

Renewable energy projects in many developing countries have demonstrated that renewable energy can directly contribute to poverty reduction by providing the energy needed for creating business and employment. Renewable energy technology can also make indirect contribution to alleviating poverty by providing energy for cooking, space heating, and lighting. Renewable energy can also contribute to education, by providing electricity to schools. The use of renewable energy source is rapidly increasing as alternatives to conventional sources. Public attitude towards renewable energy sources has positively changed in recent years. The desire for attaining sustainable development through the use of renewable resources for decreasing pollutions, trying to decrease dependency on imported fuels or to exploit the locally available renewable resources. Partially it is believed that due to lack of awareness and adequate manpower qualifications in these sources at the different levels. Energy education in many countries is still not so dynamic to coup with the ever changing circumstances and developments. A survey has been conducted on the public awareness on the renewable resources of energy. This study presents an assessment of public awareness, acceptance, and attitude towards renewable energy. The aims of the study were to identify and explore public awareness renewable energy based on the respondent's educational level and area of residence.

Keywords: Education, Conventional energy, Public awareness, Development.

INTRODUCTION

Sustainable use is a widely accepted goal for renewable source management. It meets the needs of the present without compromising the ability of future generations to meet their needs. Renewable energy is useful that is collected from renewable resources, which are naturally replenished on a human timescale, including carbon neutral sources like sunlight, wind, rain, tides, waves, and geothermal heat.[1] Renewable energy often provides energy in four important areas: electricity generation , air and water heating /cooling, transportation energy services.

Renewable energy sources are practically infinite in quantity, environmentally friendly, and have the potential of involving people at the local level. Solar, wind and bioenergy sources are now a days prominent ways of satisfying the demands of households in rural as well as urban

communities dependent on the use of traditional fossil fuels .

Solar energy

 [2]

Solar energy is radiant light and heat from the Sun that is harnessed using a range of technologies such as solar water heating , photovoltaics , solar thermal energy, solar architecture , molten salt power plants and artificial photosynthesis .

India is endowed with vast solar energy potential. About 5000 trillion kWh per year energy is incident over India's land area with most parts receiving 4-7 kWh per square meter per day. Recently, India achieved 5th global position in solar power development by surpassing Italy. Solar power capacity has increased by more than 11 times in the last 5 years. In order to achieve the above target, government of India have launched various schemes in the country like solar park schemes, VGF schemes, CPSU schemes, defense s cheme, bundling scheme, grid connected solar roof top schemes etc.,

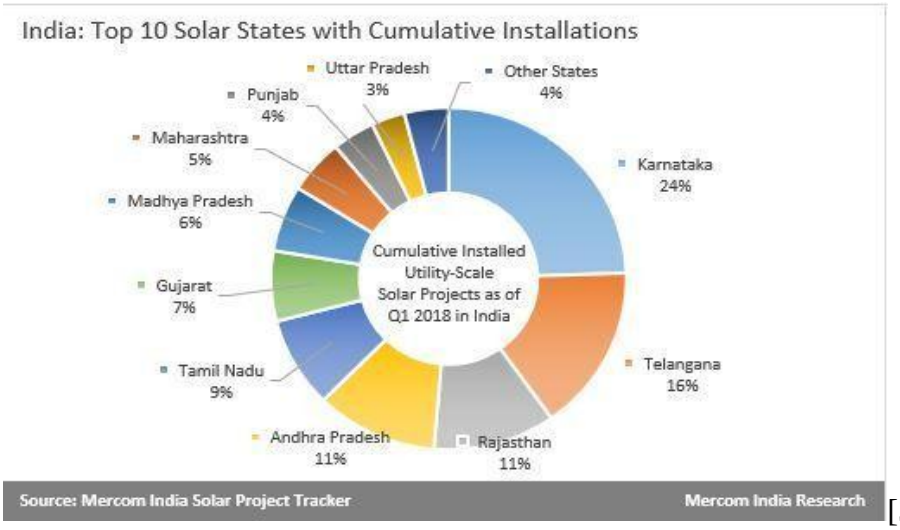

[3]

Fig 3: Cumulative installations of solar projects in different states of India.

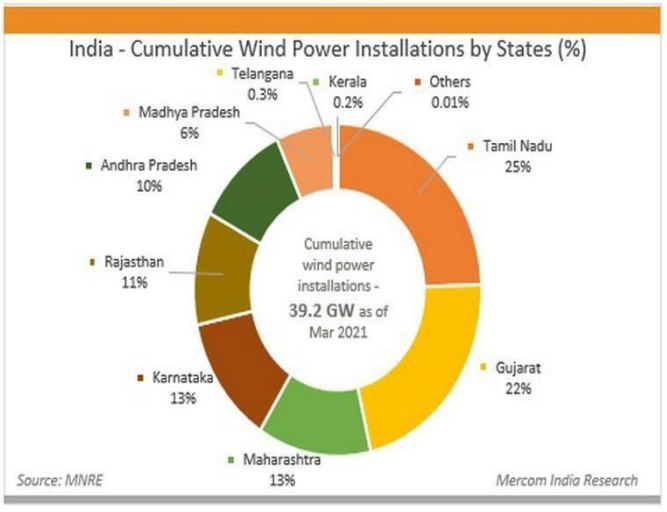
2. Wind energy

 [4]

Wind power or **wind energy** is the use of wind to provide mechanical power through wind turbines to turn electric generators for electrical power. Wind power is a popular sustainable, renewable energy source that has a much smaller impact on the environment compared to burning fossil fuels.

Wind power generation capacity in India has significantly increased in recent years. The expansion of wind industry has resulted in a strong ecosystem, project operation capabilities and manufacturing base of about 10,000MW per annum. As of 28 February 2021, the total installed wind power capacity was 38.789 GW, the fourth largest installed wind power capacity in the world. Wind power capacity is mainly spread across the Southern, Western and Northern regions.

The government is promoting wind power projects in entire country through private sector investment by providing various fiscal and financial incentives such as accelerated depreciation benefit such that concessional custom duty exemption on certain components of wind electric generators. Besides, Generation Based Incentive [GBI] scheme was available for the wind projects.



[5]

Fig 5: This chart represents the wind power installations in the different states of India

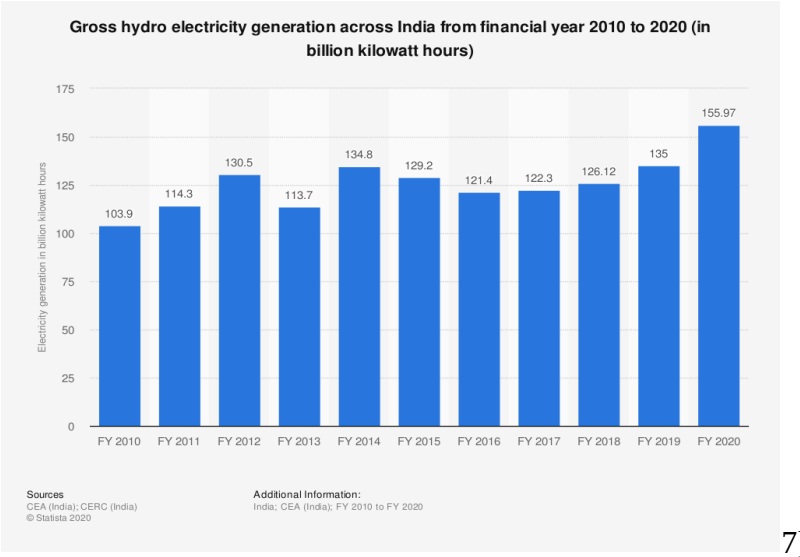
3. Hydropower energy

 [6]

Hydropower, also known as **water power**, is the use of falling or fast-running water to produce electricity or to power machines. This is achieved by converting the gravitational potential or kinetic energy of a water source to produce power.[1] Hydropower is a method of sustainable energy production.

India is blessed with immense amount of hydroelectric potential and rank 5th in terms of exploitable hydro-potential on global scenario. As per assessment made by CEA, India is endowed with economically exploitable hydropower potential to the tune of 1, 48,700 MW of installed capacity.

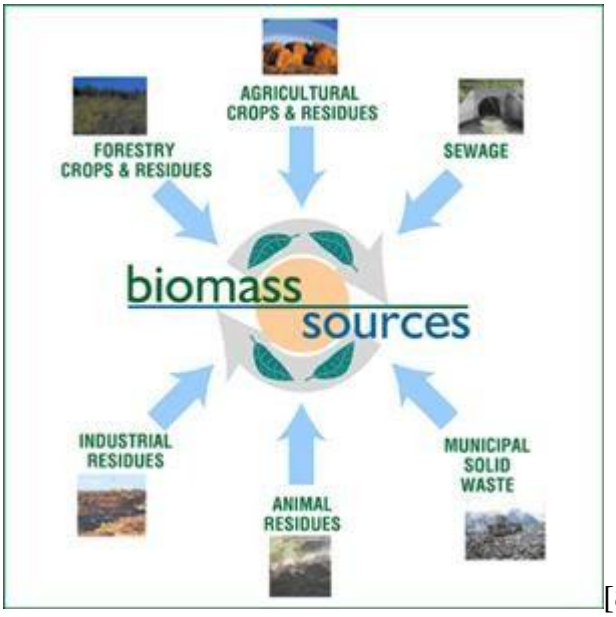
In 1998, Government of India announced "Hydro Power Development "under which impetus is given to development of hydropower in the country. In totally India is endowed with hydro-potential of about 2,50,000 MW .



7]

Fig 7: Gross hydroelectricity generation in India

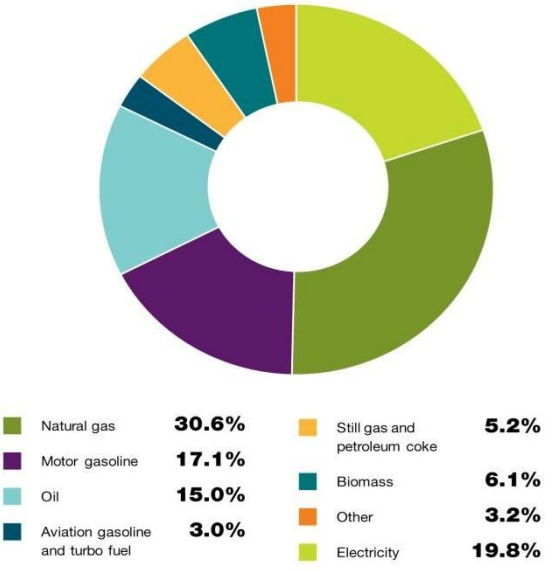
4. Biomass



[8]

Biomass has always been an important energy source for the country considering the benefits it offers. It is renewable, widely available, carbon neutral and has the potential to provide significant employment in rural areas. Biomass is also capable of providing firm energy. About 32% of the total primary energy used in the country is still derived from the biomass and more than 70% of the country's population depends upon it for its energy needs.

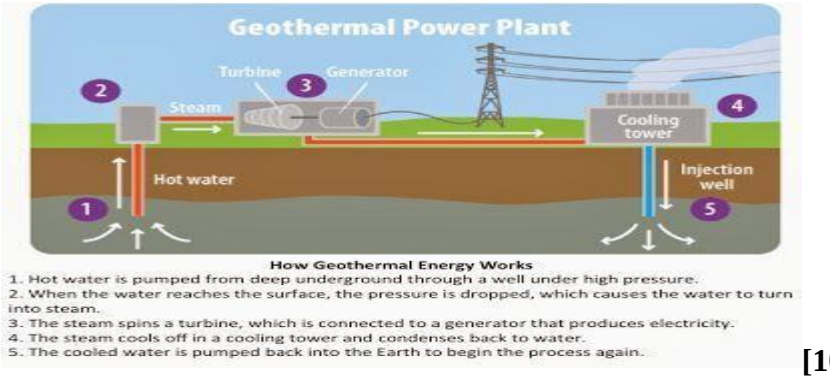
As per a recent study sponsored by Ministry of New and Renewable Energy [MNRE], the current availability of biomass in India is estimated about 750 million metric tonnes per year. The study indicated estimated surplus biomass availability at about 230 million metric tonnes perannum covering agricultural residues corresponding to a potential of about 28 GW.



[9]

Fig 9:This pie chart shows the use of biomass with comparissson with the other sources of energy and electricity

5. Geothermal energy



[10]

Geothermal energy is the energy contained as heat in the Earth's interior. These overview describes the internal structure of the earth together with the heat transfer mechanisms inside mantle and crust. It also shows the location of geothermal fields on specific areas of the earth.

The Earth's heat flow and geothermal gradient are defined, as well as the types of geothermal fields, the geologic environment of geothermal energy, and the methods of exploration for geothermal resources including drilling and resource assessment.

Recent technological advances have dramatically reduced costs and there by exanded the range and the size of weighable resource and in 2021 the US. Department of energy estimates that geothermal energy from a power plant" built today" costs about $0.05kWh. Geothermal energyhas provided commercial base- load electricity around the world for more than a century.

Conclusion

Renewable energy has a direct relationship with sustainable development through its impact on human development and economic development. The study brought the opportunities to light associated with renewable energy sources, energy security, energy access, social and economic development and climate change mitigation and reduction of environmental and health impacts . There are challenges that tend to hinder the sustainability of renewable energy sources and its ability to mitigate climate change.

As India is a developing country most of the people would not be aware of renewable resource of energy. To educate the people we can give awareness in the schools and colleges about renewable energy sources and for the working class people can be educated in the company, offices or in their work place and due to implementation of renewable energy unemployment and poverty can be lifted up.

People awareness plays a crucial role in implementing these renewable energy resources uses in everyday life. But educating it to the public is crucial. Implementation of schemes does not bring awareness themselves. Hence necessary procedures need to be done. Publicity improves the use among the people and hence renewable resources use increases drastically.

Even though India has achieved a fast and remarkable economic growth, energy is still scarce. Strong economic growth in India is escalating the demand for energy, and more energy sources are required to cover this demand. At the same time, due to the increasing population and environmental deterioration, the country faces the challenge of sustainable development. The gap between demand and supply of power is expected to rise in the future.

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12: PUBLIC AWARENESS AND EDUCATION FOR RENEWABLE SOURCE OF ENERGYRENEWABLE ENERGY: A GIFT OF NATURE

Abhinavya.U.K and Shraddha.S*

K.L.E's. S. Nijalingappa college

Abstract

Energy plays a vital role for the survival of mankind. Any kind of activity such as physical, chemical or mechanical needs energy to be completed. Amongst all the other kinds of energy the most efficient and sustainable is the renewable source of energy since these are available abundant in nature and inexhaustible.

There are numerous rural areas in the world which lacks basic amenities. Lower income is quite common in these kinds of remote areas. Hence to overcome this inadequacy of comfortable life, the source of renewable energy would be effective in the perspective of lending employment opportunities or directly supplying the basic facilities. Therefore it becomes too important to educate the public and create awareness about about the utility and advantages of this precious gift of nature.

Key words: - Awareness, Educating, Sustainable, Inexhaustible, Quality of life

Introduction

Renewable source of energy can be used as an important tool for the better lifestyle and modernization. The standard of living of not only rural people but also the urban people will also be improvised with these energy resources. This renewable source of energy includes naturally available solar energy, wind energy, geothermal energy, tidal energy, bioenergy etc.

Often people may not realize the advantages which will be available from our surroundings and spend huge amount of capital looking for a beneficial and comfortable life. These energies can also be utilized without maximum hazards or any kind of pollution to the environment.

Government has taken a step forward and introduced many kinds of technologies and practices which include people's involvement to ensure a better quality of life.

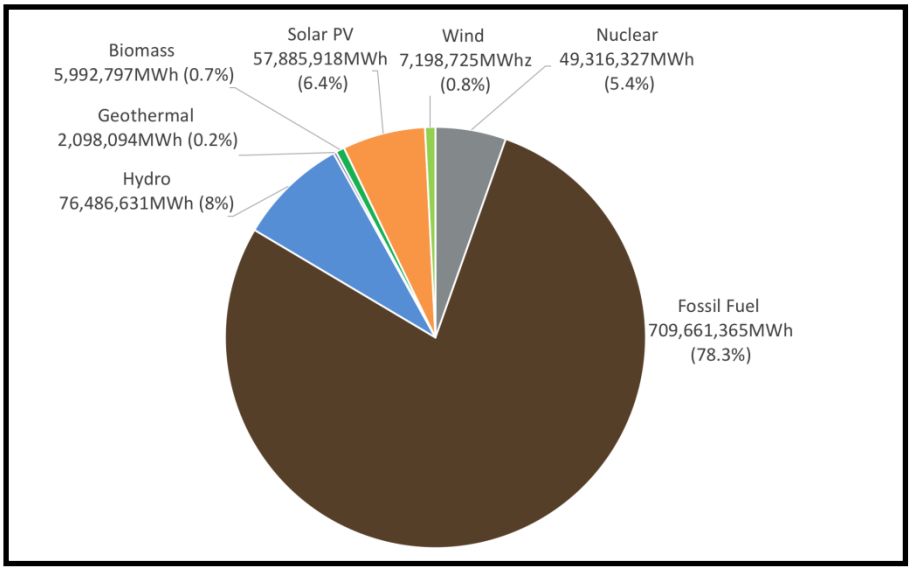


Fig (a) - Figure showing ratio of renewable sources used in the year 2018

USAGES AND IMPLEMENTATIONS OF RENEWABLE ENERGY SOURCES

"The nation that leads in a renewable energy will be the nation that leads the world"

-James Cameron

World just cannot rely only on the sources alternative energies, since their expenses have just reached the sky above, so the renewable resources are those kinds, which will be productive as well as cost effective.

Renewable energy facilitates the use of never ending, inexhaustible energy sources, which will be contributing factor for the developing countries especially for the village areas. Along with many other countries India has also taken a very serious note on developing and utilising these renewable resources by appointment of separate council of ministry named as Ministry of Non-conventional Energy Resources (MNRE)[1]

Renewable energy sources have many prospects in various ways. The most profuse one amongst them is the solar energy

- Solar energy- It can be used both in the form of radiation and heat energy. Significantly used in the photo- voltaic cell which helps in the production of electricity using the radiation. Other applications include solar water heaters, solar cookers, other agricultural uses comprises of solar crop driers and many more, which would be of greater assistance to rural people [2]
- Wind energy - Another natural and most essential source is wind energy, which helps in generation of electricity power supply, obtaining underground water through wind mills. It is said that the world's fastest growing energy source
- Falling water- Falling of water with greater velocity helps in electricity generation by hydroelectric power stations and it also helps in running power machines.
- Biomass - the fermentation process occurring through the living organisms is utilised in the production of biogas which can be used instead of LPG. It could also be efficient in the production of alcohols. It Als has its applications in the water treatment of aquaculture.
- Geothermal energy- This energy can be basically derived by the earth's inside temperature by means of hot springs, dry streams etc . This would be commercially used for power supply and heat pumps. Hot water can also be used for the industrial purposes.
- Hydrogen and fuel cells - Hydrogen can be extracted from the renewable energy sources like splitting up of water or by the solar energy and could be used for the non-emission vehicles and also for the production of electricity.

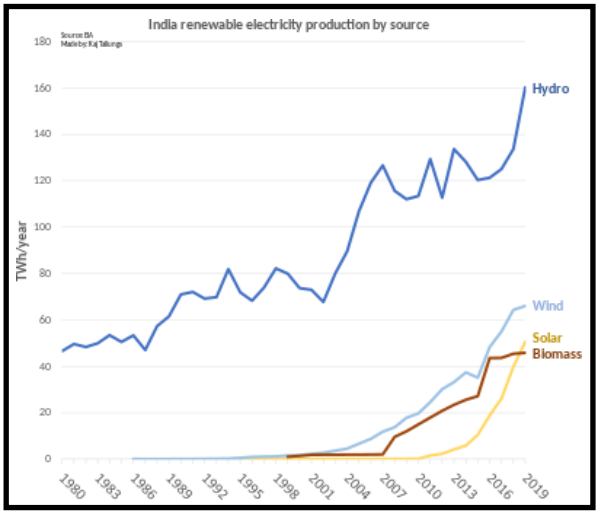


Fig (b) - Graph showing electricity produced by renewable source of energy in India

ACKNOWLEDGEMENT OF RENEWABLES TO PUBLIC

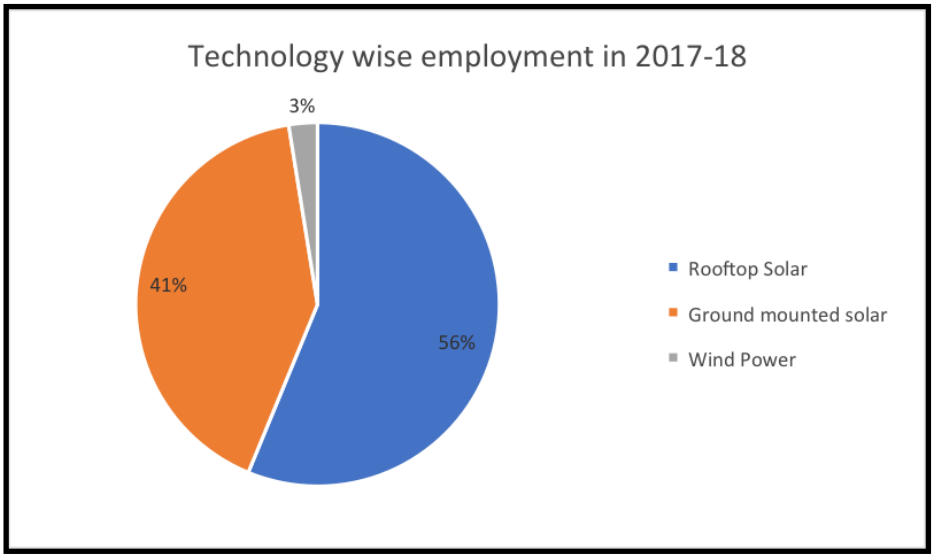
In order to achieve all the innumerable advantages of these energy sources various technologies and programmes have been designed and it becomes equally important that it must reach out the common people so that they can take its full convenience.

- India has made it possible by its most reputed TATA energy research institute , which serves renewable technology support to manufacturers, enabling the quality as well.
- Many projects based on this interest have been put forward by the Renewable Energy Development Agency (IRDA) [3]
- Till today we have been successful in the installation of 32 million modern cook stoves , 500000 solar hot water systems, 57 megawatts of photovoltaic installations, 1920 kilowatts of electric power systems, 1167 megawatts of wind farms and 34.36 megawatts of biomass gasifier electric systems. [4]
- Brazil has been efficient in production of ethanol from the energy crops of sugar and used in vehicles, thus reducing need of its oil imports[5]

Furthermore advancements in the field of Renewable energy sources can be made with the interests of public. However, they must be first and foremost made to understand the need of these sources instead of other alternatives. So educating the people about the contributions of renewable energies becomes crucial.

- There must be campaign about these renewables, which does not cause harm for environment as well as beneficial as much as alternatives.
- Government encouraging programmes must be conducted to promote these resources.
- The Non-GovernmentalOrganizations (NGO) and other private organizations must aim at educating public about its usages, its functions, their reasonable budget and modernization of the world with the help of these sources.
- Encouragement for the involvement of the public in the projects based on these renewables.
- Motivating common folks of the remote areas by the street dramas or skits.

- Providing employment opportunities for them at various technical assistance could be helpful in developing and underdeveloped countries.



Fig(c) - pie chart showing jobs created based on renewable source of energy

- Workshops, seminars, conferences help a lot among the individuals at urban level for the better perception of the renewables.
- Social media awareness is the modern and effect key for the widespread of the benefits of these inexhaustible sources.
- Various incentives and recognitions should be given for those people who practice the act of utilizing renewable sources in their houses.
- In certain small towns or villages, people do not believe in contributing towards these projects due to their low income, their sense of fear must be cleared and the projects must be undertaken with special care and well guidance in such type of places.

- Public must be made aware of the fact that despite of having numerous environmental issues, the other alternate sources like fossil fuels also have perilous effects on human health as well , which is least or absolutely no ill effects about renewable sources.
- Recycling has already been incorporated in the minds of people; it has to be even more advanced for the better world.

Conclusion

Since we have innumerable advantages of these sources, we have got to make use of it in a very efficient and a productive way in various sectors such as domestic, agricultural , industrial etc as these energies are inexhaustible and easily replenishable they are a kind of most valuable asset for us. Yes there are certain limitations for these kinds of energies but we could united work for the furthermore development towards the progress of these energy resources which in turn results in the progress of our nation. Henceforth it is the duty for each and every individual to use in the instructed way and make the best use if this abundant and precious renewable source of energy. For this to happen primarily public had to be educated and made aware for choosing the natural energy instead of other alternatives which is the utmost responsibility as the citizens of our nation.

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13: RENEWABLE SOURCES OF ENERGY FOR GLOBAL SUSTAINABLE ENVIRONMENT

Nalina S*, Vidyashri R#, Monisha K#, Neha M#

KLE's S Nijalingappa College, Rajajinagar, Bengaluru – 560010, Karnataka, India.

Abstract

The world is an interconnected system with linked supply chains with increasing daily requirement of energy by all populations across the world while the earth in its form cannot change. The stress on limited natural resources of earth to satisfy human social and economic development, welfare and health is increasing thus reducing its biocapacity. Increased use of renewable resources that act as alternatives to limited and scarce natural resources to help mitigate climate change is an excellent approach which needs to be sustainable in order to meet energy demand of future generations. Currently 80 % of global energy and 66% of electrical generation are supplied from fossil fuels contributing approximately 60% of greenhouse gas emission responsible for climate change. Transition to cleaner energy has already began in many countries in line with sustainable development goal 7 affordable and clean energy and Paris climate deal yet renewable energy and energy efficiency technology face competition with highly subsidised carbon intensive energy technologies renewable energies could be deployed more rapidly if energy policies addressed both subsidies and impacts of fossil fuel a majority of the communities around the world rely heavily on oil, natural gas and coal for their energy needs. These fuels draw on lots of resources that will eventually diminish, which in turn makes them too expensive or too environmentally damaging to recover[1] This review article discusses the advantages and disadvantages of renewable energies; therefore based on the benefits of these energy resources, the use of renewable energies, instead of, fossil fuels will be a good solution for the control of the environmental, social and economic problems of our communities. The study suggested some measures and policy recommendations which when considered would help achieve the goal of renewable energy thus to reduce emissions, mitigate climate change and provide a clean environment as well as clean energy for all and future generations. The environment provides a series of renewable and non-renewable energy sources i.e., solar, wind, hydropower, geothermal, biofuels, natural gas, coal, petroleum, uranium. Increased use of fossil fuels without actions to mitigate greenhouse gases will have global climate change implications

Introduction

An energy source is a necessary element of socio-economic development. The increasing economic growth of developing nations in the last decades has caused an accelerated increase in energy consumption. This trend is anticipated to grow. A prediction of future power consumption is essential for the investigation of adequate environmental and economic policies. On outlook to future power consumption helps to determine future investments in renewable energy. Energy supply and security have not only increased the essential issues for the development of human society but also for their global political and economic patterns. The world is fast becoming an interconnected system of supply chain with increasing daily requirement of energy by all populations across the world with scarce natural resources available. It highlights the need for a shift towards renewable resources with the need for energy and its related services to satisfy human social and economic development, welfare and health is increasing. All societies call for the services of energy to meet basic human needs such as: health, lighting, cooking, space comfort, mobility and communication and serve as generative processes. Securing energy supply and curbing energy contribution to climate change are the two-overriding challenges of the energy sector on the road to a sustainable future. It is overwhelming to know in today's world that 1.4 billion people lack access to electricity, while 85% of them live in rural areas. As a result of this, the number of rural communities relying on the traditional use of biomass is projected to rise from 2.7 billion today to 2.8 billion in 2030).

The dominance of fossil fuel-based power generation (Coal, Oil and Gas) and an exponential increase in population for the past decades have led to a growing demand for energy resulting in global challenges associated with a rapid growth in carbon dioxide (CO_2) emissions. A significant climate change has become one of the greatest challenges of the twenty-first century. Its grave impacts may still be avoided if efforts are made to transform current energy systems. Renewable energy sources hold the key potential to displace greenhouse gas emissions from fossil fuel-based power generating and thereby mitigating climate change

Sustainable development has become the centre of recent national policies, strategies and development plans of many countries. The United Nations General Assembly proposed a set of global Sustainable Development Goals (SDGs) which included 17 goals and 169 targets at the UN in New York by the Open Working Group. In addition, a preliminary set of 330 indicators was introduced in March 2015. The SDGs place greater value and demands on the scientific community than did the Millennium Development Goals. In addressing climate change, renewable energy, food, health and water provision requires a coordinated global monitoring and modelling of many factors which are socially, economically and environmentally oriented

Energy sources with alternatives in renewable energy sources. The recent launch of a set of global SDGs is helping to make sure that climate change for twenty-first century and its impacts are combated, and a sustainable future is ensured and made as a bequest for future generations.

Against this backdrop, the study seeks to examine the potentials and trends of sustainable development with renewable energy sources and climate change mitigation, the extent to which it can help and the potential challenges it poses and how a shift from fossil to renewable energy sources is a sure way of mitigating climate change.

Renewable energy sources and sustainability

Renewable energy sources replenish themselves naturally without being depleted in the earth; they include bioenergy, hydropower, geothermal energy, solar energy, wind energy and ocean (tide and wave) energy

Sustainable energy can be defined as, "a dynamic harmony between the equitable availability of energy-intensive goods and services to all people and preservation of the earth for future generations".

The world's growing energy need, alongside increasing population led to the continual use of fossil fuel-based energy sources (Coal, Oil and Gas) which became problematic by creating several challenges such as: depletion of fossil fuel reserves, greenhouse gas emissions and reduced bio capacity of earth other environmental concerns, geopolitical and military conflicts, and the continual fuel price fluctuations. These problems will create unsustainable situations which will eventually result in potentially irreversible threat to human societies (UNFCC, 2015). Notwithstanding, renewable energy sources are the most outstanding alternative and the only solution to the growing challenges (Tiwari & Mishra, 2011). Reliable energy supply is essential in all economies for heating, lighting, industrial equipment, transport, etc . Renewable energy supplies reduce the emission of greenhouse gases significantly if replaced with fossil fuels. Since renewable energy supplies are obtained naturally from on going flows of energy in our surroundings, it should be sustainable. For renewable energy to be sustainable, it must be limitless and provide non-harmful delivery of environmental goods and services. For instance, a sustainable biofuel should not increase the net CO_2 emissions, should not unfavourably affect food security, nor threaten biodiversity.

In spite of the outstanding advantages of renewable energy sources, certain shortcoming exists such as: the discontinuity of generation due to seasonal variations as most renewable energy resources is climate-dependent, that is why its exploitation requires complex design, planning and control optimization methods. Fortunately, the continuous technological advances in computer hardware and software are permitting scientific researchers to handle these optimization difficulties using computational resources applicable to the renewable and sustainable energy field.

Renewable energy sources and technology

Renewable energy sources are energy sources from natural and persistent flow of energy happening in our immediate environment. They include: bioenergy, direct solar energy, geothermal energy, hydropower, wind and ocean energy (tide and wave).

Hydropower

Hydropower is an essential energy source harnessed from water moving from higher to lower elevation levels, primarily to turn turbines and generate electricity. Hydropower projects include Dam project with reservoirs, run-of-river and in-stream projects and cover a range in project scale. Hydropower technologies are technically mature and its projects exploit a resource that vary temporarily. The operation of hydropower reservoirs often reflects their multiple uses, for example flood and drought control, irrigation, drinking water and navigation the primary energy is provided by gravity and the height the water falls down on to the turbine.

Hydropower environmental and social impact

Hydropower generation does not produce greenhouse gases and thus mostly termed as a green source of energy. Nonetheless, it has its advantages and disadvantages. It improves the socio-economic development of a country; but, also considering the social impact, displacement of communities alongside the hydropower plant . The exploitation of the sites for hydropower such as, reservoirs that are often artificially created leading to flooding of the former natural environment. Hydroelectric structures affect river body's ecology, largely by inducing a change into its hydrologic characteristics and by disturbing the ecological continuity of sediment transport and fish migration through the building of dams, dikes and weirs. In countries where substantial plants or tree covers are flooded during the construction of a dam, there may be formation of methane gas when plants start rotting in the water, either released directly or when water is processed in turbines.

Bioenergy

Bioenergy is a renewable energy source derived from biological sources. Bioenergy is an important source of energy, which can be used for transport using biodiesel, electricity generation, cooking and heating. Electricity from bioenergy attracts a large range of different sources, including forest by-products such as wood residues; agricultural residues such as sugar cane waste; and animal husbandry residue such as cow dung. One advantage of biomass energy-based electricity is that fuel is often a by-product, residue or waste product from the above sources. Significantly, it does not create a competition between land for food and land for fuel presently, global production of biofuels is comparatively low, but continuously increasing the annual biodiesel consumption in the United States was 15 billion litres in 2006. It has been

growing at a rate of 30–50% per year to achieve an annual target of 30 billion litres at the end of year 2012.

Bioenergy environmental and social impact

The use of biological components (plant and animal source) to produce energy has always been a cause of worry especially to the general public and as to whether its food produce are to be used to provide fuel since there are cases of food aid needed around the world in deprived countries. About 99.7% of human food is obtained from the terrestrial environment, while about 0.3% comes from the aquatic domain. Most of the suitable land for biomass production is already in use . Current studies have underlined both positive and negative environmental and socio-economic effects of bioenergy. Like orthodox agriculture and forestry systems, bioenergy can worsen soil and vegetation degradation related with the overexploitation of forest, too exhaustive crop and forest residue removal, and water overuse Diversion of crops or land into bioenergy production can induce food commodity prices and food security. Proper operational management can bring about some positive effects which include enhanced biodiversity, soil carbon increases and improved soil productivity.

Direct solar energy

The word “direct” solar energy refers to the energy base for those renewable energy source technologies that draw on the Sun’s energy directly. Some renewable technologies, such as wind and ocean thermal, use solar energy after it has been absorbed on the earth and converted to the other forms. Solar energy technology is obtained from solar irradiance to generate electricity using photovoltaic (PV) and concentrating solar power (CSP), to produce thermal energy, to meet direct lighting needs and, potentially, to produce fuels that might be used for transport and other purposes). According to the World Energy Council “the total energy from solar radiation falling on the earth was more than 7,500 times the World’s total annual primary energy consumption of 450 EJ”.

Geothermal energy

Geothermal energy is obtained naturally from the earth’s interior as heat energy source. The origin of the heat is linked with the internal structure of the planet and the physical processes occurring there. Although heat is present in the earth’s crust in huge quantities, not to mention the deepest parts, it is unevenly distributed, rarely concentrated, and often at depths too great to be exploited mechanically.

Wind energy

The emergence of wind as an important source of the World's energy has taken a commanding lead among renewable sources. Wind exists everywhere in the world, in some places with considerable energy density Wind energy harnesses kinetic energy from moving air. The primary application of the importance to climate change mitigation is to produce electricity from large turbines located onshore (land) or offshore (in sea or fresh water). Onshore wind energy technologies are already being manufactured and deployed on a large scale. Wind turbines convert the energy of wind into electricity.

Ocean energy (tide and wave)

Surface waves are created when wind passes over water (Ocean). The faster the wind speed, the longer the wind is sustained, the greater distance the wind travels, the greater the wave height, and the greater the wave energy produced (Jacobson & Delucchi, 2011). The ocean stores enough energy to meet the total worldwide demand for power many times over in the form of waves, tide, currents and heat. The year 2008 saw the beginning of the first generation of commercial Ocean energy devices, with the first units being installed in the UK-SeaGen and Portugal-Pelamis. There are presently four ways of obtaining energy from sea areas, namely from Wind, Tides, Waves and Thermal differences between deep and shallow Sea water .

Renewable energy and sustainable development

Renewable energy has a direct relationship with sustainable development through its impact on human development and economic productivity . Renewable energy sources provide opportunities in energy security, social and economic development, energy access, climate change mitigation and reduction of environmental and health impacts.

Energy security

The notion of energy security is generally used; however there is no consensus on its precise interpretation. Yet, the concern in energy security is based on the idea that there is a continuous supply of energy which is critical for the running of an economy. Given the interdependence of economic growth and energy consumption, access to a stable energy supply is of importance to the political world and a technical and monetary challenge for both developed and developing countries, because prolonged interferences would generate serious economic and basic functionality difficulties for most societies Renewable energy sources are evenly distributed around the globe as compared to fossils and in general less traded on the market. Renewable energy reduces energy imports and contributes diversification of the portfolio of supply options and reduces an economy's vulnerability to price volatility and represent opportunities to enhanceenergy security across the globe. The introduction of renewable energy can also make contribution to increasing the reliability of energy services, to be specific in areas that often

suffer from insufficient grid access. A diverse portfolio of energy sources together with good management and system design can help to enhance security.

Social and economic development

Generally, the energy sector has been perceived as a key to economic development with a strong correlation between economic growth and expansion of energy consumption. Globally, per capita incomes are positively correlated with per capita energy use and economic growth can be identified as the most essential factor behind increasing energy consumption in the last decades. It in turn creates employment; renewable energy study in 2008, proved that employment from renewable energy technologies was about 2.3 million jobs worldwide, which also has improved health, education, gender equality and environmental safety.

Energy access

The sustainable development goal seven (affordable and clean energy) seeks to ensure that energy is clean, affordable, available and accessible to all and this can be achieved with renewable energy source since they are generally distributed across the globe. Access concerns need to be understood in a local context and in most countries there is an obvious difference between electrification in the urban and rural areas, this is especially true in sub-Saharan Africa and South Asian regions.

Distributed grids based on the renewable energy are generally more competitive in rural areas with significant distances to the national grid and the low levels of rural electrification offer substantial openings for renewable energy-based mini-grid systems to provide them with electricity access Renewable energy **.**

Challenges affecting renewable energy sources

Renewable energy sources could become the major energy supply option in low-carbon energy economies. Disruptive alterations in all energy systems are necessary for tapping widely available renewable Energy sources. Organizing the energy transition from non-sustainable to renewable energy is often described as the major challenge of the first half of the twenty-first century (Verbruggen et al., 2010). Figure 5 shows the interconnection of factors affecting renewable energy supplies and sustainability. It is evident from Figure 5 that a major barrier towards the use of renewable energy source depends on a country's policy and policy instrument which in turn affect the cost and technological innovations. In addition, technological innovations affect the cost of renewable energy technologies which in turn leads to market failures and low patronization of the renewable energy technology. In the light of this, an

effective renewable energy policy should take the interconnection of factors affecting renewable energy supplies and sustainability into consideration.

Figure5: Interconnection of factors affecting renewable energy supplies and sustainability, adapted from Edenhofer et al. (2011); Verbruggen et al. (2010)

The following are policy recommendations emanating from the study that can help mitigate climate change and its impacts.

•All sectors and regions have the potential to contribute by investing in Renewable energy technologies and policies to help reduce it.

•Reducing our carbon footprint through the changes in lifestyle and behaviour patterns can contribute a great deal to the mitigation of climate change.

•Research into innovations and technologies that can reduce land use and also reduce accidents from renewable energy sources and the risk of resource competition, for example in Bioenergy where food for consumption competing with energy production.

•Enhancing international cooperation and support for developing countries towards the expansion of infrastructure and upgrading technology for modern supply and sustainable energy services as a way of mitigating climate change and its impacts.

Renewable energy in India

The primary objective for deploying renewable energy in India is to advance economic development, improve energy security, improve access to energy, and mitigate climate change. Sustainable development is possible by use of sustainable energy and by ensuring access to affordable, reliable, sustainable, and modern energy for citizens. Strong government support and the increasingly opportune economic situation have pushed India to be one of the top leaders in the world's most attractive renewable energy markets. The government has designed policies, programs, and a liberal environment to attract foreign investments to ramp up the country in the renewable energy market at a rapid rate. It is anticipated that the renewable energy sector can create a large number of domestic jobs over the following years. This paper aims to present significant achievements, prospects, projections, generation of electricity, as well as challenges and investment and employment opportunities due to the development of renewable energy in India. In this review, we have identified the various obstacles faced by the renewable sector.

Conclusion

Energy is a requirement in our everyday life as a way of improving human development leading to economic growth and productivity. The shift -renewables will help mitigate climate change is an excellent way but needs to be sustainable in order to ensure a sustainable future for generations to meet their energy needs. Knowledge regarding the interrelations between sustainable development and renewable energy in particular is still limited. The aim of the paper was to ascertain if renewable energy sources were sustainable and how a shift from fossil fuel-based energy sources to renewable energy sources would help reduce climate change and its impact. Qualitative research was employed by reviewing papers in the scope of the study. Even though the complete lifecycle of renewable energy sources have no net emissions which will help limit future global greenhouse gas emissions. Nevertheless, the cost, price, political environment and market conditions have become barriers preventing developing, least developed and developed countries to fully utilize its potentials. In this way, a creation of global opportunity through international cooperation that supports least developed and developing countries towards the accessibility of renewable energy, energy efficiency, clean energy technology and research and energy infrastructure investment will reduce the cost of renewable energy, eliminate barriers to energy efficiency (high discount rate) and promote new potentials towards climate change mitigation.

The study brought to light the opportunities associated with renewable energy sources; energy security, energy access, social and economic development and climate change mitigation and reduction of environmental and health impacts. There are challenges that tend to hinder the sustainability of renewable energy sources and its ability to mitigate climate change. These challenges are: market failures, lack of information, access to raw materials for future renewable resource deployment, and most importantly our (humans) way of utilizing energy in an inefficient way.

From the findings, the following suggestions are made that can help improve the concerns of renewable energy being sustainable and also reduce the rate of the depletion of the ozone layer due to the emissions of GHG especially carbon dioxide (CO2):

•Formulation of policies and discussions from all sectors towards the improvement of technologies in the renewable sector to sustain them.

•Changes in our use of energy in a more efficient way as individuals, countries and the world as a whole. Efforts that aim at increasing the share of renewable energy and clean fossil fuel technologies into global energy portfolio will help reduce climate change and its impacts. Energy efficiency programmes should be introduced globally, which give tax exemptions to firms who prove to provide energy efficiency initiatives (energy-efficient homes), product design (energy-efficient equipment) and services (industrial combined heat and power). Introducing the concept of usability, adaptability and accessibility into energy-dependent product design is a way of promoting energy efficient behaviours.

•Increase research in these areas, so that the fear of some renewables posing risks in the future is limited.

•Improve education, awareness-raising and human institutional capacity on climate change mitigation, adaptation, impact reduction and early warning. Developed countries should incorporate decarbonisation policies and strategies into the industry, energy, agricultural, forest, health, transport, water resource, building and other sectors that have potential of increasing greenhouse gas emissions. Efforts in developing countries aimed at improving institutional training, strengthening institutions and improving capacity of research on climate change will increase awareness, promote adaptation and sustainable development. Least developed countries should develop and test tools and methods with a global support that direct policy and decision-making for climate change mitigation, adaptation and early warnings. Supporting a global dialogue through international cooperation and partnership with developed, developing and least developed countries will promote the development, dissemination and transfer of environmentally friendly technologies, innovation and technology, access to science, and among others which will increase the mutual agreement towards combating climate change and its impacts.

If these suggestions are implemented, the sustainability of renewable energy resources would be addressed as well as the seventh and thirteenth goal of sustainable development which seeks to ensure access to affordable, reliable, sustainable, modern energy for all and combat climate change and its impact.

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18. Kandp TC, Garg HP (1998) Renewable energy education for technicians/mechanics. Renewable Energy. (14(1–4):393–400
19. Article Google Scholaration of a grid-connected microgrid system.

14: ASSESMENT OF STUDENT ATTITUDE AND AWARENESS TOWARDS RENEWABLEENERGY

M. R. Chaya

Department of Chemistry, KLE Society' S.Nijalingappa College Rajajinagar, Bengaluru-10

Abstract:

Renewable energy is growing rapidly and becoming a popular alternative source of energy. Sustainable energy development has been related to environmental issues, which can be eradicated by replacing fossil fuels with natural resources. Public awareness is important towards accomplishing this goal of implementing alternative source of energy. Thus, this study focused on the survey of renewable energy awareness which was conducted for the degree students of KLE'S S.Nijalingappa College. The information gathered by 207 students though Google forms and was analysed of the student's attitudes towards renewable energy. This survey is especially expected to be useful in determining the renewable energy content of the curriculum for relevant educational institutions and for the development of short and medium-term energy policies for future plans in other institutions

Key words:
Renewable Energy Sources, Attitude and Awareness, Sustainable energies, Renewable energy adoption.

Introduction

The future of the any country depends on the availability and transport of energy. Fossil fuels like coal, oil and natural gas are currently the world's primary energy sources. The heavy dependence on the fossil fuel in 20th century largely reduced the natural reserve of it. Aware of its finite reserve and adverse effect on environment, demand is increasing trying to find and use alternative energy sources. Development of sustainable renewable energy sources is crucial to a healthy relationship of society and the environment. The use of renewable energy sources are rapidly increasing as alternatives to conventional sources. Awareness is a key factor in promoting renewable energy proliferation. People are familiar but not educated on popular

energy issues. Public opinion of different energy sources is critical for the planning of future energy portfolios.

A survey was conducted to assess attitude and awareness of the degree students of KLE'S S.Nijalingappa College towards renewable energy. The information gathered was analysed of the student's attitudes towards renewable energy. This survey is especially expected to be useful in determining the renewable energy content of the curriculum for relevant educational institutions and for the development of short and medium-term energy policies for future plans in other institutions. The paper describes students' attitudes and awareness towards Renewal Energy.

Study objective:

Main Objective of this survey is to assess the awareness of youth towards renewable source of energy and also to evaluate the knowledge of youth towards different renewable resources and their benefits and their perceptions towards renewable energy resources. The survey also aims to gauge the preference of youth to spread the awareness and to contribute to the cause as an individual.

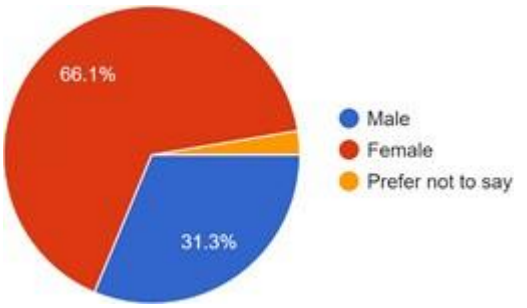
Methodology:

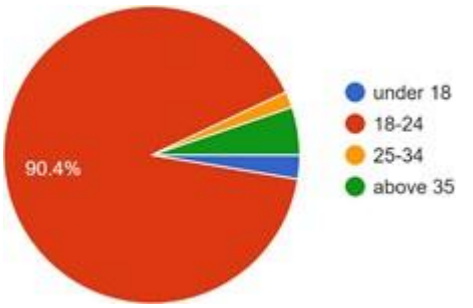
A survey of renewable energy awareness is conducted in this paper was planned and validated questionnaires were prepared in order to determine the awareness of the degree students of KLE'S S. Nijalingappa College students through Google forms. Totally 20 questions of the following parameters namely knowledge of renewable energy sources and power generation, Scarcity of energy in the India, comparison of fossil fuels use and renewable power, Relationship between Renewable energy and Climate change and its effect, The relation between biodiversity and renewable energy technologies, The current status of renewable energy technologies in India, Perception on whether prices of renewables will reduce to a considerable level, Plans and policies of the government on renewable energy, encouragement by government as well as at a personal level, , opinions for encouragement, leads for encouraging renewable energy growth with financial incentives, Willingness to take the lead in renewable energy adoption, Barriers towards the adoption of renewable energy technologies, Willingness to invest in renewable energy technologies, Access to information on renewable energy initiatives and programmes, Public acceptability of renewables were selected for analysis The survey depended on gender, age and education parameters of 200 students studying in degree college.

Results and Discussion:

- **Gender and Age group domain**

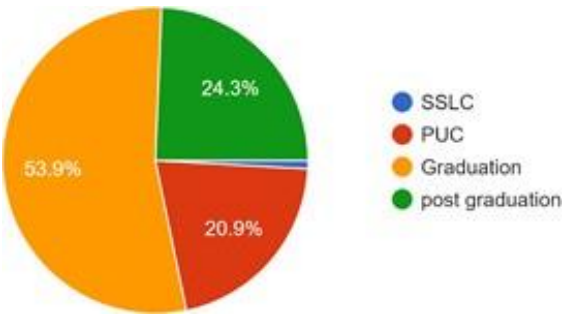
The gender and age group of the responses is pictorially depicted below. From the graph it is evident that majority of the responses were received from females (66.1%) and .the age group of 18-24.





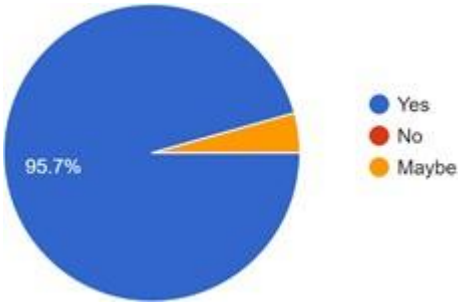
- **Educational qualifications**

The educational qualifications of the respondents were as follows. The graph indicates that 53% were graduated.



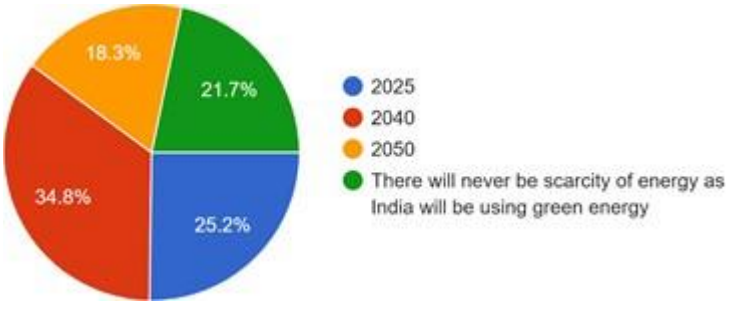
- **Awareness about difference between renewable and non-renewable energy**

It confirms from the data that 95.7% of the respondents know the difference between renewable and non-renewable energy.

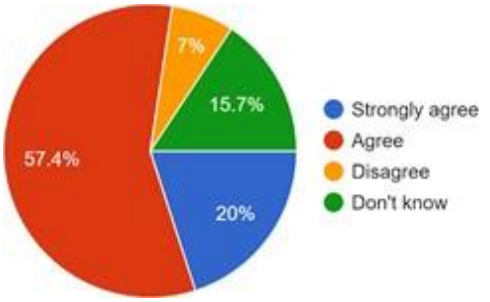


- **Scarcity of energy in the India**

Mixed opinions of the respondents about scarcity of energy in the India were as follows. The Respondents aware of the fact that burning fossil fuels at current rate may depleted by 2024 (34.8%). 21.7% of the respondents think positively that there will never be scarcity of energy as India will be using Green energy.

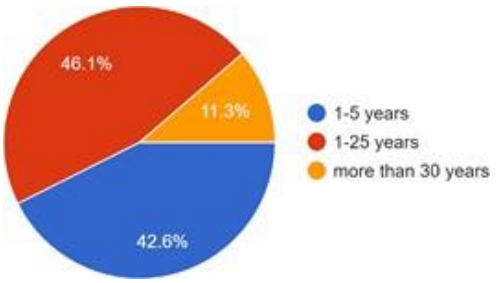


- **The energy generated from renewable technologies can replace the use of conventional fuels.**



The survey questions to assess the awareness among students about the potential of Renewable Energy to replace use of fossil fuel showed very positive response, with 57.4% agreeing to the proposition that Renewable Energy will replace use of conventional fuel in the near future.

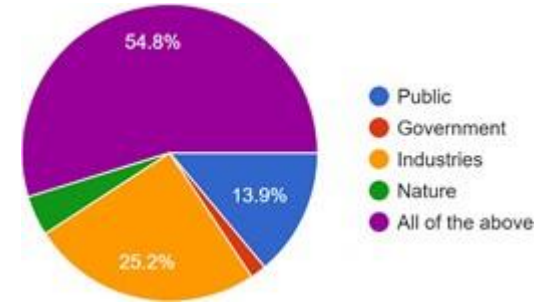
This leads to the conclusion that 'students have a positive outlook about the role that Renewable Energy can play in the near future and its potential to gradually replace dependence on fossil fuel usage. Very few respondents disagreed (7%) to the proposition. This could be a result of sheer unawareness related to Renewable Energy potential as well as scepticism about renewable energy. The 'don't know' option was used by15.7%. They may be unaware or less aware of Renewable Energy technologies usage due to lack of information sharing and dissemination.



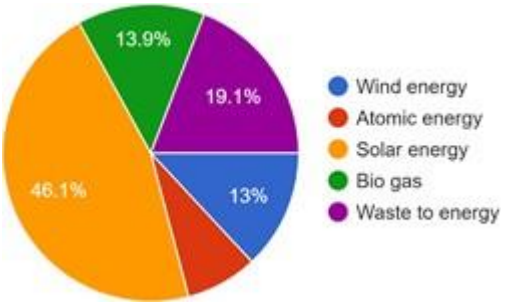
Further analysis of the respondents in the 'agree' category was done to estimate the perception about the 'time-frame' The Respondents feel that renewables can replace use of fossil fuel in the near future. 42.6% said within 5 years and 11.3% said more than 30 years and 46.1% agrees that renewable energy will replace conventional fuels by next 25 years.

- **Relationship between Renewable energy Climate change and its effect**

The Respondents understands that renewable energy minimizes carbon pollution and has a much lower impact on our environment. 54.8% of them feel that Public, Government, Industries and even nature is also responsible for Climate change.



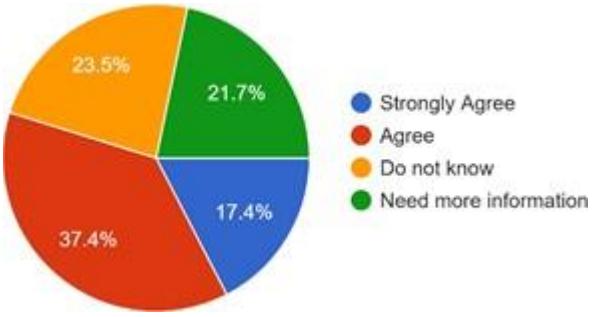
- **The current status of renewable energy technologies in India**



An important aspect to check the awareness of people on renewables is to test their understanding on the current scenario of renewable energy technologies. With this objective in mind, the respondents were asked to choose from a set of renewable energy sources which in their view has a 'higher potential in India'. This question tries to identify which specific renewable energy source has a noticeable presence in people's mind and has been promoted by the government.

Out of the five most widely used sources – wind, solar, atomic, biomass, waste-to-energy – solar energy got the highest response (46.1%). This awareness can be attributed to the coverage of the initiatives taken by the Indian government for solar energy policy and programme promotions in the media. Also waste-to-energy (19.1%) and biomass (13.9%) got a moderate response, followed by wind (13%) and atomic energy (7.8%). Therefore, 'solar energy' emerges as one of the most popular renewable energy options in India.

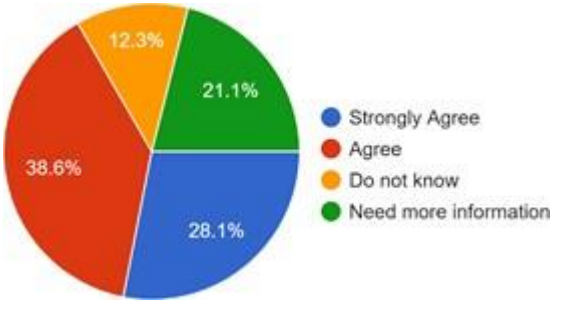
- **Perception on whether prices of renewables will reduce to a considerable level**



To determine awareness of prices of renewables, the following question was put forward: 'Do you think renewable energy will match the price of conventional energy and will eventually become cheaper'?

About 37.4% of the respondents agree that prices of renewables will reduce to a considerable level and will eventually become cheaper than conventional energy. This clearly shows a positive inclination and understanding on renewable energy investment. Of the respondents, 17.4%'strongly agree' with the view that renewables will replace conventional fuel sources in the future. While 23.5% respondents 'don't agree' with the question posed. This shows that some sections are still not convinced about investing in renewable energy technology. Also, their understanding seems to be influenced by the perception that renewable energy technology is expensive. The category of 'need more information', received 21.7%. They do not have any idea about the cost of renewable energy technology.

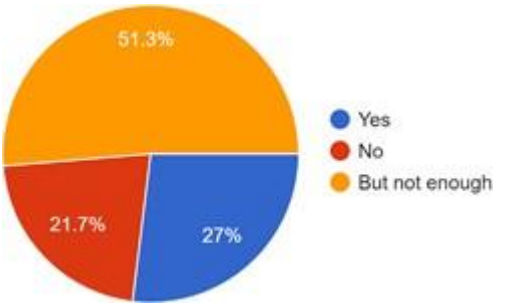
- **The relation between biodiversity and renewable energy technologies**



66.7% of the respondents believe that renewable energy has much lesser impact on biodiversity and the environment, as compared to fossil fuel based energy and knew renewable energy based

technologies do not have any harmful impact on the environment and biodiversity. Further, 33.3% of the respondents had any idea.

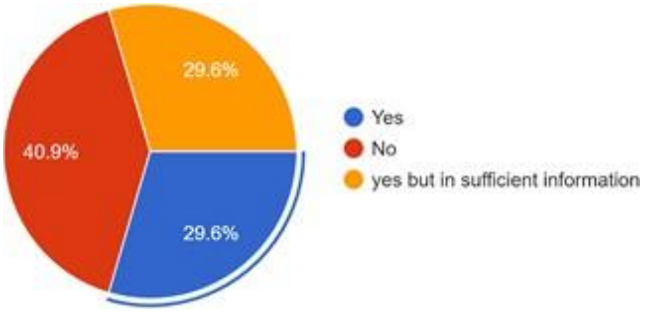
- **Plans and policies of the government on renewable energy**



In order to analyse students perception about government policies and schemes for renewable energy technologies, it was important to analyse two important aspects: first, whether they are actually aware of government's plans and policies on renewables; second, are they aware of subsidies available for renewable energy applications.

It is seen that more than half of the respondents, 78.3% were of the view that there have been initiatives by the government, but 51.3% believe that these initiatives are not enough to make the switch possible. This clearly highlights that there exists a huge gap between government-led initiatives and the actual beneficiaries'.

Of the total respondents, 21.7% had 'no knowledge of these initiatives at all'. This brings to light a very important fact that 'adoption of renewable energy among common citizens is not taking place as should be the ideal case. Therefore, this calls for action on the part of the government with regard to effective 'dissemination of information' on subsidies/plans/ policies that have individual/household-centric benefits.

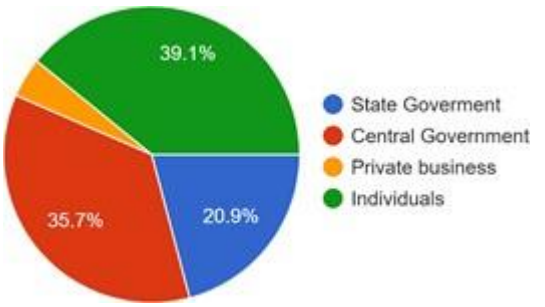


For an analysis of aware of government subsidies to purchase renewable energy applications 59.2% respondents said 'yes aware but have insufficient information on availing these subsidies' and 40.9% said 'no'. This proves that renewable energy applications still require correct, usable and consumer friendly information on government subsidies. Only 29.6% of the respondents were aware of the subsidies available. This low percentage also highlights the fact that there is a lot more that needs to be done in terms of easy and accessible information transfer.

- **Willingness to take the lead in renewable energy adoption**

Analysing the willingness to adopt renewable energy technologies and on who, they think, should take the lead in facilitating action on renewable energy adoption to the respondents. The options include central government, state government, private business and individuals.

Most respondents (39.1%) feel that a wider adoption of renewable energy is possible only through individuals. The central government was preferred to be the second choice to be the change agent and lead the action in making the transition possible, with 35.7% respondents voicing their opinion.20.9% of the respondents voicing their opinion towards state government. This shows that the government through its plans/policies/subsidy initiatives can act as an effective catalyst in the adoption of renewable energy among individuals/households.



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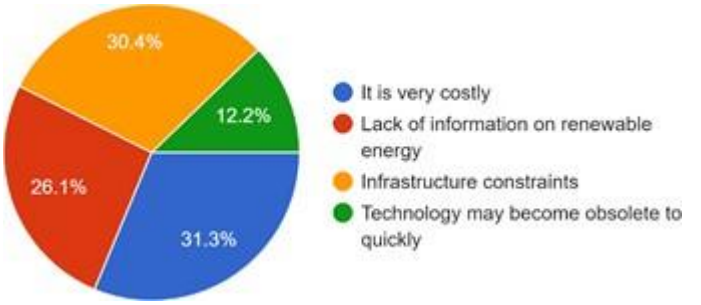
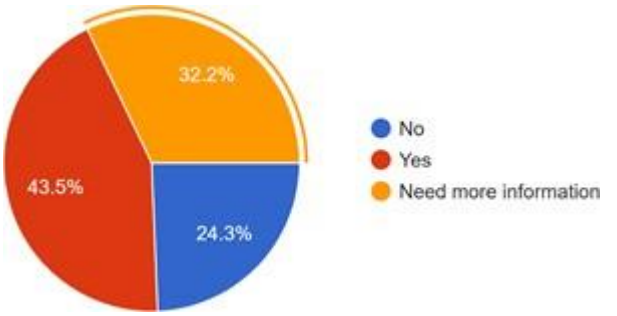
- **Barriers towards the adoption of renewable energy technologies**



In order to analyse the barriers towards adoption of renewable energy technologies, the respondents were asked a simple question on what are the most common reasons for a non-user to not install a renewable energy product. While 31.3% of the respondents think that renewables are expensive, 30.4% felt that infrastructure as a constraint for renewable energy adoption at the household level.. 26.1% said that they are not aware of such technologies. 12.2% of them consider the renewable energy technology may become obsolete quickly.

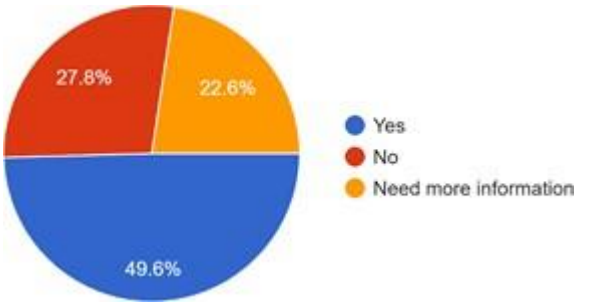
- **Willingness to invest in renewable energy technologies**



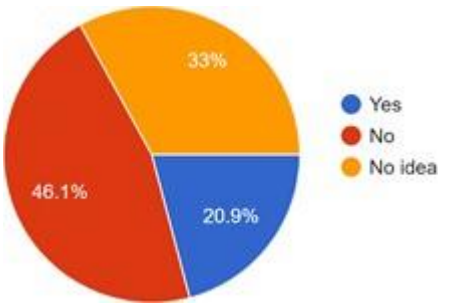
To assess the motivation level to invest in renewable energy technologies, they were asked to share their opinion on whether or not investment in renewables would be financially sustainable in the long run. A majority of the respondents (43.5%) had a positive support for investment which is seen by the responses received as yes. This helps us infer that these groups of students understand the long-term benefits of switching to renewable energy. Students who 'need more information' constitute about 32.3%, which is the share of students seeking more information on

'renewable energy investment'. 25.3% students opted for "no" which could perhaps be the result of existing information gap, understanding and the common perception that renewable energy is expensive.

- **Access to information on renewable energy initiatives and programmes**



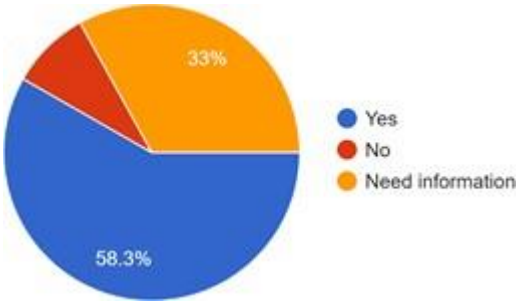
About 27.8% of the respondents are not aware of appropriate platforms to access information on renewable energyrelated initiatives and programmes. Further, nearly 72.2 per cent of the respondents think that their local media do not cover news related to policies, initiatives and programmes on renewables.



About 46.1% of the respondents are not aware of appropriate platforms to access information on renewable energyrelated initiatives and programmes. They were of the view that their local media did not cover news on renewable energy policies, programmes, products, innovations, etc., initiated by the government, NGOs and other agencies. This shows that there is a huge target audience who are keen on getting information on renewable energy related activities and initiatives. 20.9% of students, who opted for 'no idea', were those who know about renewables but do not know the right platforms to read more on it. The analysis hints at the compelling need

for effective dissemination of information by government/NGOs and other related organizations on renewables through proper communication mediums like magazines, websites, editorials, etc

- **Public acceptability of renewables**



In order to assess the possibility of shift to renewables at the household level, an analysis of a common perception was done. Acceptability depends largely on preciseness the potential of renewables. This is based on the premise that acceptability of renewables can be made possible only when they believe in its potential to meet their energy demand.

More than 50% of the respondents opted for 'yes 'as they agree that renewable energy can meet their household energy demand partially or completely'. This shows that 58.3% of the respondents support the idea of shifting to renewables and are convinced of its potential. A small number of respondents, i.e., 8.7% said "no" and had the opinion that renewable energy cannot meet their household demand even partially or completely. While 33% of respondents said that they 'need more information' for assessing the potential of renewable energy to meet their energy demand partially or completely. These students do not have the relevant and required information to make the shift to renewables.

Conclusion

Although a large number of students are aware of the importance of energy and its role in the growth and development of the nation, it is also very much comprehendible that there is a yawning gap which needs to be addressed in the area of energy education and awareness in India.It confirms from the data that the student understands mostly that renewable energy is the non-polluting source and going for utilisation of renewable energy is a very good idea.The respondents aware of the fact that burning fossil fuels at current rate may deplete in the near future. Students have a positive outlook about the role of renewable energy and its potential that

gradually replace dependence on fossil fuel usage. It was also clear that students knew about different forms generation of energy. Among the renewable energy sources it was found that Student's opinion supported solar energy as the best option for generating energy. As for the comparison of the energy generation from the renewable energy with that from fossil fuel students opinion was that renewable energy was much better.The Respondents understands that renewable energy minimizes carbon pollution and has a much lower impact on our environment. Public, Government, Industries and even nature is also responsible for Climate change. The respondents agree that prices of renewables will reduce to a considerable level and will eventually become cheaper than conventional energy. This clearly shows a positive inclination and understanding on renewable energy investment. The respondents believe that renewable energy has much lesser impact on biodiversity and the environment, as compared to fossil fuel based energy and knew renewable energy based technologies do not have any harmful impact on the environment and biodiversity. Many slightly agreed that government encouragement is necessary for the promotion of renewable energy. It was observed that respondents individually had to take a lead for developing renewable energy use at the household level as well as business development. They strongly believe that the government through its plans/policies/subsidy initiatives can act as an effective catalyst in the adoption of renewable energy among individuals/households. The respondents think that renewables are expensive, which is one of the barriers towards the adoption of renewable energy technologies.Access to information on renewable energy initiatives and programmes by the local media is not satisfactory and compelling need for effective dissemination of information by government/NGOs and other related organizations on renewables through proper communication mediums like magazines, websites, and editorials. Majority of Respondents willing to shift positively towards renewables at the household level.

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15: RENEWABLE ENERGY RESEARCH AND APPLICATIONS

Pujar Shashikant Rajshekar*, Rajaiah B, R. A Yadahalli, Soujanya. B and Shruthi J

Department of Chemistry, KLE's S. Nijalingappa college Rajajinagar, Bengaluru -10

Author for Correspondence: shashikanthpujar@klesnc.org

Abstract: Renewable clean energy has become an important part of the current energy structure, andalso an important direction of energy development. Asa typical representative of renewable energy, wind and solar energy has been large-scale development and wide application.Because of theenergy transmission limitation, "energy" has becomemain form of use.Renewable energy is pollution-free and environment benign, solar energy has been the main pivotal point due to its natural abundance. In this review, the different research application on the solar energy sustainability and the different types of renewable energy and the research developments and their application are discussed.

Keywords: Renewable energy, solar energy; Wind energy,; Hydroelectric renewable energy, Geothermal renewable energy

Introduction: Renewable energy, sometimes referred to as "clean" or "green" energy, is a booming innovation that is bringing down energy costs and delivering on its promise of a cleaner, greener future. When we say, "renewable energy", "renewable energy sources", or "green energy" we mean any energy from a source that is not depleted when used, such as the wind or sun; we can use an unlimited amount of the sun or wind's energy because its supply is infinite. Solar and wind generation are breaking record after record as they slowly start to penetrate national electricity grid without compromising on electricity. This means that renewable energy sources are slowly but surely displacing natural fossil fuel energy (e.g., coal and oil) in the power sector and offering the benefit of lower emissions and pollution levels. While renewable energy is sometimes thought of as a new technology, harnessing the power of nature has long since been used for heating, lighting, transportation, and more. Wind, for example, has been used for hundreds of years by sailors to move boats across the ocean.

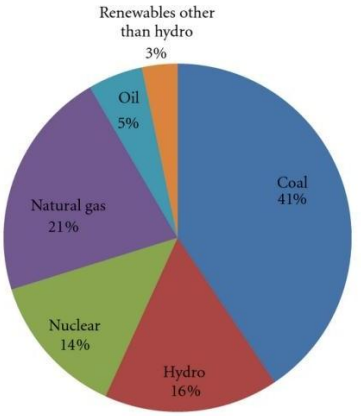
Meanwhile, farmers have long since relied on the wind to make their windmills turn and grind down grain. The sun has also been used for a very long time to help kindle fires and in some cases for cooking. However, over the course of the last few hundred years and especially during the industrial revolution, humans have turned to cheaper and dirtier energy sources. While these are not more abundant than renewable sources like the sun and wind, they are much more convenient and efficient to use… or, at least, they have been up until now, that we have innovative and cheaper ways to capture and retain renewable energy sources such as the sun and wind, renewables are becoming a much more important power source. In Europe, for example, energy from renewable sources made up 34 percent of gross electricity consumption, up from 32 percent in 2018. The renewables expansion is happening on both a large and small scale, from rooftop solar panels on homes to giant offshore wind farms and battery plants. Renewables have become so reliable, in fact, that some rural communities rely on it entirely for lighting and heating. Renewable energy sources account for a growing chunk of energy consumption in Europe, the U.S., and the wider world. They are a fast-growing source of clean, low or zero-carbon electricity. While cost can sometimes be a barrier to the adoption of renewable sources as we will explore in more detail later rapid advances in technology, supply chains, and government policy have contributed to their growth in recent years. These renewable energy sources are important because they provide reliable power supplies and fuel diversification. These help to improve energy security, the environment, and conserve natural resources and habitats. They also reduce the need for costly fuel imports and accidents such as oil spills, such as the Deep

water Horizon oil spill of 2010 which claimed the lives of 11 rig workers and millions of marine animals, including mammals, birds, and fish.

Environmental Degradation, Climate Change, and Energy: Environmental degradation and climate change are stated to be among some of the challenges facing the world today. Despite the fact that there are some natural processes causing environmental and climatic deviations, current research indicates that these processes are insignificant compared to the human-induced processes. Processes such as those concerning unsustainable energy extraction, conversion, and utilisation have contributed to the worsening of these global changes. Environmental degradation and increase in global average temperature have altered the natural way the earth regulates its atmospheric air composition and temperature thereby weakening the earth's self-climate regulating system. Climate change is defined in many ways. According to Intergovernmental Panel on Climate Change (IPCC), "climate change refers to any change in climate system over time which can be identified (e.g., using statistical tests), whether due to natural variability or as a result of human activity." United Nations Framework Convention on Climate Change—UNFCCC defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". According to Young Europeans Discuss Sustainable Development, "Climate change is a long-term change in the statistical distribution of weather patterns over periods of time that range from decades to millions of years. It may be a change in the average weather conditions or a change in the distribution of weather events with respect to an average period of time." Therefore, from these definitions, when answering the question of climate change in a country or region through research, both natural and human-induced weather changes in climate system have to be analysed over a relatively long period of time (several decades or century). The main cause of climate change is the global warming as a result of human-induced gases (or emissions) that trap heat from solar energy in the atmosphere in the same way a "greenhouse" does. They are also known as Greenhouse Gases (GHGs). Carbon dioxide is the major greenhouse gas; others are methane, nitrous oxide, and carbon-fluorinated gases. All GHGs have different capacities of trapping heat (global warming potential) but when it comes to analysing their potentials, these

GHGs are weighted relative to the global warming potential of carbon dioxide. IPCC states that global GHG emissions levels have grown since preindustrial times, with an increase of 70% between 1970 and 2004. The IPCC further states that the largest growth in global GHG emissions between 1970 and 2004 had come from the energy supply sector that is dominated by fossil fuels. The other sectors that contributed with significant shares of GHG are the transport, industry and land use, land use change, and forestry (LULUCF). With the current development practices, IPCC states that global GHG emissions will continue to grow over the next decades [16]. Some recent studies agree with IPCC projections. For example, a study on trends in the global CO_2 emission supported by The Netherlands Environmental Assessment Agency and Joint Research Centre of the European Commission states that the CO_2 emissions increased by 3% in 2011. This increase is above the past decade's average annual increase of 2.7%. In 2011, around 35 billion CO_2 equivalents was emitted globally and the top emitters are China (29%), the United States (16%), the European Union (11%), India (6%), the Russian Federation (5%), and Japan (4%) . Some scientific studies conclude that avoiding the most severe changes in the climate system will require keeping the average global warming to not more than 2°C relative to preindustrial levels. The human response to challenges of global climate change is basically twofold: to reduce greenhouse gas emissions into the atmosphere (mitigation) and to adapt to the impacts of climate change (adaptation). Greenhouse gas emissions from the energy sector account for about 70% of the total GHG emissions and electricity generation account for a bigger share of global energy consumption. The fossil fuels are still the dominant source of energy for electricity generation; in 2009 they contributed to about two-thirds (67%) of the total global electricity generation capacity of about 20,000 TWh; with coal alone contributing about 40% of the capacity, refer to Figure given below. Fossil fuel, especially coal, remains the largest source of electricity generation in the near future, considering the fact that the current proven coal

reserve is able to take more than a century to get depleted, as stated before.



Fuel shares of global electricity generation in 2009, adapted from International Energy Agency.

Due to the disadvantages highlighted by the dirty energy utility and their adverse effects on the nature the world is focussing on the greener and safer use of Renewable energy and its current research and application for the sustainability is the current focal point of the renewable energy. In this review the types of renewable energy and its research and application for the sustainability are summarised.

Types of Renewable Energy: Solar and wind are the two most referred types of renewable energy which are profound utility.

1. Solar renewable energy: Solar energy is energy that comes from the sun. This is harnessed by solar (or photovoltaic PV) cells made from silicon that is found in solar panels. These cells transform sunlight into electricity. The most common types of solar systems are those found on top of rooftops that generate electricity locally for homes and businesses. However, solar panel systems on a large enough scale can be powerful enough to power entire neighbourhood and provide electricity for thousands of homes. Solar is now seen as such a viable energy source, in fact, Solar is an example of zero-carbon energy; it doesn't produce any pollutants or harmful by-products beyond those generated during the solar PV cell manufacturing process.

2. Wind renewable energy [56]: Wind energy is harnessed through wind turbines that in some cases can be as tall as skyscrapers. While wind turbines are usually found on-shore, but they can also be found off-shore where wind speeds tend to be higher. A turbine system works by the wind energy turning its blades. This feeds an electric generator and produces electricity which can then be used by the grid. The wind has quickly become the cheapest energy source available in many parts of the world. In Europe, the latest estimates say that there is now 142 GW of installed wind energy capacity and in 2015 it accounted for 44.2 percent of total power capacity installations.

3. Hydroelectric renewable energy [57]: Hydroelectric renewable energy is currently the largest renewable energy source in the United States, but wind energy is expected to catch up soon. While it is a viable renewable energy source, there is limited potential for it to be captured because it relies on fast-flowing water, such as that found in a river or waterfall, descending from a high point to create a force that spins a generator's turbine blades. That being said, there are many who argue that hydroelectric is not in fact a renewable source. This is because large-scale hydroelectric plants can sometimes reduce natural water flows and restrict access to animal habitats and human populations that rely on rivers and waterways for survival. On a smaller scale, however, **carefully managed hydroelectric plants are not thought to be damaging to the environment.**

4. Geothermal renewable energy: Geothermal energy is the heat that comes from the sub-surface of the Earth. It is contained in the rocks and fluids beneath the earth's crust and can be found as far down to the earth's hot molten rock, magma. To create power from geothermal energy, wells must be dug deep into underground reservoirs to access the steam and hot water they contain. This can then be used to drive turbines connected to electricity generators. Geothermal energy is used in over 20 countries. The most famous countries with geothermal activity are the United States (California's geysers) and Iceland, which has been used as far back as 1907 to produce over 25 percent of its energy. Today, Iceland has five geothermal power plants that leverage the hundreds of hot springs and volcanoes that can be found throughout the country.

I. Recent Developments in Renewable Energy Research and Applications:

1. Solar renewable energy: Lot of research has been done on solar panels and its modifications. The sun being the prime source of energy which is produced from the nuclear fusion reaction of hydrogen nuclei

$$^{2}_{1}H + {}^{2}_{1}H \longrightarrow {}^{3}_{2}H + {}^{0}_{1}n \text{ ---------- -- 3.27 MeV}$$

$$^{2}_{1}H + {}^{3}_{1}H \longrightarrow {}^{4}_{2}He + {}^{0}_{1}n \text{ ---------- --17.5M eV}$$

During this process of fusion, four hydrogen atoms combine to form one helium atom with a loss of mass which is radiated as thermal energy [3] This radiant energy produced by fusion reactions is free from any pollutant, gases, or other reaction by-product. This is why it is the major driving force of all the clean energy technology, in view of the climatic disturbance caused by the emission of carbon from the fossil fuels deposits. One of the biggest advantages of solar energy is that it is free reachable to common people and available in abundant supply compared to that of the price of various fossil fuels and oils in the past decade [1] - [7] . Moreover, solar energy requires considerably lower manpower expenses over conventional energy production technology.

Though the solar energy is freely available everywhere, there is still an initial expenditure on the equipment's for harvesting this radiant energy by developing solar cells, panels and modules [8] . These small and tiny solar cells produce no noise during their operation. On the other hand, the big power pumping devices produce unbearable sound pollution, and therefore they are very disturbing to the society [6] - [8]. Nowadays, due to the decreasing amount of renewable energy resources, the per watt cost of solar energy device has become more important in the last decade, and is definitely set to become economical in the coming years and grow as better technology in terms of both cost and applications [9] [10]. In spite of numerous advantages, this energy has few limitations too. Firstly, solar energy doesn't radiate at night. Secondly, the solar energy is almost not constant all the time. There must be plenty of sunlight available to generate electrical energy from a solar PV device [7] [10] [11].
Moreover, apart from daily fluctuations in the intensity of radiant energy, the solar energy is hindered to reach the earth during bad climatic conditions. For example, the amount of sunlight reaching the earth's surface depends on location, time as well as weather as it falls during winter season as compared to the summer, and the Sun's radiation is less intense [10] [11]. To overcome these demerits of this technology, solar energy must be stored elsewhere at night and the highly efficient solar cells and modules needs to be developed. There have been an enormous amount of research activities to harvest the Sun's energy effectively by developing solar cells/panels with high conversion efficiencies. The photovoltaic conversion efficiency is referred to the efficiency of solar PV modules, and is defined as the fraction of Sun's energy that can be converted into electricity. Solar panels are a huge collection of tiny solar cells arranged in a definite geometrical shape to produce a given amount of power supply. The storage of solar power is still has not been achieved successfully. Currently the radiation efficiency of solar panel is up to 22% [11]. There are many solar photovoltaic batteries available which are usually more expensive and bulky. These are more suitable for small scale or household solar needs compared to large solar plants [12] [13]. The working mechanism of solar cells is based on the three factors: (1) Adsorption of light in order to generate the charge careers, holes (p-type) and electrons (n-type) (2) Separation of charge careers, and (2) the collection of charge careers at the respective electrodes establishing the potential difference across the p-n junction. The generation of voltage difference noticed at the p-n junction of the cell in response to visible radiation is utilized to do the work. In the past, various kinds of semiconductor materials and technologies are devised to design solar cells with low cost as well as high conversion efficiency. Traditional solar panels made from silicon crystalline wafer modules are heavier which makes the transportation difficult. These are generally the large sized solar panels covered with glass

sheets. A heavier and bulky solar panel requires a lot of space and sometime big roofs to fit these bulky and large solar panels in case of high power applications [11]-[13]. Therefore, in this article keeping in mind the efficient use of solar energy by solar cells research and development, we will study the different types of solar cells.

Solar Cells: The photovoltaic (PV) effect was first observed by Alexandre-Edmond Becquerel in 1839 [14]. Subsequently, in 1946 the first modern solar cell made of silicon was invented by RusselOhl [14] [15]. Earlier photovoltaic solar cells are thin silicon wafers that transform sunlight energy into electrical power. The modern photovoltaic technology is based on the principle of electron hole creation in each cell composed of two different layers (p-type and n-type materials) of a semiconductor material, as shown in Figure 2. In this arrangement of the structure, when a photon of sufficient energy impinges on the p-type and n-type junction, an electron is ejected by gaining energy from the striking photon and moves from one layer to another. This creates an electron and a hole in the process and by this process electrical power is generated [16]. The various types of materials applied for photovoltaic solar cells includes mainly in the form of silicon (single crystal, multi-crystalline, amorphous silicon) [3]-[6], cadmium-telluride [3] [4], copper-indium-gallium-selenide [3] [4] [8], and copper-indium-gallium-sulfide [10] [16]. On the basis of these materials, the photovoltaic solar cells are categorized into various classes as discussed in the following sections

2.1. **First Generation Solar Cell**—Wafer Based As it is already mentioned, the first generation solar cells are produced on silicon wafers. It is the oldest and the most popular technology due to high power efficiencies. The silicon wafer based technology is further categorized into two subgroups named as [2]-[4] [10] [16].

- Single/ Mono-crystalline silicon solar cell.
- Poly/Multi-crystalline silicon solar cell.

Single/ Mono-crystalline silicon solar cell: Mono crystalline solar cell, as the name indicates, is manufactured from single crystals of silicon by a process called Czochralski process [16]-[18]. During the manufacturing process, Si crystals are sliced from the big sized ingots. These large single crystal productions require precise processing as the process of "recrystallizing" the cell is more expensive and multi process. The efficiency of mono-crystalline single-crystalline silicon solar cells lies between 17% - 18% [8].

Polycrystalline Silicon Solar Cell (Poly-Si or Mc-Si) Polycrystalline PV modules are generally composed of a number of different crystals, coupled to one another in a single cell. The processing of polycrystalline Si solar cells is more economical, which are produced by cooling graphite mold filled containing molten silicon. Polycrystalline Si solar cells are currently the most popular solar cells. They are believed to occupy most up to 48% of the solar cell production worldwide during 2008 [19]. During solidification of the molten silicon, various crystal structures are formed. Though they are slightly cheaper to fabricate compared to monocrystalline silicon solar panels, yet are less efficient ~12% - 14% [20].

Second Generation Solar Cell: Thin Film Solar Cells Most of the thin film solar cells and a-Si are second generation solar cells, and are more economical as compared to the first generation silicon wafer solar cells. Silicon-wafer cells have light absorbing layers up to 350 μm thick,

while thin-film solar cells have very thin light absorbing layers, generally of the order of 1 μm thickness [21]. Thin film solar cells are classified as;

• a-Si.

• CdTe.

• CIGS (copper indium gallium di-selenide).

Amorphous Silicon Thin Film (a-Si) Solar Cell Amorphous Si (a-Si) PV modules are the primitive solar cells that are first to be manufactured industrially. Amorphous (a-Si) solar cells can be manufactured at a low processing temperature, thereby permitting the use of various low cost, polymer and other flexible substrates. These substrates require a smaller amount of energy for processing [22]. Therefore, a-Si amorphous solar cell is comparatively cheaper and widely available. The "amorphous" word with respect to solar cell means that the comprising silicon material of the cell lacks a definite arrangement of atoms in the lattice, non-crystalline structure, or not highly structured. These are fabricated by coating the doped silicon material to the backside of the substrate/glass plate. These solar cells generally are dark brown in color on the reflecting side while silverish on the conducting side [23]. The main issue of a-Si solar cell is the poor and almost unstable efficiency. The cell efficiency automatically falls at PV module level. Currently, the efficiencies of commercial PV modules vary in the range of 4% - 8%. They can be easily operated at elevated temperatures, and are suitable for the changing climatic conditions where sun shines for few hours [24]. Cadmium Telluride (CdTe) Thin Film Solar Cell Among thin-film solar cells, cadmium telluride (CdTe) is one of the leading candidate for the development of cheaper, economically viable photovoltaic (PV) devices, and it is also the first PV technology at a low cost [8] [25] [26]. CdTe has a band gap of ~1.5 eV as well as high optical absorption coefficient and chemical stability. These properties make CdTe most attractive material for designing of thin-film solar cells. CdTe is an excellent direct band gap crystalline compound semiconductor which makes the absorption of light easier and improves the efficiency. It is generally constructed by sandwiching between cadmium sulfide layers to form a p-n junction diode. The manufacturing process involves three steps: Firstly, the CdTe based solar cells are synthesized from polycrystalline materials and glass is chosen a substrate. Second process involves deposition, i.e., the multiple layers of CdTe solar cells are coated on to substrate using different economical methods. It is already mentioned that CdTe has a direct optimum band gap (~1.45 eV) with high absorption coefficient over 5 × 1015/cm [27]. Therefore, its efficiency usually operates in the range 9% - 11% [8] [28]. CdTe solar cells can be made on polymer substrates and flexible. However, there are various environmental issues with cadmium component of solar cell. Cadmium is regarded as a heavy metal and potential toxic agent that can accumulate in human bodies, animals and plants. The disposal of the toxic Cd based materials as well as their recycling can be highly expensive and damaging too to our environment and society

[10] [24]. Therefore, a limited supply of cadmium and environmental hazard associated with its use are the main issues with this CdTe technology [26]-[29].

Copper Indium Gallium Di-Selenide (CIGS) Solar Cells CIGS is a quaternary compound semiconductor comprising of the four elements, namely: Copper, Indium, Gallium and Selenium [10] [30]. CIGS are also direct band gap type semiconductors. Compared to the CdTe thin film solar cell, CIGS hold a higher efficiency ~10% - 12%. Due to their significantly high efficiency and economy, CIGS based solar cell technology forms one of the most likely thin film technologies. The processing of CIGS is done by the following techniques: sputtering, evaporation, electrochemical coating technique, printing and electron beam deposition [16] [31]. In addition, the sputtering can be a two or multi-step process involving with deposition and subsequent interaction with selenium later, or can be a one-step reactive process. However, evaporation is similar to the sputtering in the sense that it can be used in a single step, two-step or multiple processing steps. The substrates for CIGS material can be chosen from glass plate, polymers substrates, steel, aluminum etc. The advantages of CIGS thin film solar cells include its prolonged life without a considerable degradation. These properties of CIGS indicate an easy solution to enhance the efficiency [8] [22] [28]. Table 1 shows a comparison of popular wafer based solar cell and thin film solar cell [16] [17]

Third Generation Solar Cells: Third generation cells are the new promising technologies but are not commercially investigated in detail. Most of the developed 3rd generation solar cell types are [2]: 1) Nano crystal based solar cells. 2) Polymer based solar cells. 3) Dye sensitized solar cells. 4) Concentrated solar cells.

Nano Crystal Based Solar Cells: Nanocrystal based solar cells are generally also known as Quantum dots (QD) solar cells. These solar cells are composed of a semiconductor, generally from transition metal groups which are in the size of nanocrystal range made of semiconducting materials. QD is just a name of the crystal size ranging typically within a few nanometers in size, for example, materials like porous Si or porous TiO2, which are frequently used in QD [32]. The structure of the QD solar cells is shown in Figure 4 [10]. With the advance of nanotechnology, these nanocrystals of semiconducting material are targeted to replace the semiconducting material in bulk state such as Si, CdTe or CIGS. This idea of the QD based solar cell with a theoretical formulation were employed for the design of a p-i-n solar cell over the self-organized in As/GaAs system [32]. Generally, the nanocrystals are mixed into a bath and coated onto the Si substrate. These crystals rotate very fast and flow away due to the centrifugal force. In conventional compound semiconductor solar cells, generally a photon will excite an electron there by creating one electron-hole pair [33]. However, when a photon strikes a QD made of the similar semiconductor material, numerous electron-hole pairs can be formed, usually 2 or 3, also 7 has been observed in few cases [2] [29].

Polymer Solar Cells: Polymer solar cells (PSC) are generally flexible solar cells due to the polymer substrate. The first PSC were invented by the research group of Tang et al. at Kodak Research Lab. [2]. A PSC is composed of a serially connected thin functional layers coated on a polymer foil or ribbon. It works usually as a combination of donor (polymer) and a acceptor (fullerene). There are various types of materials for the absorption of sunlight, including organic material like a conjugate/conducting polymer [2] [34]. In 2000, Heeger, MacDiarmid, and Shirakawa fetched the Nobel Prize in Chemistry for the discovering a new category of polymer materials known as conducting polymers [35] [36]. The PSC and other organic solar cells operate on same principle known as the photovoltaic effect, i.e., where the transformation of the energy occurs in the form of electromagnetic radiations into electrical current [37]. Yu et al. mixedpoly [2-methoxy-5-(2'-ethylhexyloxy)-p-phenylenevinylene] (PPV), C60 and its other derivatives to develop the first polymer solar cell and obtained a high power conversion efficiency [38]. This process triggered the development of a new age in the polymer materials for capturing the solar power. After significantly optimizing the parameters, researchers achieved efficiency over 3.0% for PPV type PSCs [38]-[40]. These unique properties of PSCs opened a new gateway for new applications in the formation of stretchable solar devices including textiles and fabrics [39]. A modern recycling concept known as polarizing organic photovoltaics (ZOPVs) was also developed for increasing the function of liquid crystal displays utilizing the same polarizer, a photovoltaic device and proper light conditions/solar panel [39]-[41].

Dye Sensitized Solar Cells (DSSC): Recent research has been focused on improving solar efficiency by molecular manipulation, use of nanotechnology for harvesting light energy [42]-[45]. The first DSSC solar cell was introduced by Michel Gratzel in Swiss federal institute of technology [10] [16]. DSSCs based solar cells generally employ dye molecules between the different electrodes. The DSSC device consists of four components: semiconductor electrode (n-type TiO2 and p-type NiO), a dye sensitizer, redox mediator, and a counter electrode (carbon or Pt) [46]. The DSSCs attractive due to the simple conventional processing methods like printing techniques, are highly flexible, transparent and low cost as well [10]. The novelty in the DSSC solar cells arise due to the photosensitization of nano grained TiO2 coatings coupled with the visible optically active dyes, thus increasing the efficiencies greater than 10% [42]-[44] [46] [47]. However, there are certain challenges like degradation of dye molecules and hence stability issues [10]. This is due to poor optical absorption of sensitizers which results in poor conversion efficiency. The dye molecules generally degrade after exposure to ultraviolet and infrared radiations leading to a decrease in the lifetime and stability of the cells. Moreover, coating with a barrier layer may also increase the manufacturing more expensive and lower the efficiency [8].

Concentrated Solar Cells: Concentrating photovoltaic (CPV) has been established since the 1970s [45] [48] [49]. It is the newest technology in the solar cell research and development. The main principle of concentrated cells is to collect a large amount of solar energy onto a tiny region over the PV solar cell, as shown in Figure 5. The principle of this technology is based on optics,

by using large mirrors and lens arrangement to focus sunlight rays onto a small region on the solar cell [8]. The converging of the sunlight radiations thus produces a large amount of heat energy. This heat energy is further driven by a heat engine controlled by a power generator with integrated. CPVs have shown their promising nature in solar world [49] [50]. It ca n be classified into low, medium, and high concentrated solar cells depending on the power of the lens systems [49]. Concentrating photovoltaic technology have the following merits, such as solar cell efficiencies >40%, absence of any moving parts, no thermal mass, speedy response time and can be scalable to a range of sizes.

Perovskite Based Solar Cell: Perovskites are a class of compounds defined by the formula ABX3 where X represents a halogen such as I , Br , Cl and A and B are cations of different size. Perovskite solar cells are recent discovery among the solar cell research community and possess several advantages over conventional silicon and thin film based solar cells. Conventional Si based solar cells need expensive, multiple processing steps and require high temperatures (>1000˚C) and vacuums facilities [51] [52]. The perovskites based solar cells can have efficiency up to 31% [53]. It can be predicted that these perovskites may also play an important role in next-generation electric automobiles batteries, according to an interesting investigation recently performed by Volkswagen [52] [53]. However, current issues with perovskite solar cells are their stability and durability. The material degrades over time, and hence a drop in overall efficiency. Therefore more research is needed to bring these cells into the market place.

Advances in Energy Storage: Since the sunlight is not always available, all these businesses of PV solar cells may not work at night and a lot of electricity will go unused [54]. Therefore energy storage is an important factor in solar cell market. A comparison and summary of various types of solar cells is summarized in Table 1. Several energy storage devices are available in the market but those are highly expensive and a short life span. Recently, in 2014, Harvard University researchers developed a new type of battery based on organic molecules called Quinone. It is found in plants and is economical in a sense that it can store sunlight energy for a couple of days [55]. The world's first solar cell energy storage is introduced by Wu and his co-workers at Ohio State University. This device not only can store energy but can also reduce the costs of renewable energy by 25%, relying on a new aqueous, rechargeable lithium-oxygen battery used in sunlight [56]

In the nutshell, solar power generation has been developed as one of the most demanding renewable sources of electricity. It has several advantages compared to other forms of energy like fossils fuels and petroleum deposits. It is an alternative which is promising and consistent to meet the high energy demand. Though the methods of utilizing solar energy are simple, yet need an efficient and durable solar material. Technology based on nano-crystal QD of semiconductors based solar cell can theoretically convert more than sixty percent of the whole solar spectrum into electric power. The polymer base solar cells are also a viable option. However, their

degradation over time is a serious concern. There are various challenges for this industry, including lowering the cost of production, public awareness and best infrastructure. Solar energy is the need of the day and research on the solar cells has a promising future worldwide.

2. Recent developments on wind renewable energy: Wind power is the conversion of wind energy into a useful form of energy, such as using wind turbines to make electrical power, windmills for mechanical power, wind pumps for water pumping or drainage, or sails to propel ships. Large wind farms consist of hundreds of individual wind turbines which are connected to the electric power transmission network. For new constructions, onshore wind is an inexpensive source of electricity, competitive with or in many places cheaper than fossil fuel plants. Small onshore wind farms provide electricity to isolated locations. Utility companies increasingly buy surplus electricity produced by small domestic wind turbines. Offshore wind is steadier and stronger than on land, and offshore farms have less visual impact, but construction and maintenance costs are considerably higher. Wind power, as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation and uses little land. The effects on the environment are generally less problematic than those from other power sources. As of 2011, Denmark is generating more than a quarter of its electricity from wind and 83 countries around the world are using wind power to supply the electricity grid. In 2010 wind energy production Power management techniques such as having excess capacity storage, geographically distributed turbines, dispatch able backing sources, storage such as pumped-storage hydroelectricity, exporting and importing power to neighbouring areas or reducing demand when wind production is low, can greatly mitigate these problems. In addition, weather forecasting permits the electricity network to be readied for the predictable variations in production that occur.

Wind Power Trends: A steep increase in wind power installation capacity has been observed in India and across the globe as well in the past two decades. Figure 1: a & b shows the recent trends depicting the inclination for the green energy. Fig. a shows that about 50 times growth in the global installed capacity in about 15 years.

Resources become more cost-competitive: With a sharp increase in prices of fossil fuels (i.e. coal and R-LNG) internationally and domestic fuel shortages expected to continue at least over the medium term leading to reliance on imported coal & R-LNG for the power sector, there has been an upward pressure on the overall cost of generation of power using fossil fuels. It is renewable widely distributed and clean and doesn’t produce any greenhouse gases.

3. Recent developments on hydroelectric electric power:

Hydropower is a fuelled by water, so it's a clean fuel source. Hydropower doesn't pollute the air l ike power plants that burn fossil fuels, such as coal or natural gas.

Hydropower is a domestic source of energy, produced in the United States.

Hydropower relies on the water cycle,

which is driven by the sun, thus it's a renewable power source.
Hydropower is generally available
as needed; Engineers can control the flow of water through the turbines to produce
electricity on demand.
Hydropower plants provide benefits in addition to clean electricity. Impoundment hydropower cr eates reservoirs that offer a variety of recreational opportunities, notably
fishing, swimming, and boating. Most hydropower installations are required to provide some pub lic
access to the reservoir to allow the public to take advantage of these opportunities. Other benefits mayinclude water supply and flood control. Hydropower as a Renewable Energy and Its Global Resource Potential and Generation Hydraulic energy in the water is derived from a hydrological cycle, In the hydrological cycle, water constantly flows through a cycle in different phases; evaporating from lakes and oceans, forming clouds, precipitating as rain or snow, then flowing back down to the ocean, seas, dams, rivers, and other water bodies. The main source of energy driving the hydrological cycle is solar and it is estimated that about 50% of all solar radiation reaching the earth is used to evaporate water in the cycle. Because the hydrological cycle is an endless process, hydropower is considered as a renewable energy resource, according to the definition. Due to engineering reasons concerning the integrity of properties of materials for constructing hydroelectric power plants, only freshwater resources are used to generate hydropower. The main characteristics of hydropower potential are flow **Q** and head **H**, as given by the following power equation:

$\mathbf{P_{hydro}}$= **CpH**q, where **Cp** is the hydropower coefficient, a constant.

Hydropower is one of the most efficient power generation technologies. It is used in many countries and the paper has shown that some developed countries solely rely on hydropower for power supply. Therefore, the technology is mature and reliable as well. Hydropower technology can also be part of an integral energy system performing a role as an energy storage device. Hydropower storage system makes it possible for a power utility to store energy and use other energy sources with variable potential such as wind to supply an almost constant load. Some of the drawbacks for hydropower project are the relatively high investment costs and the risks associated. Economically, small-scale hydropower technology is suitable for private investments operating as independent power producers. Considering the financial constraints in many developing countries for large scale hydropower projects, small-scale projects may be one of the solutions to the small development of hydropower in such countries. Further, small-scale hydropower technology has the advantage of being applied as a standalone energy system for rural power supply. Therefore, hydropower can significantly contribute towards increased national energy access and security, mitigation of climate change and reduction of harmful air pollutants, creation of economic opportunities, and, thus, effectively leading to sustainable development.

Recent developments on geothermal renewable energy:

Geothermal energy: Geothermal energy [58] is a kind of "heat-embedded" energy, and can be used directly without conversion, better than other types of renewable energy in some extent. In certain cases, geothermal energy is more convenient to use, and would become an effective "compliment" energy for other types of energy. When renewable energy sources are used, the demand for fossil fuels is reduced.The thermal energy which is generated and stored inside the earth surface is called geo thermal energy. It is very much cost effective and environmentally friendly. With this technology, we can use the steam and hot water produced inside the earth surface to generate electricity. Geothermal energy is generated about 4,000 miles below the surface, in the earth's core .the process takes place due to the slow decay of radioactive particles, the high temperature produced inside the earth and it happens in all rocks . About 10,715 megawatts (mw) of geothermal energy is generated in 24 countries worldwide. The northern districts of Bangladesh show the prospect to explore the geothermal resources. The demand of electricity in urban as well as in the rural areas are increasing, but our production on of electricity is not increasing. The rural demand for electricity can be covered by the production of electricity through geothermal energy. The electricity demand of urban areas can be met then by this saved electricity which is supposed to be provided in the rural areas. Geothermal energy can balance the electricity consumption in these two areas.

Sizes of geothermal plant

Geothermal power plants come in small (300 kw to 10 mw), medium (10 mw to 50 mw), and large (50 mw to 100 mw and higher) capacities. A geothermal power plant usually consists of two or more turbine-generator "modules" in one plant. Extra modules can be added as more power is needed. Binary plants are especially versatile because they use relatively low reservoir temperatures. Small binary modules can be built quickly and transported easily.

Geothermal energy resources

Geothermal resources include dry steam, hot water, hot dry rock, magma, and ambient ground heat. Steam and water resources have been developed commercially for power generation and ambient ground heat is used commercially in geothermal heat pumps; methods of tapping the other resources are being studied. Research centers on lowering costs, improving methods for finding and characterizing reservoirs, and tapping broader resources. Geothermal energy resources: There are four major types of geothermal energy resources. ¾ Hydrothermal ¾ Geo pressurised brines ¾ Hot dry rocks ¾ Magma 9 ELECTRICITY FROM GEOTHERMAL Geothermal power projects convert the energy contained in hot rock into electricity by using water to absorb heat from the rock and transport it to the earth's surface, where it is converted to electrical energy through turbine-generators. Water from high-temperature (>240 °c) reservoirs is partially flashed to steam, and heat is converted to mechanical energy by passing steam

through low-pressure steam turbines. A small fraction of geothermal generation worldwide is generated using a heat exchanger and secondary working fluid to drive the turbine.

Positive attributes of geothermal energy

¾ Geothermal power plants have no smoky emissions. Binary power plants have virtually no polluting emissions. ¾ Geothermal power plants use very little land compared to conventional energy resources and can share the land with wildlife or grazing herds of cattle. They operate successfully and safely in sensitive habitats, in the middle of crops, and in forested recreation areas. ¾ Geothermal wells are sealed with steel casing cemented to the sides of the well along their length. The casing protects shallow, cold groundwater aquifers from mixing with geothermal reservoir waters. This way the cold groundwater does not get into the hot geothermal reservoir and the geothermal water does not mix with potential sources of drinking water. ¾ Geothermal power plants provide very reliable base load electricity. Some plants can increase production to supply peaking power. But geothermal plants cannot be used solely as peaking plants. ¾ Geothermal energy is "homegrown." This will create jobs, a better global trading position and less reliance on oil producing countries. ¾ In large plants the cost is 4-8 cents per kilowatt hour. This cost is almost competitive with conventional energy

Environmental impact

Geothermal energy produces no air emissions other than steam, and the water used in the conventional hydrothermal process often is injected back into the source reservoir. Because available water can be depleted, as can the heat, if too much cooler water is injected, there has been some discussion as to whether geothermal is truly "renewable". FUTURE OF GEOTHERMAL ENERGY because geothermal energy is reliable and renewable, this alternative power source will start to enjoy more growth. However, just remember that geothermal energy will not necessarily be available in many areas due to its volatile needs. Areas like California, Iceland, Hawaii and Japan are just a few places where geothermal energy is being used, many due to earthquakes and the underground volcanic activity. From the long-term perspective, it is necessary for Japan to start studying electricity generation with enhanced geothermal systems, which the United States and Australia have already started researching. In the end, there are high expectations that geothermal energy will again come into the spotlight.

Conclusion:

Renewable energy technologies offer the promise of clean, abundant energy gathered from self-renewing resources such as the sun, wind, earth, and plants. Each of the renewable energy technologies is in a different stage of research, development, and commercialization and all have differences in current and future expected costs, current industrial base, resource availability, and potential impact on greenhouse gas emissions. At present, the scale of geothermal power

industry is small because of the limitation of easily exploitable high temperature geothermal resources, therefore, the development of geothermal resources have to be primarily focused on utilization of ground source heat pumps which can make good use of the enormous low temperature geothermal resources. Renewable energy is now the current focus for the safer and greener earth that avoids the use of dirty energy

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16: A CASE STUDY ON AWARENESS ON SOLID WASTE AS RENEWABLE ENERGY SOURCE AND ITS APPLICATION

Roselin K*, Sneha R, Daizy F. and Laveneya G.
Sri Bhagawan Mahaveer Jain First Grade College
K.G.F.
Author for correspondenceroselin.jgi@gmail.com

Abstract

Renewable energy is growing rapidly and becoming a popular alternative source of energy. Public awareness is important towards accomplishing the goal in implementing Renewable energy. The aim of the study is to Identify and explore awareness of solid waste as a renewable energy. A questionnaire was prepared and analysed.85% of the respondents have heard and knew about renewable energy while 15% have not. 40%of the respondents have accepted that the solid wastes are segregated and disposed and 60% has accepted that unable to segregate due to lack of time and 40% hesitate to segregate. It shows that public requires awareness on segregation and the disposal of solid waste to help the municipality. The survey found that 80.0% of the respondents aware of the negative impacts of pollution and preferred the solid waste as a renewable energy to create a sustainable country. 70% of the respondents accepted to replace the conventional energy with renewable energy as they realized the benefits.95% of the respondents supported the municipal service in the disposal of solid waste and 80% of the respondents said that the solid waste can be used as renewable energy source and the technologies were not optimized. 60% did not know about the government's effort to enhance the implementation of renewable energy and 40% of the respondents knew about the government initiatives. The reason could be either they were less exposed or not concerned. Hence the government should take initiatives to create awareness and adopt the different technologies of solid waste as a renewable energy source.

Keywords: Government, solid waste, renewable energy, waste management, technology

Introduction

Throughout the world, energy is indispensable in our daily activities and surroundings. Conventional sources such as coal, fossil fuels, and gas are processed daily to provide energy

and electricity for buildings, households, and industries which are essential for the development of a country. However, natural resources will soon be depleted and will last less than 100 years. Renewable energy is a form of energy that are naturally obtained from the environment and from sources that can be restored themselves naturally and which cannot be depleted when used, which is also referred as clean energy that is sustainable – something that can't run out in human life period, example for renewable energy sources which includes solar energy, hydro power,biomass,geothermal,tidal energy etc.], natural resources are massively consumed which leads to a rise in cost. Carbon dioxide, which is released from fossil fuels, has been causing climate change and global warming [4-5]. Therefore, nowadays, humans cannot rely on conventional sources anymore and should progress into more friendly energy sources especially from nature [6]. The cost-saving measures could be achieved by exploring other clean and recyclable sources of energy [7-8]. Renewable energy has been known as environmentally friendly and has an infinite quantity. For instance, solar, hydro, wind and biomass energy [9-11] are prominent energy sources in generating electricity. The Ministry of Energy, Green Technology and Water of Malaysia (MEGTW) is increasing their efforts on RE and energy efficiency so that the environment and natural resources can be preserved for a long time. Re usage in generating electricity is emphasised by the Ministry together with the Five Fuel Policy. This policy was suggested in the Eighth Malaysian Plan (2001−2005) and became prominent under the Ninth Malaysian Plan (2006−2010) [12].In achieving the government goal, the community should support the government by ensuring50% implementation of renewable energy by 2050. However, public awareness of environmental problems in Malaysia remains low coupled with the lack of exposure [13-14] of alternative energy. In addition, encouraging people to move towards using renewable energy in their daily activities is not as well-practised as in developed countries. Thus, the efforts in applying green technology have to be done persistently so that people can change their lifestyle to support a sustainable environment [15-16]. The utilisation of fossil fuels for a long time ago enables the community to live in a comfort zone in which the dependency on this energy has led to excessive carbon dioxide emission. This phenomenon will lead to negative effects in the future. However, the public has shown little concern about the effects, which indicate their lack of awareness about environmental issues [17-18].Thus, it is necessary to act significantly to replace conventional energy source with

alternative energy. Raising public awareness on this issue involves educating the society and by taking the initiative to encourage people to use alternative energy [19-21]. In this study, the survey was focused on public awareness, basic knowledge and proposal suggestions on renewable energy. From our knowledge, there is no previous survey cover the whole Malaysia who lives in rural and urban area. Even though rural area not much develops as an urban area, the renewable energy information must be known by all level of people so that people will concern the latest technology that will be implemented soon. The most study specifically on secondary students, university students and pre-service teacher [22-25] which are not including veteran whose age more than 50 years old. This survey is important to recognize public concern and awareness towards renewable energy knowledge and government's effective initiative in replacing the current energy sources. Therefore, this study aims to identify and explore public awareness of renewable energy according to their educational level and residential area in the various range of age. The perspective taken concerning knowledge of renewable energy based on residential areas is related to knowledge of renewable energy and technology. This International Conference on Sustainable Energy and Green Technology 2018 IOP Conf. Series: Earth and Environmental Science 268 (2019) 012105 IOP Publishing doi:10.1088/1755-1315/268/1/012105 3 survey can evaluate the extent of the public's concern regarding the importance of renewable energy for better sustainability of the future. The government will gain information about the public's awareness level and come up with better ideas to encourage people to use renewable energy technologies in their daily life activities to help save the environment.

Solid waste holds the greatest potential as biomass source in Kolar District. The rapid expansion of industry has led to increased urbanization and growing population. These factors have dramatically increased the amount of SW (solid waste) generated in Kolar District. However, issues related to environmentally sound SW management—including waste decrease and clearance—have not been addressed sufficiently. This study presents an overview on solid waste that can be used as a source of bioenergy in Kolar District including SW as biomass sources. The management of solid waste and valorization is based on an understanding of SW′s composition and physicochemical characteristics. The results show that organic matter represents

59% of waste, followed by paper–cardboard 12%, plastic 8%, miscellaneous 8%, metals 7%, glass 4%, and wood 2%. The technology of WTE (waste-to-energy) incineration, which recovers energy from discarded SW and produces electricity and/or steam for heating, is recognized as a renewable source of energy and is playing an increasingly important role in MSW management in Kolar District. Solid waste is an unwanted product which is not a liquid or gas in our surroundings and from our daily products. Solid waste is commonly known as the municipal solid waste, trash or garbage that can be defined as the post-consumer solid waste generated by residence, commercial, and institutional(schools, hospitals, offices, etc)sources. These solid waste products includes organic or inorganic household waste, local authority as well as solid both commercial and industrial waste which have all thrown as solid waste. Solid wastes are combustible and are being used in some areas as renewable source of energy. Solid wastes are classified based on origin of waste i.e municipal solid waste, industrial solid waste, and health care solid waste. Solid wastes holds the greatest potential as biomass source .municipal and industrial waste is also a useful source of energy, but are different forms of biomass. solid waste can be used to generate electricity and heat energy from municipal solid waste. The migration of people from rural to urban areas and industrial expansion leads to huge amount of waste generation leads to socio-economic and environmental issues. The objective of this study is to evaluate the extent of the public's concern regarding the importance of renewable energy for better sustainability of the future. The government will gain information about the public's awareness level and come up with better ideas to encourage people to use solid waste as renewable energy in their daily lifeactivities to save the environment.

Description of District

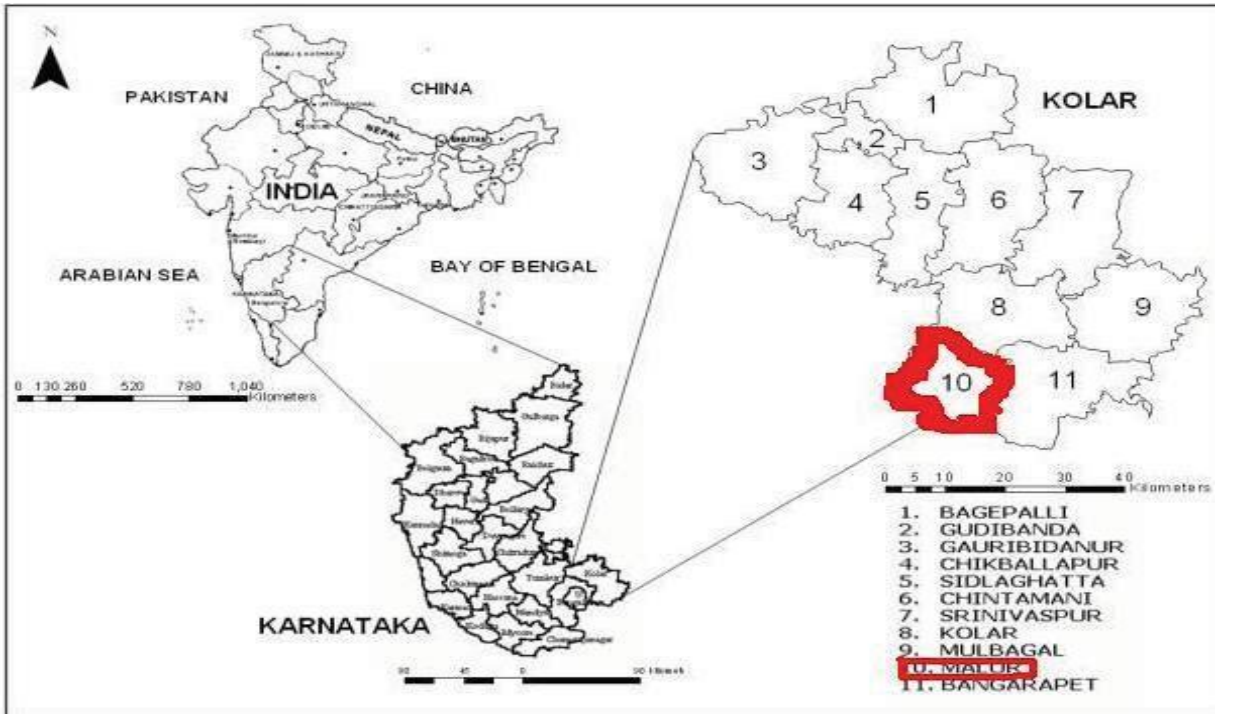
Kolar the Golden city of India is a city in the Indian state of Karnataka. It is the headquarters of Kolar District and is known for production of Milk, which recently surpassed Denmark, and gold mining. Kolar is popularly known as the land of silk, milk, Mango, (National fruit of India) and gold. Kolaramma is considered as goddess of city of Kolar. Kolar has APMC market which is 2nd largest in Asia, Largest in South India.

Kolar is leading India in production of Mango, Tomato,Milk which exported to various other nations like UK, USA, UAE etc. Kolar. Kolaramma and Someshwara are notable temples in

Kolar. The Kolaramma temple, built in Dravida Vimana style during the secondnd century, is dedicated to Shakti. It underwent renovations under Rajendra Chola I in the 10th century and the Vijayanagara kings in the 15th century. Someswara Temple is an example of 14th-century Vijayanagara art.

Kolar's early history was compiled by Fred Goodwill, superintendent of the Wesleyan Tamil mission in Bangalore and the Kolar Gold Fields, and his studies have been published in a number of journals. Older than Bangalore, Kolar dates back to the second century. The Western Gangas made Kolar their capital, ruling Mysore, Coimbatore, Salem and Travancore. During the 13th century Bhavanandi composed Nannool, his treatise on Tamil grammar.

Karnataka Political map showing Kolar(TSDF)



Methodology

Sample

In the development stage of solid waste management implementation, the study on public awareness must be emphasised to ensure that the people understand the purpose and benefit of solid waste management in their daily activities. Thus, a set of questionnaire was prepared to determine the level of public awareness about solid waste management renewable energy based on their educational level and residential area. The questionnaire was distributed within the months of October 2021. The survey questionnaires were distributed through emails and social media to family, neighbours, students, academicians, and senior citizens. A total of seventy five valid responses were collected and analysed. The respondents who answered the survey were Kolar District citizens between the age of 16 to 50 years old from various levels of educational qualifications with approximately 83.7% female and 27.3% male. The percentage of respondents according to age range is as follows: 16–25(60.0%), 26–35(20%), 36–45(12%), and 46–50(8.0%). The information obtained included the respondents' living address in the rural area, which affected their knowledge and information about renewable energy. From the collected data, most of the respondents were degree holders, indicating that they might be exposed to the current issues on green energy.

Measure

The questionnaire was designed based on public concern on the existence availability of solid waste management. The questions in the questionnaire discussed briefly on the knowledge of current issues on solid waste management and its application as renewable energy. opinion on the implementation of solid waste as renewable energy , concern on government initiatives, knowledge of renewable energy and suggestions for enhancing public awareness towards solid waste as renewable energy.

Measure

The questionnaire was designed based on public concern on the existence of renewable energy. The questions in the questionnaire discussed briefly on the knowledge of current issues on renewable energy and technology which covered the impact of renewable energy, opinion on the implementation of renewable technology, concern on government initiatives, knowledge of

renewable energy, cost of green technology, and suggestions for enhancing public awareness towards renewable energy.

Results and discussion

The data analysis shows that the majority (85%) of the respondents have heard and knew about renewable energy while 15% have not (Fig.1) .This result shows that public concern on renewable energy is high and information about renewable energy was received by the people who live in Kolar District.

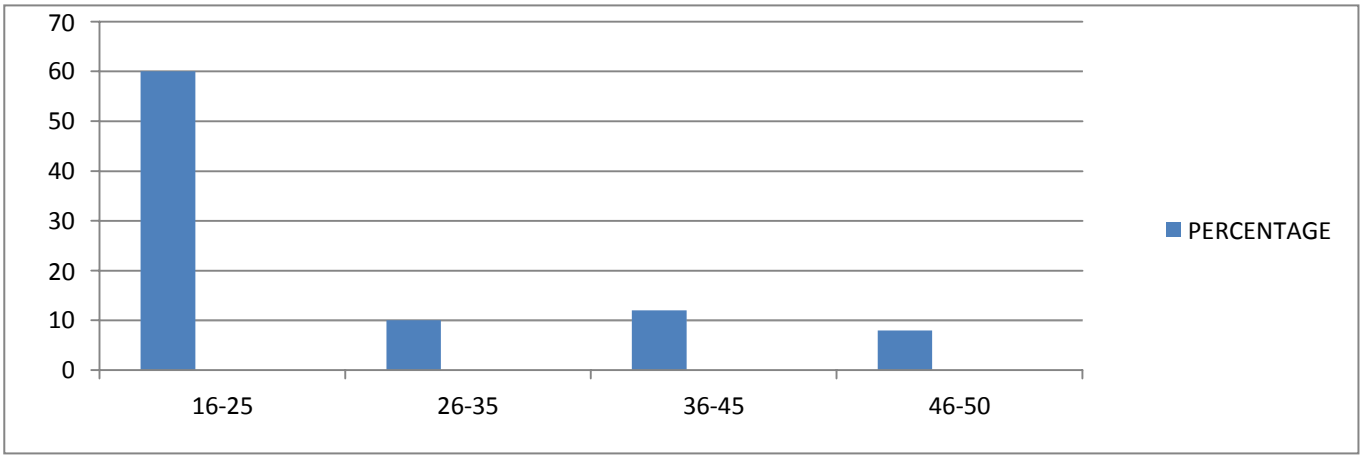
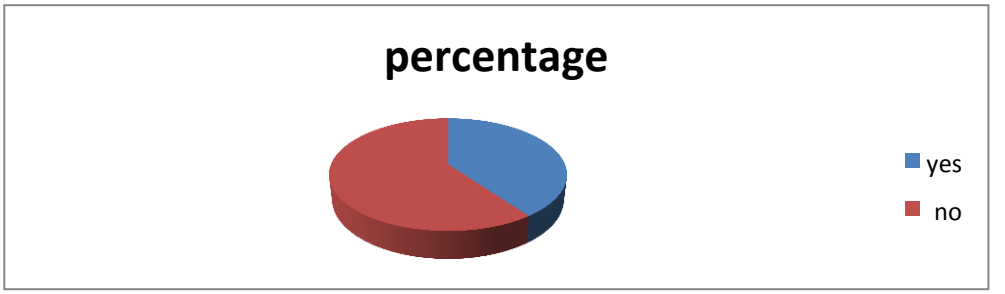


Figure 1.Respondents who have heard and know about renewable energy

The information could be gained through friends, teachers, advertisements, and events. This shows the information on renewable energy was successfully delivered in different areas of Kolar District. Moreover, easy internet access nowadays facilitates people especially those living in rural areas to receive the latest news instantaneously. This data can be used by the government to enhance people awareness towards renewable energy to ensure people understanding on the importance of renewable energy.

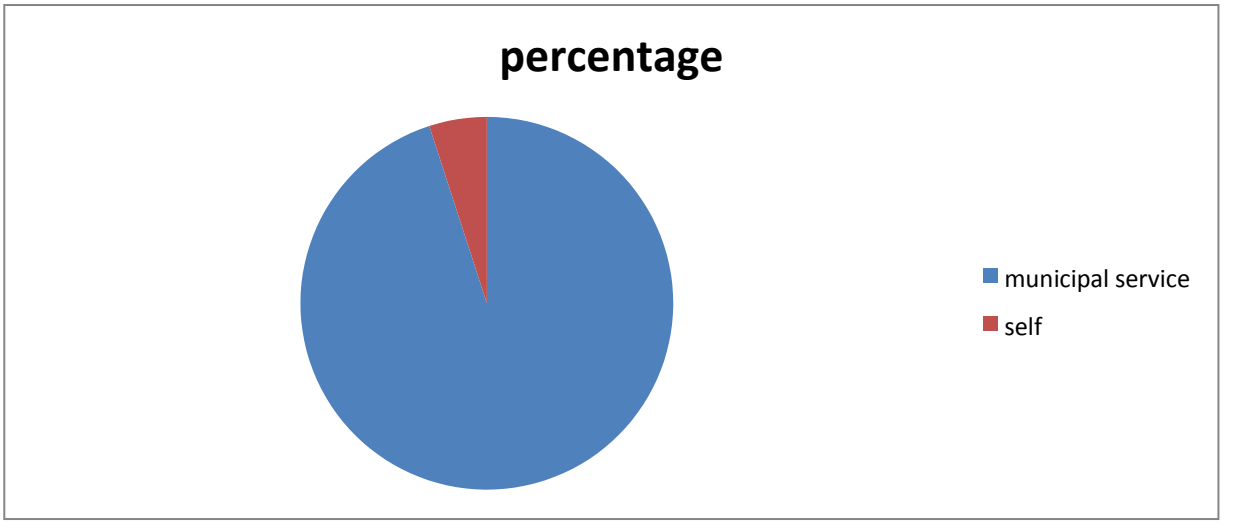
40%of the respondents have accepted that before disposal of the solid waste from the residential area, the solid wastes (food and plastic) are segregated (Fig.2) and disposed and the remaining 60% has accepted that unable to segregate due to lack of time and 40% respondent that they hesitate to segregate. This result shows that public requires awareness on segregation and the disposal of solid waste to help the municipality to utilize the solid waste as renewable energy.

Figure 2. Segregation of Solid wastes



In addition, the survey found that 80.0% of the respondents preferred to employ solid waste as a renewable energy in their daily lives. This data demonstrates that people are ready to implement solid waste as a renewable energy in their daily life activities in order to create a sustainable country. The 70% of the respondents support the idea of replacing conventional energy sources with renewable energy sources as they realized the benefits that the citizens and country could gain from the RE implementation.

Figure 3.Method of disposal of solid waste



95% of the respondents supported the municipal service in the disposal of solid waste (Fig 3) and 80% of the respondents said that the solid waste can be used as renewable energy source. 80% respondents said that the Renewable energy technologies were not optimized and hence the

government should take initiatives to create awareness and adopt the different technologies of solid waste as a renewable energy source.

Since the government target is to implement 50% of renewable energy by 2050, the question on the government initiative was included in the survey questionnaire. Most of the respondents (60%) did not know about the government's effort to enhance the implementation of renewable energy. Only 40% of the respondents knew about the government initiative. Most of the people who knew about the initiative were those who worked for the government or the private sector with exposure to the latest government news and projects. As for the respondents who did not know about the initiative, the reason could be either they were less exposed or not concerned. The public should be educated with wide knowledge of technologies for renewable energy source. Government also has to expand the latest renewable energy news to the public for better understanding on what progress going on. The long term knowledge about renewable energy is the only option for a safe and environmentally compatable energy.

Conclusion

Solid waste holds the greatest potential as biomass source in Kolar District. The rapid expansion of industry has led to increased urbanization and growing population. These factors have dramatically increased the amount of SW (solid waste) generated in Kolar District. This study presents an overview on solid waste that can be used as a source of bioenergy in Kolar District References A questionnaire was prepared and analysed.85% of the respondents have heard and knew about renewable energy while 15% have not . 40%of the respondents have accepted that the solid wastes are segregated and disposed and 60% has accepted that unable to segregate due to lack of time and 40% hesitate to segregate. It shows that public requires awareness on segregation and the disposal of solid waste to help the municipality. The survey found that 80.0% of the respondents aware of the negative impacts of pollution and preferred the solid waste as a renewable energy to create a sustainable country. 70% of the respondents accepted to replace the conventional energy with renewable energy as they realized the benefits.95% of the respondents supported the municipal service in the disposal of solid waste and 80% of the respondents said that the solid waste can be used as renewable energy source and the

technologies were not optimized. 60% did not know about the government's effort to enhance the implementation of renewable energy and 40% of the respondents knew about the government initiatives. The reason could be either they were less exposed or not concerned. Hence the government should take initiatives to create awareness and adopt the different technologies of solid waste as a renewable energy source.

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(26) Environment impact assessment report of integrated waste management facility comprising of TSDF.

17: CURRENT STATUS OF RENEWABLE ENERGY RESEARCH AND IT'S APPLICATIONS

Shiva Raju S[*], Manoj S V[1], Deeksha Yand Dr. B P Suma

Department of Chemistry, Central College,

Bengaluru City University, Bengaluru-01

Author for correspondence- shivarajus319@gmail.com

Abstract

The rapid growth in urbanization has brought increase in the level of greenhouse gas emissions and the growing population with the increase in fuel prices is the main driving forces behind efforts to exploit renewable energy sources more efficiently. Renewable energy sources come from various natural resources and are also naturally replenished easily. Renewable energy technologies are the potential solutions to current environmental problems. This article highlights the renewable energy trend in India with Indian government policies and initiatives to promote solar energy in India, and its industrial applications. Special attention has been given to the different electro catalytic materials developed to address the problems of energy conversion and storage.

Key words: Renewable energy, solar energy, single atom electrocatalyst, Hydrogen evolution reactor, Nano particles.

Introduction:

Energy is a dynamic contribution for the socio-economic development of the country. As a result of the generalization of agricultural, industrial and domestic activities, the demand for energy has increased remarkably, especially in emergent countries. Energy is one of factors play a major key role in sustainable development of any nation. It's been 75 years since we got our independence and still are under the tag 'Developing Country'. As the conventional sources have a menacing shadow on our present and future global safety,

there is a crucial requirement to promote renewable energy in Indian power sector to mitigate the climate change and to have our future prepared for the adverse effects of fossil fuel crisis. [1]

Renewable energy is collected from sources which are naturally replenished on human timescale such as wind, sunlight, geo-thermal heat etc. It is the cleanest source of energy which reduces use of fossil fuels as well as carbon emissions. As fossil fuels are seeing a down phase and causing threat to our environment and ecosystem. Since there is an increasing demand for energy, these renewable energy resources come in the way as the best solution for energy crisis as they are clean, green energy and inexhaustible. [2]

As India struggles with coal shortage, renewable energy seems to be the blue sky. India is the only country in the world to have an exclusive ministry for renewable energy development. With the expansion of renewable energy, we can also create new industries and jobs and can move world towards a safer side. Also there is a great demand for energy, increasing investments and sunlight available throughout the year which makes India more suitable for renewable energy production. [3]

However, the persistent problems related to renewable energy such as intermittency of renewable power and battery storage per unit is currently high and many more. Therefore, to mitigate these problems, many researches have been going on and various research groups are coming forward with novel materials which have tailor made properties to address the problems of energy conversion and conservation. In this article we are focussing on current research trend in the field of renewable energy conversions and storage.

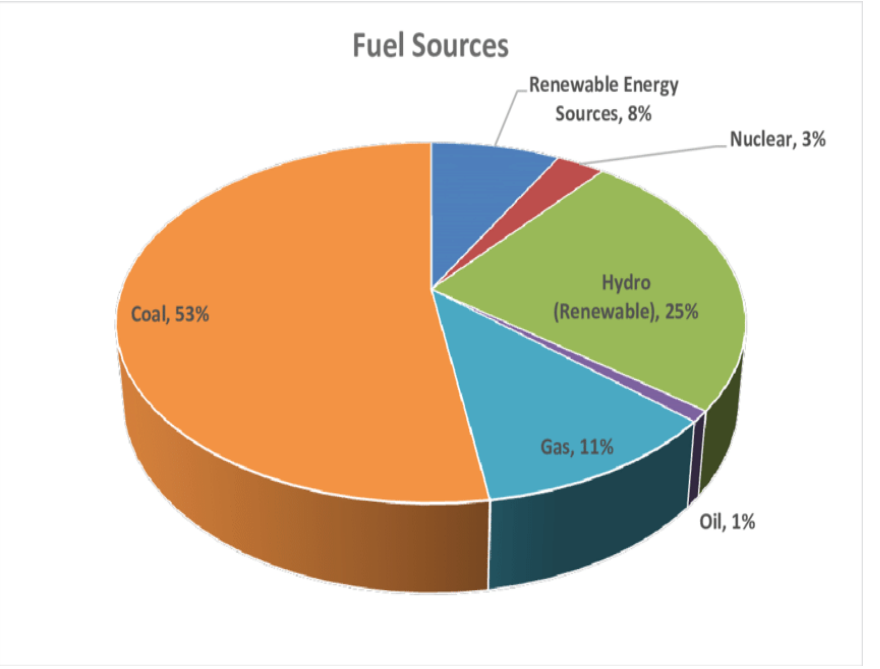

Figure 1: India current renewable energy sources as of July 2009 (Source: India Energy Data, Statistics and Analysis-Oil, Gas, Electricity, Coal)

Current status

The Government Of India has taken many initiatives to boost the Indian renewable energy sectors such as Pradhan Mantri Kisan Urja Suraksha Evam Utthan Mahabhiyan (PM KUSUM) to provide clean energy to more than 3.5 million farmers by solarising their agricultural pumps, Roof Top Solar (RTS) programme with a target of achieving cumulative capacity of 40,000MW by the year 2022, Solar Parks Programme to facilitate solar project developers to set up projects in a plug-and-play model, Green Energy Corridors to facilitate the evacuation of electricity from renewable energy projects, Greening Of Islands with an intend to fully convert Andaman and Nicobar, Lakshadweep islands to Green Energy where energy needs will be met using Renewable Energy sources. [4]

The Ministry of New and Renewable Energy (MNRE), Government of India is set to achieve 450 GW of renewable energy installed capacity by 2030. Also 39 percent of our installed capacity is from non-fossil fuels and is expected to reach 40 percent by 2022. The

Government of India has recently launched the production linked incentive scheme for the manufacture of high efficiency solar PV modules. India is developing the National Green Hydrogen Energy Mission to scale up Hydrogen production and utilisation across various sectors. [5]

If we look at the power demand, production and supply India FY 2021, Karnataka heads the India's list of states producing solar energy by producing 7100 MW. The northern region of India was expected to have the highest energy requirement at over 421 thousand million units. However, the availability of energy was at a surplus of 4.7 percent in the same region that year.

It's been hundreds of years since the idea of combination of sunlight and catalyst could provide both renewable energy and means to transform carbon dioxide. It is also obligatory that the attempt to convert carbon dioxide to liquid fuel also releases oxygen. It is good that, we have viable catalysts to ensure the oxidation of water. For the reductive cycle, discussions are going on as to whether to convert carbon dioxide to methanol or ethylene by direct electroreduction or to use derivative of the catalysed water-gas shift reaction at the primary stage, followed by a small series of catalysed processes leading to succession hydrogenation of carbon monoxide to produce fuel. Many attempts have been made to increase catalysis chemistry and also to produce speciality chemicals by the use of micro algae. [6]

Single atom electrocatalysts (SAEC's) have attracted recent researchers by its fascinating catalytic responses which are incomparable with conventional catalysts. The electrocatalytic performances of SAEC's are closely related to the specific metal species, their co-ordination number, chemical identity of nearest neighbouring atoms, etc. They are the best catalysts for electrochemical conversions like oxygen reduction reactions, oxygen evolution reactions, hydrogen evolution reactions, nitrogen reduction reactions, carbon dioxide reaction reactions and show high performances. Single-atom electrocatalysts with tunable local environments have shown great promise in the direction of diverse renewable energy conversions. [7]

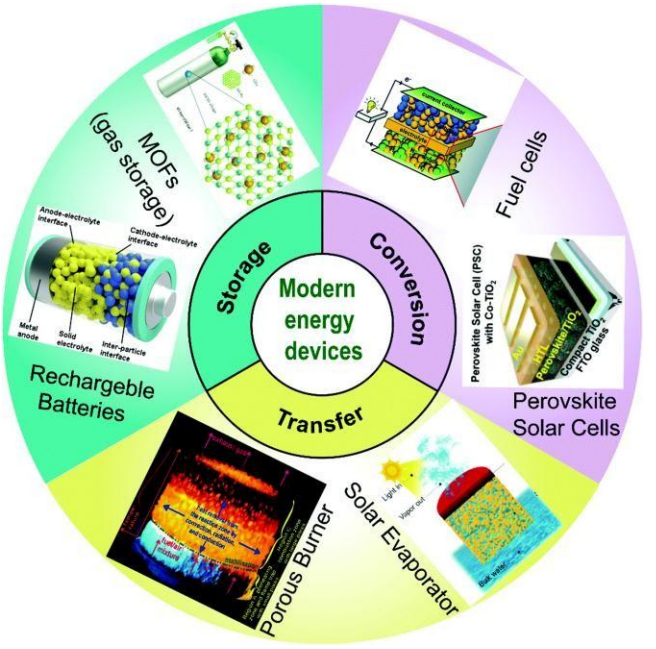

Figure 2: Schematic representation of advanced energy devices that host modern energy materials

The Hydrogen Evolution Reactor (HER) based catalyst which uses noble metal is one of the emerging renewable energy sources to derive high energy density hydrogen fuel from electrochemical water splitting. As these catalysts are not abundant and costlier, development of catalysts based on carbon based composite materials have opened up, which are favourable alternative for HER in terms of abundancy and cost. In this direction graphene capsules decorated with boron-carbon-nitride sheets have been developed by pyrolysing a mixture of pyridine borane and custom based GCS. The carbon rich BCN at GC sheets are also prepared via the CCVD approach as metal-free catalysts for hydrogen generation reactions. [8]

S M Musavi et al. developed a nanocomposite in the renewable solar energy storage systems and its applications to thermal comfort, and energy management. In this work, a stable phase charge material (PCM) nano-composite has been designed for solar energy absorption and storage in building. N-nonadecane as PCM, Silicon dioxide (SiO_2) nanoparticles as supporting materials and graphene as thermal conductivity promoter were used to obtain N-nonadecane-SiO_2-Graphene nano composite. Here the solar energy

absorption and storage rate of the cement board integrated with obtained nano composite was enhanced due to the improved interfacial thermal transfer by graphene compared to the cement-only board under equivalent conditions. [9]

The applications of renewable energy sources are numerous. It is well known that they are clean and green and inexhaustible energy resources. Solar energy source have wide applications in solar home systems, dryers, solar cookers, thermal power generators, water heaters etc. Wind energy helps in power generation in wind generators, wind mills, water pumps etc.

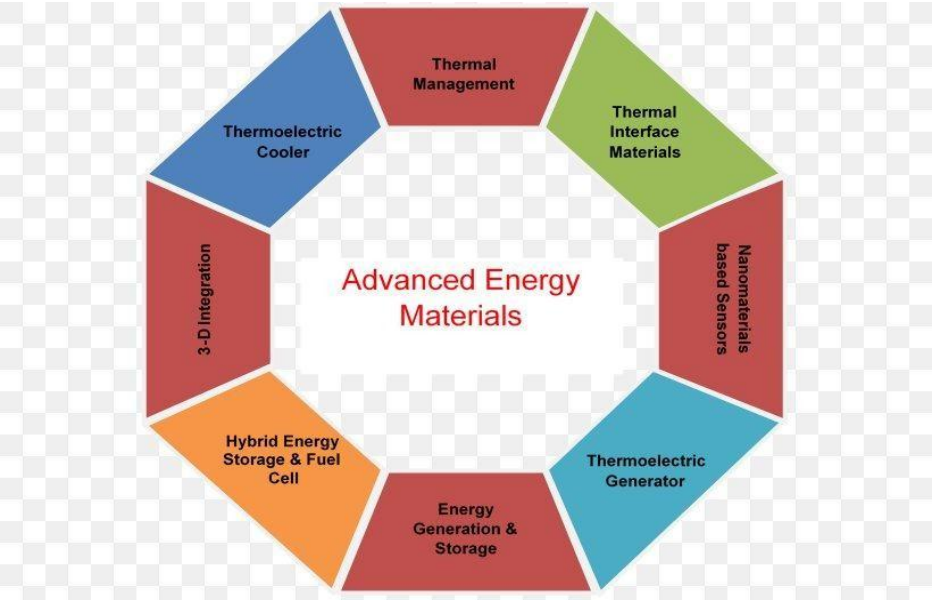

Figure 3: Advanced Energy Materials for diverse applications.

Single atom electro catalyst with tunable local environments have shown greater capability in renewable energy conversions. More understandings of it would accelerate the development of new generation SAECs with high activity, selectivity and stability for a wide range of renewable energy conversions. The GSN3 management nanocomposite absorbs and stores solar thermal energy and has the potential to be used for renewable energy storage and energy management. The DSC measurements have shown that it had a phase change temperature of about 22.81, latent heat of capacity of 120.40 J/g and had excellent thermal durability after 500 thermal cycles.

Recently, hollow nanostructures including nanocages and nanoframes had appeared as an expanding class of promising electrocatalysts. The hollow nanostructures could expose a high proportion of active surfaces for electrocatalysis. In this regard, carbon-rich graphene capsule-decorated boron-carbon-nitride (BCN@GC) sheet has been developed by Liu et al. Here the 3D hollow structure of GC increases surface area of BCN by providing more exposed active sites for the hydrogen adsorption or desorption reaction. The higher performance was based on a large specific surface area and reduced electrical resistance. The long term stability proposes an effective metal free HER electrocatalyst for commercial application in the renewable energy field [10].

Conclusions and future perspectives

It has been a long time in understanding the renewable energy, its sources and generation. There is no need for the re-invention of the wheel. Of course, many researchers have been still attempting to understand renewable energy in a better way and to get a best result out of it. Single-atom electrocatalysts with tunable local chemical environments have shown great potential in diverse renewable energy conversions. The availability of facile and scalable approaches is a criterion for the application of high-performance electrocatalysts with accurately tailored chemical strategies for renewable energy conversions. Therefore, there is a massive research possible in the area of multicomponent hollow nanostructures with greater complexity than binary or ternary systems as electrocatalysts. Additionally, examples of hollow nanostructures of many catalytically important metal compounds, such as metal oxides, sulfides, and phosphides, are very few. The ultimate goal is to substitute the current precious-metal-based electrocatalysts with further abundant transition metals. It should be stressed that there have been tremendous advances in operando spectroscopic tools and in protocols for producing single-molecule catalytic sites that promise well for future developments in this field. Even Solar photo voltaic energy could provide more energy in near future compare to other renewable energies.

Now, we have reached a position where we are producing renewable energy in huge amounts to overcome the problems faced due to the usage of non-renewable sources. We should understand the importance of the usage of renewable energy and should encourage

its growth as to promote global safety. The ultimate aim is to achieve a bright energy future with minimal environmental impacts.

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11. Sub theme: Renewable Sources of Energy for global sustainable environment

18: RENEWABLE RESOURCE "A SUITABLE CHOICE FOR BETTERMENT".

Shankar Madawale, Ramappa A Yadahalli and Shraddha S

Abstract:

Energy is the basic necessity for the progress of the nation. In the world of rapid evolution, the major revolution was the idea of utilization of renewable resources. It brought drastic changes in every possible area by overcoming the limitations of conventional sources of energy. Sun, being the most powerful weapon acts as the source of all energies. As it can be transformed into multiple forms providing the energy source for various uses. The renewable resources not only are the abundant sources of energy but also its characteristics of minimizing environmental impacts, produce lesser secondary wastes and helps in developing the sustainable global environment. Even though its introduction, installation and implementation are risky, its utilization provision should be promoted to have promising globally sophisticated environment for future generation.

Introduction

As the population in the world is increasing with loop and bound, the demand of energy is uncontrollably increasing in spite of strenuous efforts made to increase the efficiency of energy use. With the rapid depletion of conventional energy sources and increasing energy demand, worldwide primary energy consumption has grown by 1.8% in 2012 [1]. Due to urbanization andindustrialization, fossil fuel reserves are deteriorating. Renewable resources are replenished by nature and are the form of sun which is unlimited energy block. The use of conventional sources of energy not only diminishes with exploitation but also causes environmental disasters. Global warming due to greenhouse gas emissions and health risks are the adverse impacts which are non- negligible. It has been the main objective worldwide, to have control over environmental issues. So, there are intensified researches and projects to protect the environment with more efficient and green power plants [1]. Renewable resources serve dual goals of reducing greenhouse gas emissions and providing cost- effective sufficient energy sources. Renewable energy resources are those resources which are called as an alternative source of energy as it can be used to produce energy again and again. Renewable energy

sources that meet the domestic energy requirements have the potential to provide energy services by zero or almost zero emissions of both air pollutants and greenhouse gases. Renewable energy system development will make it possible to resolve the presently most crucial task like improving the energy supply reliability and organic fuel economy. It also plays a major role in solving problems of local energy and water supply, increasing the standard of living and hence also by providing the employment opportunities for the local population that ensures the all-round development in the remote areas [5]. Renewable energy systems have benefited from developments in electronics, biotechnology, material sciences and in other energy areas [2]. The renewable energy replaces the conventional fuels and four distinct areas such as power generation transport fuels hot water and rural energy services [4]. It is surprising that in today's world around 1.4 billion people are lack access to electricity while 85% of them live in rural areas. Hence, it makes a point of usage of renewable resources.

Discussion

Climatic impacts

The major reason for adopting the renewable resources is the climatic impact that is caused by the conventional sources of energy. It has been the major concern for humanity in the 21st century. The use of conventional energy sources has brought the result of increased frequency and intensity of the heat waves, reduction in the cold related deaths, increased floods and droughts changes in the distribution of the vector borne diseases and their effects on the risk of disasters and malnutrition. The most important problem is the global climate change which is caused by global warming or greenhouse effect. The concentration of CO_2, CH_4, CFCs, halons and N_2O, ozone and pre-oxy acetonitrile nitrate in the atmosphere is acting to trap the heat radiated from the Earth surface and is raising the surface temperature of the earth. In addition to this, the industries contribute directly or indirectly through electricity consumption about 37% of the global greenhouse emissions of which over 80% is from energy use. Renewable resources of energy access key to overcome this disastrous issue [4].

Another valid reason to adopt the renewable source of energy is the energy efficiency and to make up for the demand of energy source. Electricity has the greatest demand. Global electricity

generation from renewable resources is expected to grow 2.7 times between 2010 and 2035 as indicated [3]. Hence, the renewable resources make a huge difference in bringing out different forms of energy that will ensure to have the sustainable environment both in rural and urban areas.

Description of renewable energy sources

Sun is the source of all energies. On the earth planet, solar energy is the most abundant energy resource and it is available for the use and its direct (the solar radiation) and indirect (wind, hydro, biomass, ocean, etc.) forms.

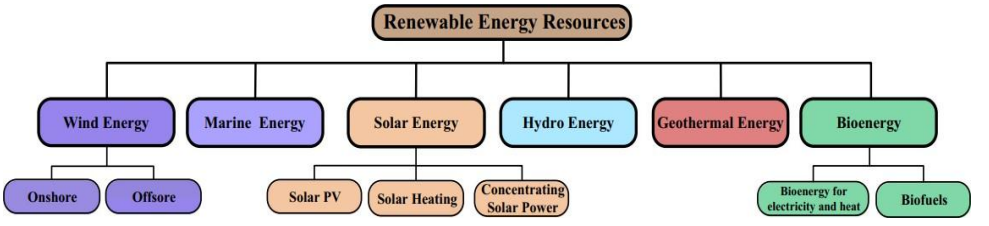

Fig.1: Schematic representation of renewable resources [1].

Solar thermal application

There is the vast scope to utilize available solar energy for thermal applications such as cooking, water heating, crop drying, etc. Solar cooking is the most direct and convenient application of solar energy. Solar water heaters are another application in the field of thermal solar thermal energy. Solar drying technology offers an alternative which can process the vegetables and the fruits in clean and hygienic and sanitary conditions with great standards of zero energy costs. It saves energy, time, occupies less area and improves product quality and ensures environmental protection [5]

Concentrating solar power

Concentrating solar power technologies produce electricity by concentrating direct beam solar irradiance to heat a liquid, solid or gas that is then used in downstream process for electricity generation [1]. This also has low operating cost and high efficiency and can produce a reliable

supply of energy by utilizing thermal storage. CSP applications range from small distributed system of tens of KW to large centralized power standards of hundreds of MW [4-5].

Photovoltaic

Photo voltaic systems directly convert solar energy into electricity. It works on the principle of photo voltaic effect which depends on interactions of photons with energy equal to or more than the band gap of PV materials. The basic building block of a PV system is the PV cell which is a semiconductor device that converts solar energy into direct current electricity. The PV models combined with a set of additional application dependent system components (inverters, batteries, electrical components and mounting systems) form a PV system. PV system are highly modular that is the modules can be linked together to provide power ranging from few Watts to tens of MW. The most established solar PV technologies are silicon-based systems which are also called as thin film models which consists of non-silicon semiconductor material is highly important [1]. Off grid PV systems have a significant opportunity for economic application in the UN electrified areas of developing countries. Grid tied PV systems use an inverter to convert electricity from direct current to alternating current and then supplied the generated electricity to the electric grid [1]. Organic materials have recently been intensively studied for photovoltaic applications not because of the harvesting the sun's power more efficiently but because power generation from organic photovoltaic materials will cost considerably less than other photovoltaic technologies [4]. 80% of the present worldwide energy use is based on fossil fuels most parts of India receive 427 kilo of energy radiation per square meter per day with 250 to 300 sunny days in a year. India has a good level of solar radiation receiving the solar energy in spite of this abundance only 0.04 % of the basic power used by humans comes directly from the solar sources because using a photo all time panel cost more than the burning fossil fuels [4].This causes no air or water pollution and is available abundantly [1] Yet, the solar energy usage is minimal because the energy source depends upon the availability of the sunlight. Deficiency of efficient solar energy collection would impact majorly [1-2]. Despite advances in technology, Solar panels remained almost prohibitively expensive [4]. There is necessity to have the storage and backup in case of the cloudy days. With respect to the environmental impacts, solar energy might cause soil erosion, landscape change and production of hazardous wastes [1].

Bio energy or biomass

Biomass is the organic collection which improved food crops, woody plants and grassy residue from the agriculture or forestry, oil-rich algae and organic component of the municipal and industrial waste [4]. It has the storage of sun's energy through photosynthesis. Bioenergy is the conversion of biomass into useful forms of energy such as heat, electricity and liquid fuels [1].

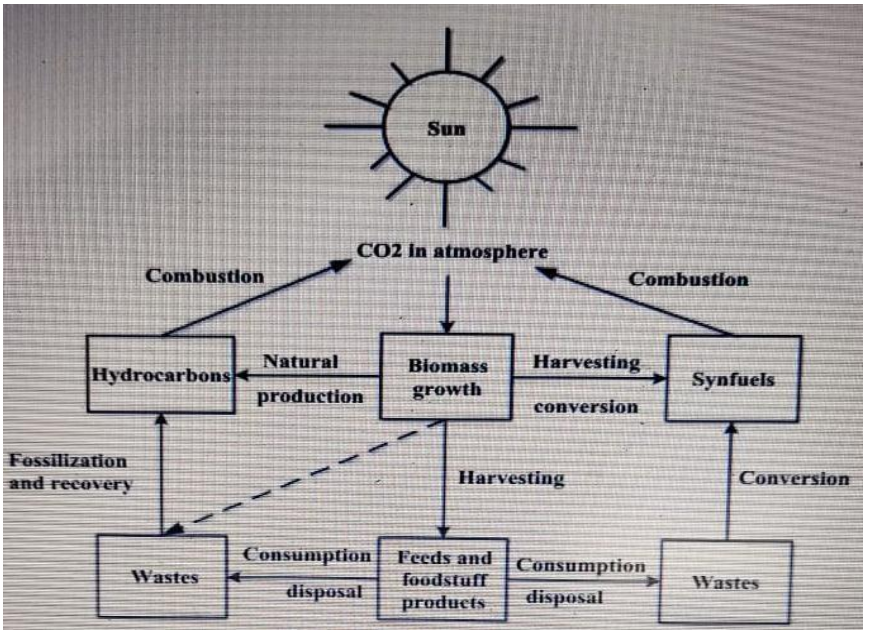

Fig 2: Main features of biomass technology [1].

The use of biomass energy has the potential to greatly reduce greenhouse gas emissions, dependence on the foreign oil landfills and finally suppose a local agriculture and forest product industries. The main biomass feedstocks for power are paper mill residue and municipal waste [4].

Biogas systems are considered to be the strong alternative to the traditional space heating systems. It provides an excellent opportunity for mitigation of greenhouse gas emission and reducing global warming through substituting firewood for cooking, kerosene for lighting and cooking and chemical fertilizers [5] for biomass fuels. The most common feed stocks today are corn grain or ethanol Jatrophacurcas for biodiesel and long-term plans including growing and using dedicated energy crops as fast-growing trees grasses. These feedstocks can grow

sustainably on land that will not support intensive food crops. Other benefit of biomass is its capability to convert into a range of valuable fuels, chemicals materials and products much like crude oil. Beneficial biomass can also be considered a part of terrestrial carbon cycle the balance cycling of the carbon from the atmosphere into the plants and then into the soil and atmosphere during plant decay [4]. It is more optimal as it also helps in reducing the waste materials on earth since it is burnt for obtaining the biomass energy. It provides an option for replacing the fossil fuels with sustainable biomass fuel. As there is crop residue conversion, it increases the value of agricultural output [5].But the burning of biomass can result in air pollution and sometimes it may not be cost effective.

Geothermal energy

Geothermal energy is a powerful and efficient way to extract renewable energy from the earth by natural processes. This can be performed on a small scale to provide heat for a residential unit by using a geothermal heat pump, or on a large scale for energy production through a geothermal power plant [1]. These uses can be grouped into three categories such as for heating systems (and direct use), for generation of electricity, and for use in geothermal heat pumps [4]. Besides these practical uses of geothermal energy, this plant does not make use of fuel. Thus, it is both sustainable and safe for the environment. The emissions of geothermal energy operations are low. These operations neither pollute the air nor contribute to global warming. Renewable energies also meet the growing energy needs and allow the technological developments without damaging the future of our planet, the atmosphere and the environment.

Geothermal energy sources are classified as hydrothermal systems, conductive systems and deep aquifers. Hydrothermal systems include liquid and vapor dominated types. Conductive systems include hot rock and magma over a wide range of temperatures and deep aquifers contain circulating fluids in porous media or fracture zones at depths typically greater than 3 km, though they lack a localized magmatic heat source [4]. The disadvantage of geothermal energy power plants is its location because finding suitable locations for these power plants is not an easy task. The power derived from geothermal energy is difficult to transport. And its energy production is not as sufficient to make up to energy demand as produced by other forms [1].

Wind energy

Wind technology converts the energy available in wind to electricity or mechanical power through the use of wind turbines. The function of a wind turbine is to convert the motion of the wind into rotational energy that can be used to drive a generator. Wind turbines capture the power from the wind by means of aerodynamically designed blades and convert it into rotating mechanical power. Wind turbine blades use airfoils to develop mechanical power [2]. First, the native materials used to construct the turbines promote the domestic economy. Second, the turbines are a profitable investment; growth and development in the technology predict a high potential return, and increases in investment augment the country. Lastly, the wind energy opens new markets and new prospects. Right now, mechanics are working to increase capacity factors so that energy can be stored for times when there is not much wind. Related wind energy project can be seen as a new economic opportunity for the world, as production of a new energy efficient generation continues [4]. The intermittent and unpredictable nature of the wind power would limit its contribution to any region, unless large scale energy storage or intercontinental transmission is available [1]. Environmental constrains, such as the presence of forests and protected areas, further limit the location of the wind turbines, as would simple public acceptance. The wind farms are not necessarily attractive, and they have generated complaints about noise, interference with radio and TV signals, and the killing of, or interfering with, different migratory birds

Hydropower

Hydropower is generated from water moving in the hydrological cycle, which is driven by solar radiation. It is the flow of water in rivers, driven by the force of gravity to move from higher to lower elevations that can be used to generate hydropower [1]. Hydropower plants are classified into three categories according to operation and type of water flow. Run-of-River (RoR), storage (reservoir) and pumped storage. HPPs vary from small to large in terms of scale, depending on the hydrology and topography of the watershed. The hydropower has several advantages over most other sources generating electrical power. It includes a high level of reliability, proven technology, high efficiency, very low operating and maintenance costs, and the ability to easily adjust to load changes [5]. Generally, many hydropower plants are located in the conjunction

with reservoirs, which provide water, flood control, and recreation benefits for the community. In addition, hydropower does not produce waste products that cause acid rain, and greenhouse gases [2].

Hydropower include high initial costs of facilities which dependence on precipitation (no control over amount of water available), changes in stream regimens (can affect fish, plants, and wildlife by changing stream levels, flow patterns, and temperature), inundation of land and wildlife habitat (creation of reservoir), and displacement of people living in the reservoir area.

Scientists try to discover how to harness the energy produced from movement of the ocean. The hydropower has several advantages. The renewable marine (ocean) energy comes from six distinct sources: waves, tidal range, tidal currents, ocean currents, ocean thermal energy conversion and salinity gradients, each with different origins and requiring different technologies for conversion.

Implementation of renewable resources

Because the size of most renewable energy equipment is small, renewable energy technologies can advance at a faster pace than conventional technologies. While large energy facilities require extensive construction in the field, where labor is costly and productivity gains difficult to achieve. Most renewable energy equipment can be constructed in factories, where it is easier to app modern manufacturing techniques that facilitate cost reduction. The small scale of the equipment also makes the time required from initial design to operation short, so that needed improvements can be identified by field testing and quickly incorporated into modified designs. In this way, many generations of technology can be introduced in short periods [2].

Sustainability

However, in the last quarter-century, the twin concepts of sustainability and renewable energy have emerged as a defining imperative of humanity that is situated at the nexus of science, technology, culture, economics, policy and the environment. These twin concepts are framed as a means to mitigate the negative impacts of natural resource depletion, energy consumption, water consumption and climatic change, greenhouse gas emissions associated with anthropogenic

activities. Sustainable development has become the motive of recent national policies, strategies and development plans of many countries for healthy environment. The replacing fossil fuel-based energy sources with renewable energy sources, which includes bio-energy, solar energy, geothermal energy, hydropower energy, wind and ocean energy (tide and wave), would help in bringing revolution in turn provision of sustainable environment [2].

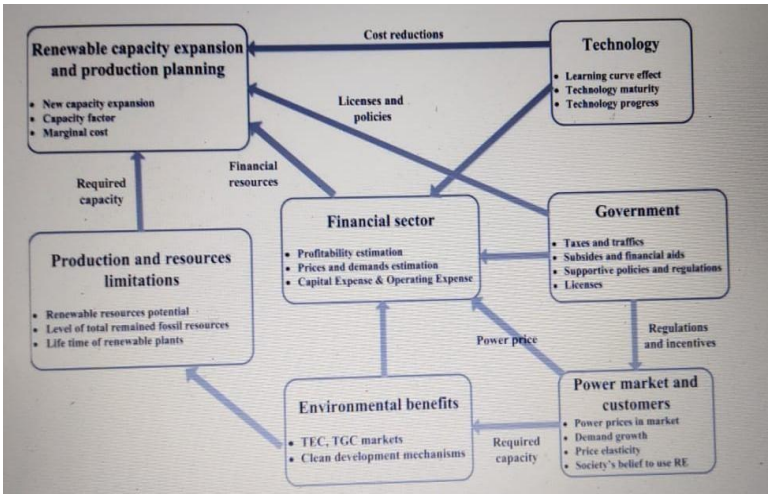

Fig 3: Renewable resources market development process [2].

Policies and awareness

Development and demonstration of renewable energy technologies should be increased to reflect the influential roles of renewable energy technologies part in analyzing and implementation of energy, developmental, and environmental objectives under governmental guidance [2].

Government regulations of electric utilities should be carefully reviewed to ensure that investments in new generating equipment are consistent with a renewables-intensive future and that utilities are involved in programs to demonstrate new renewable energy technologies in their service territories.

Policies designed to encourage the development and utilization of biofuels must be closely coordinated with both national agricultural development programs and efforts to restore degraded lands.

Awareness among youth would bring major differences. Hence, national institutions should be created or strengthened to implement renewable energy programs. International development funds available for the energy sector should be directed increasingly to renewable. Organizations like such would play major role in researching the current status of energy consumption and analyze the energy resources that to be an alternative renewable resource, which should be led by refined, educative, great leaders. A strong international institution should be created to assist and coordinate national and regional programs for increased use of renewables, to support the assessment of energy options, and to support centers of excellence in specialized areas of renewable energy research. There are many ways such policies could be implemented [2].

Necessity of renewable resources

Social and economic development: Production of renewable energy, particularly. biomass, can provide economic development and employment opportunities, especially in rural areas, that otherwise have limited opportunities for economic growth. Renewable energy can thus help reduce poverty in rural areas and reduce pressure for urban migration. Land restoration: Growing biomass for energy on degraded lands can provide the incentives and financing needed to restore lands rendered nearly useless by previous agricultural or forestry practices. This would also be a conservational measure to avoid soil erosion. Reduced air pollution: Renewable energy technologies, such as methanol or hydrogen for fuel-- cell vehicles, produce no pollutants which otherwise make a separate economic requirement for its control. Abatement of global warming: Renewable energy use does not produce carbon dioxide and other greenhouse emissions that contribute to global warming. Fuel supply diversity: There would be substantial interregional energy trade in a renewables-- intensive energy future, involving a diversity of energy carriers and suppliers. As these produces relatively very higher amount of energy there would be less vulnerable to monopoly price manipulation or unexpected disruptions of supplies. Such competition will also remarkably bring the price of energy affordable, leading eventually to stabilization of the world oil price. The growth in world energy trade would also provide new opportunities for energy suppliers. Especially promising are the prospects for trade in alcohol fuels such as methanol derived from biomass, natural gas. Reducing the risks of nuclear weapons proliferation: Competitive renewable resources could reduce incentives to build a large world

infrastructure in support of nuclear energy, thus avoiding major increases in the production, transportation, and storage of plutonium and other nuclear materials that could be diverted to nuclear weapons production.

Conclusion

With immense increase in the demand for energy, renewable energy resources evolved as the alternative source of energy. But, it is acceptable now that renewable sources of energy can be used as main energy sources. It achieves the goal of production of energy sufficient in accordance with the energy demand and makes it reluctant to opt it due to its minimal hazards to the environment through greenhouse gas emissions or causing global warming. In its vast ideology it promotes employment, energy supplies even in the very corner of the globe. It serves as the best key for sustainable, self-sufficient environment.

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19: DESALINATION THROUGH RENEWABLE ENERGY SOURCES

Nikhil Vamshi N, Shankar V Madawale and. R.A.Yadahalli

KLE's S Nijalingappa College Rajajinagar, Bengaluru-10

Abstract:

Since time immemorial water has been a major role- playing commodity for all life forms. Majority of the living forms cannot complete their day without water. Water is the most abundant resource on earth which almost covers two-third of the earth's surface. However, about 97% of the earth's water is seawater which is unfit to be used to meet day to day needs of humans. About 3% of the water is fresh water found in lakes, ponds, streams etc., As the population is increasing drastically, more volume of fresh water is required to meet the needs. Since the percentage of fresh water cannot be elevated, other conventional methods are followed to obtain fresh water from seawater to cope up with the demand. The process of desalination is used to obtain water fit to use from the seawater which however has high salinity. The separation of salts from seawater requires large amount of energy which when produced from fossil fuels, can damage the environment. Therefore there is a need to employ environmentally- friendly energy sources in order to desalinate the seawater. The eco-friendly methods include the renewable sources of energy such as solar energy, photovoltaics, wind energy, geothermal energy. All of these non-conventional sources of energy are exploited to desalinate the marine water.

Keywords*:* seawater, freshwater, renewable energy, solar energy, photovoltaics, wind energy, geothermal energy, desalinate.

Introduction:

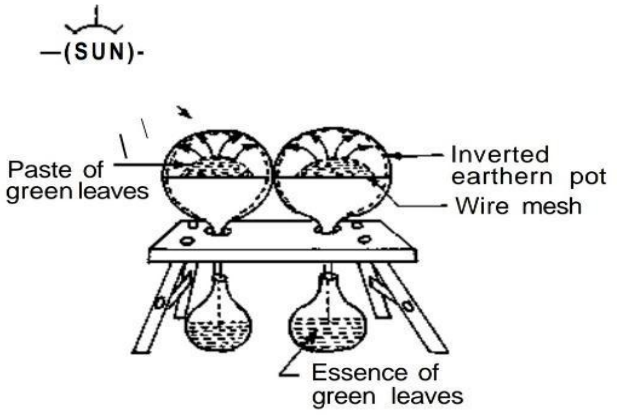
One of the major resources necessary for the sustainability of live forms on the earth is water. Water plays a vital role in all living beings, therefore making it an essential commodity of life. More than two-third of earth's surface is covered with water. Most of the available water is present as seawater or icebergs in the Polar Regions. More than 97% of the earth's water is salty; rest around 3% is fresh water present in rivers, lakes, streams, poles meet the day to day needs of

life forms. 70% from this tiny 3% of world's fresh water is frozen in glaciers, permanent snow covers, ice and permafrost.

Water is essential to life. Water and energy are two inseparable commodities that govern the lives of humanity and promote civilization. The history of mankind proves that water and civilization are two inseparable entities. History proves the importance of water in sustainability of life and the development of civilisation. The most important significance of this influence is the Nile River in Egypt. The river provided water for irrigation and mud full of nutrients. Ancient Egyptian engineers were able to master the river water and Egypt, as an agricultural nation, became the main wheat exporting country in the whole Mediterranean basin.[1]

Historical records:

In the early fourth century B.C., Aristotle described a method to evaporate impure water and then condense it to obtain potable drinking water. It is believed that sailors at sea boiled seawater and suspended large sponges from the mouth of a brass vessel to absorb what is evaporated. In drawing this off the sponges they found out it was sweet water.



[2]

Fig. 1. Solar distillation apparatus

Later on during the Renaissance, Giovani Batista Della Porta (1535-1615), one of the most important scientists of his time, wrote many books. In one of them, he mentions three desalination systems (1558). In 1559 he issued the second edition, where he mentions about

seven methods of desalination. The most important of them is a solar distillation apparatus that converted brackish water into fresh water.[1]

Desalination:

Desalination is a phenomenon by which the excess salt content from the water is removed through different processes. According to WHO, the permissible limit of salinity in water is 500parts per million (ppm) and for special cases up to 1000ppm. While most of the water available on earth has the salinity up to 10,000ppm, and seawater normally has salinity range of 35,000-45,000ppm in the form of total dissolved salts. The purpose of desalination is to clean or purify the seawater or brackish water and supply water with total dissolved salts with the permissible limits of 500ppm or less. This is accomplished by several desalination techniques like reverse osmosis, electro dialysis, vapour compression, multistage flash distillation, multiple-effect distillation and solar distillation.

The process of desalination is energy consuming, and therefore only some countries rely on this process. Many Middle Eastern countries are rich in oil, thus having enough economy and fuel to run desalination techniques. The drastic increase in the phenomenon of desalination may lead to series of problems if it is running on oil. The major drawback of using oil or fossil fuel to desalinate seawater is related to environmental pollution and energy consumption.it has been estimated that the production of 22millionm^3 / day requires about 203 million tons of oil per year [1]. Hence the use of oil might be questionable.to overcome the drawback of the use of fossil fuel in desalination phenomenon, many alternatives were considered, and one being the use of renewable sources of energy to overcome the crisis of freshwater.

Since ancient times humans have used renewable energy sources (RES), but the remarkable development of renewable systems has taken place after the petroleum crisis in 1973. In present day scenario humans are trying to depend more upon the renewable sources, as many conventional sources such as petroleum products are at a verge of depletion. The use of renewable energy would also heal the environment as they are eco-friendly and might also be a pocket friendly option as well if installed in a large scale at once.

Solar desalination is used by nature produce rain, which is the chief source of fresh water supply. Solar radiation falling on the surface of the sea is absorbed as heat and causes evaporation of the water. The vapour rises above the surface and is moved by wind. When this vapour cools down to its dew point, condensation occurs and fresh water precipitates as rain.

All available man-made distillation systems are small-scale duplication of this natural system

The saline seawater or brackish water can be converted into fresh water through these distillation systems and the amount of potable water may be increased. Thus, by exploiting the renewable sources of energy potable water can be obtained and thereby one can meet the water demands.

Techniques:

The phenomenon of desalination can be achieved by different techniques. Large scale desalination processes use either phase change or semi-permeable membranes to separate the solvent.

[3]

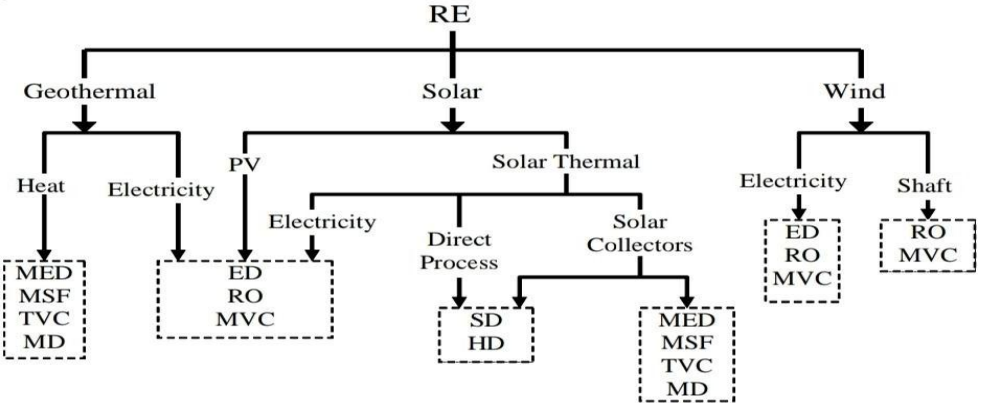


Fig. 2. Possible technological combinations of renewable energy and desalination methods.

- MED- Multiple effect distillation.
- MSF- Multi-stage flash process.
- TVC-The vapor compression process.
- MD- Membrane distillation.
- ED- Electrodialysis.
- RO- Reverse osmosis

- MVC-Mechanical vapor compression.
- SD- Solar distillation.
- HD- Humidification-dehumidification.

1. Direct collection systems:

This system includes solar distillation or solar still. This is a simple technology which can be operated by unskilled workers and has how maintenance. This can be used anywhere which pose lesser problems. Solar distillation works on the phenomenon of greenhouse effect. Here the solar radiation is directly used to evaporate fresh water from seawater or brackish water.

The system consists of a large basin constructed out of cement, galvanised iron sheet or fibre reinforced plastic in which a fixed amount of seawater is enclosed in a 'V' shaped glass envelope. The inner surface of the basin in coated with black material to absorb the solar radiation. The black material thus absorbs the solar radiation which causes the temperature inside the setup to increase and thus resulting in the evaporation of the fresh water from the seawater and getting trapped on the inner surface of the glass envelope. The water vapours condense, move along the trough of the envelope and is collected at the reservoir. The glass envelope allows only the solar radiations to enter inside as the outer surface is transparent and the infrared radiations from the water vapours are not allowed to go out as the inner surface of the glass envelope is opaque. This generates the heat inside and the heat gets trapped inside as there is no way of heat loss from the interior surface.

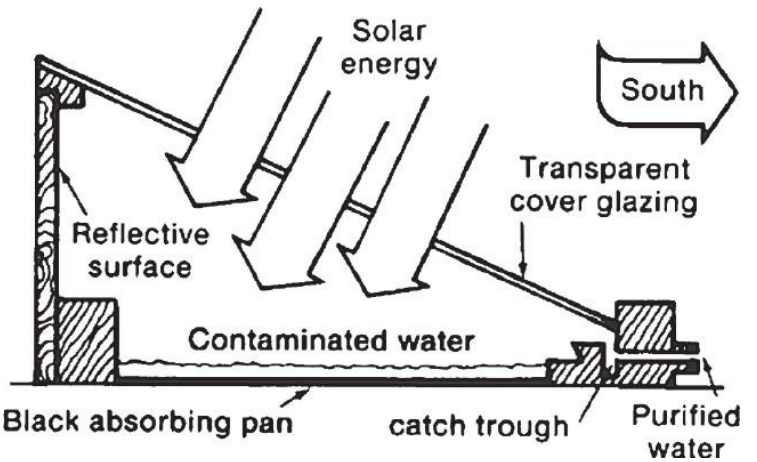


Fig.3. Solar still distillation

2. Indirect collection systems:

In this type of systems, there are two separate sub-systems, a renewable energy collector and a plant to transform the collected energy into fresh water. The systems are of two types;

Phase change processes;

1. Multipleeffects boiling (MEB)

2. Vapour compression. (VC)

The operating principle of phase change processes is reusing the latent heat of evaporation to preheat the feed while at the same time condensing the steam to produce fresh water.

Membrane processes;

1. Reverse osmosis (RO)

2. Electrodialysis (ED)

The operating principle of membrane processes leads to the direct production of electricity from solar or wind energy which is used to drive the plant.[1]

Multiple effects boiling (MEB) process:

Multiple effect boiling process or multiple effect distillation is a distillation process which is often used for seawater or brackish water desalination. It consists of multiple stages or “effects”. In each stage the water is heated by steam in tubes, usually by spraying saline water on the tubes. Some of the water evaporates and this steam flows into the next stage which while condensing heats the water and evaporated more water. Each stage essentially reuses the energy from the previous stage, with successively lower temperatures and pressures after each stage.

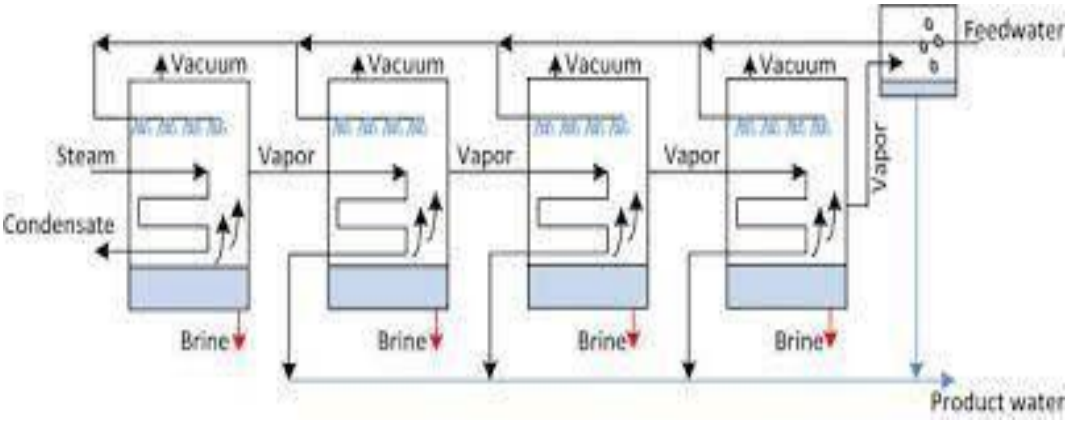


Fig. 4. Schematic representation of multiple effect boiling process

Vapour compression (VC):

In vapour compression distillation, the heat for the evaporation comes from the compression of vapor. The VCD plants work on the principle of reducing the boiling point temperature by reducing the pressure. Two methods are used to condense the water vapor to produce sufficient heat to evaporate incoming seawater. A mechanical compressor and a steam jet. The mechanical compressor is usually electrically driven. Since compression of the vapor increases both the pressure and temperature of the vapor, it is possible to use the latent heat rejected during condensation to generate additional vapor.[4]

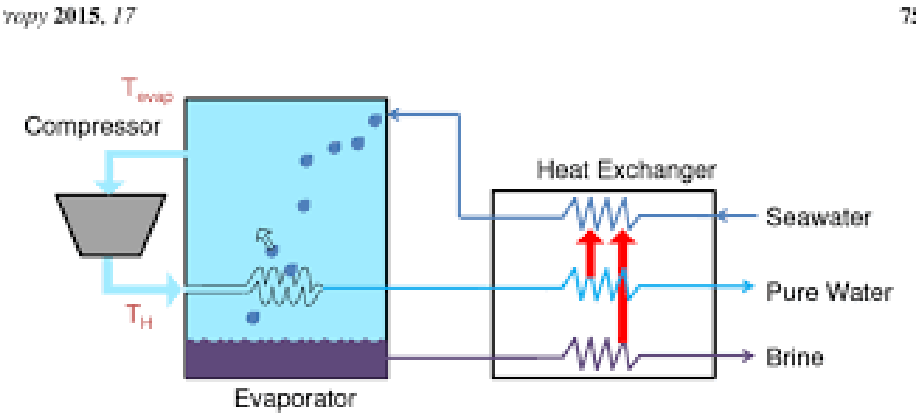


Fig.5. Schematic representation of Vapor compression process

Reverse osmosis (RO):

In the reverse osmosis (RO) process, the osmotic pressure is overcome by applying external pressure higher than the osmotic pressure on the seawater. Thus, water flows in the reverse direction to the natural flow across the membrane, leaving the dissolved salts behind with an increased salt concentration. No heating or phase change is necessary. The major energy required for desalting is for pressurising the seawater feed. A typical seawater RO plant consists of four manor components;

- Feed water pre-treatment.
- High pressure pumping
- Membrane assembly
- Permeate post treatment.

Pre-treatment involves the removal of debris and suspended particles present in the seawater. String wound polypropylene filters are used to remove particles of 1-5µm in diameter. Oxidising biocides such as chlorine and bisulphite are added to kill bacteria followed by the deactivation of chlorine respectively.

The high pressure pump supplies the pressure needed to push water through the membrane. Typical pressures for the brackish water range from 1.6 -2.6MPa. in case of seawater, they range from 5.5-8MPa.

Membrane assembly consists of pressure vessel with a membrane that allows feedwater to be pressed against it. The membrane must be strong enough to withstand the pressure applied.

The post treatment generally includes pH adjustment, addition oh lime, removal of dissolved gases such as carbon dioxide and disinfectant.

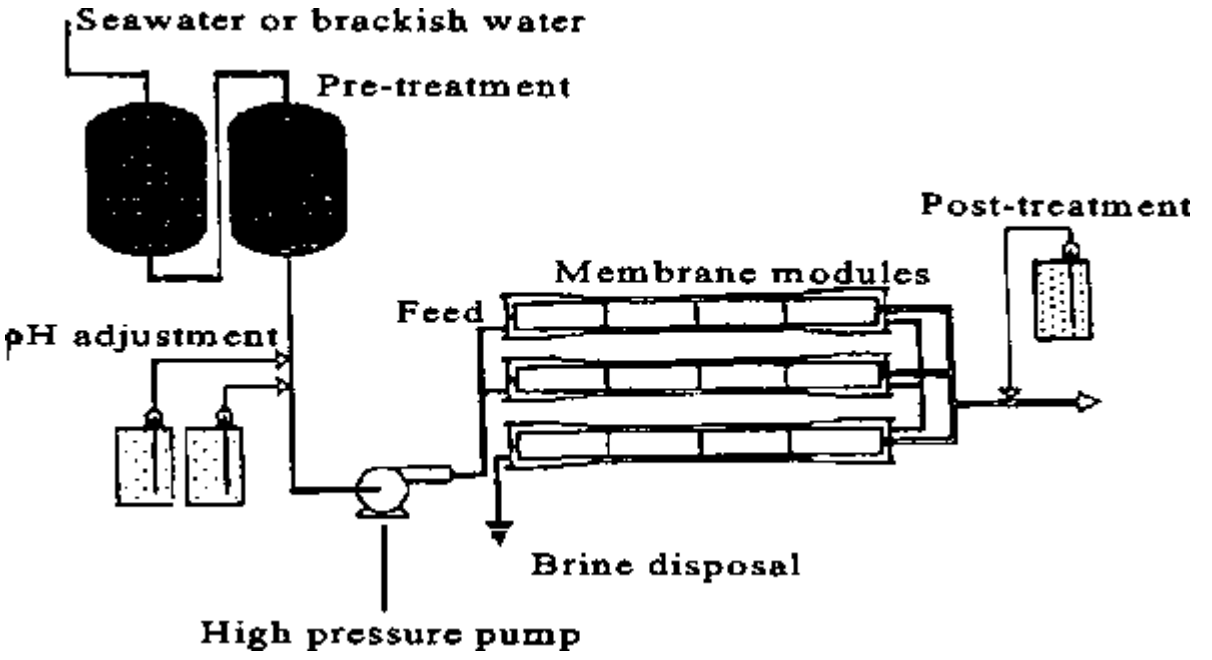


Fig. 6. Schematic representation of Reverse osmosis process

Electrodialysis (ED):

This system works by reducing the salinity by transferring ions from the feed water compartment, through membranes, under the influence of an electric potential difference. This uses the DC electric field to remove salt ions in the brackish water. Saline feedwater contains dissolved salts separated into positive and negative ions like sodium and chloride ions respectively. The ions will move towards oppositely charged electrodes immersed in the solution. Many cationic and anionic membranes can be used to separate the cations and anions present in the water, which leaves fresh water in between the membranes.

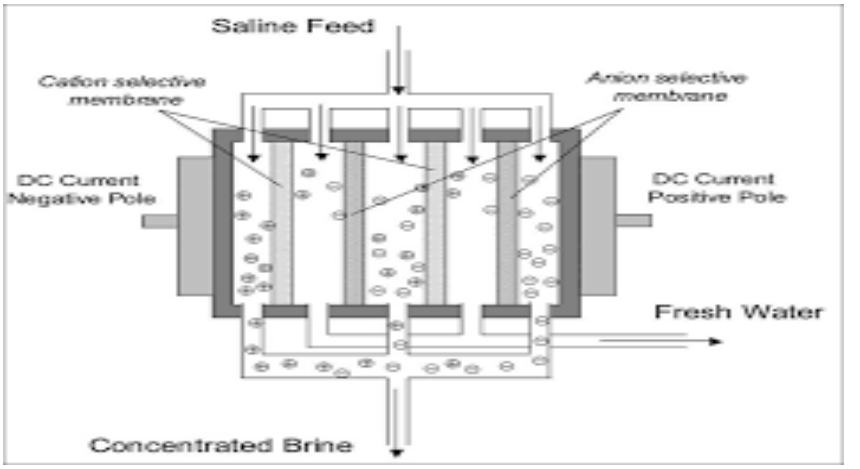
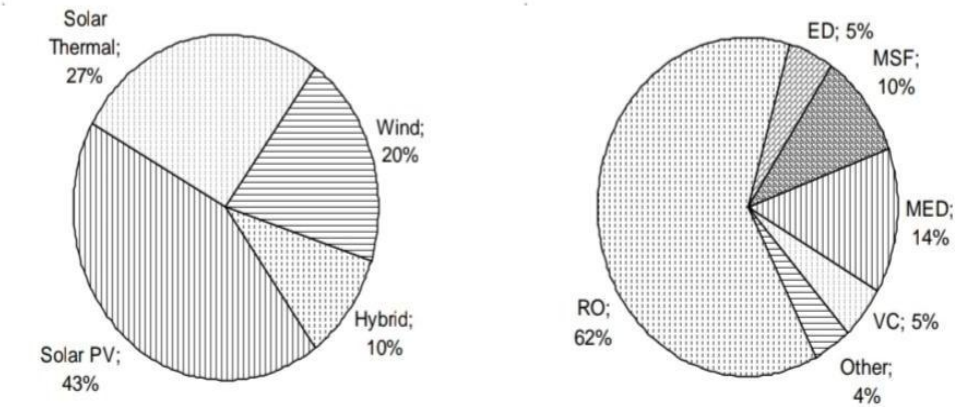


Fig.7. Schematic representation of Electrodialysis process



[3]

Fig.8, Renewable energy driven desalination processes and energy sources

Conclusion:

The art of using renewable energy sources as an alternate to fossil fuels is making the world a sustainable place by creating environmentally friendly atmosphere. The use of renewable energy for desalination appears nowadays to be reasonable. Water is an essential resource to all living forms. Humans cannot complete their day to day needs without water. As the population is increasing gradually, the usage of water is also increasing. Humans are exploiting water for their basic needs are forgetting their responsibility in conserving the same. Water scarcity is a major problem the world is facing at present situation. It is high time to conserve water and to use water very wisely.

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20: A STUDY ON CHALLENGES IN PRODUCTION AND USAGE OF BIOFUEL IN INDIA

Dhanush S*, Louisena Vinoth Priya L and Cinthiya D
Department of Life Science
Sri Bhagawan Mahaveer Jain first Grade College
Geetha road, Robertsonpet, KGF

Author for correspondence: sridharsri7889@gmail.com

Abstract

Renewable energy is a source that cannot be depleted and inexhaustive which supplies a continuous clean energy which can be regenerated. Renewable energy sources, biomass can be directly converted into liquid fuels, called "biofuels. Scientists are continually addressing these challenges, working to improve viability and reliability of renewable resources. The objective of the study is to study on the challenges on the production and utilization of biofuel in India. The methodology of the paper was done by review of literature and the secondary data from the current literature on the study on the challenges on the production and utilization of biofuel in India. The finding of the study was that a high power quality is needed to ensure stability and high efficiency power for production of biofuels. Loss of natural habitat can change the hydrology and reduces the wildlife areas. It depends on weather, climate and geographical location; therefore one type of energy generation is not appropriate for that particular region. There is a lack of information and awareness about the benefits and need of renewable energy. Investment and capital allowances have been made available for the implementation. Future research endeavors in biofuel production should be placed on the search of novel biofuel production species, optimization and improvement of culture conditions, genetic engineering of biofuel-producing species. In recent years, governments and private companies around the globe have ramped up the production of biofuels; the supply is so lesser than demand so companies are scaling back their long-term investments.

Key Words: Renewable resource, Biodiesel, Biofuel, Environment, pollution, fossil fuel

Introduction

Renewable resources of energy are a source that cannot be depleted and in exhaustive which supplies a continuous clean energy which can be regenerated. When we talk about energy resources, there is always a question of sustainability. It's mandatory that resources provide enough energy to meet our requirements such as electricity, run our vehicles and machines working regularly. However, it is also important to consider how these resources can be used long term. Some resources will practically never run out these are known as renewable resources. Renewable resources produces energy, which causes less pollution and greenhouse gas emissions, which is in favour to climate and temperature some of the sources of energy are wind energy, biomass energy, tidal energy , hydropower, biofuels ,solar energy etc. The solar energy is generated when sunshine is available and turns off at night; wind energy also depends on the availability of wind, so if the wind speed is very low, the turbine will not turn, and this result in zero power flow to the grid. On the other hand, too much wind can damage the generator and therefore a delicate balance needs to be maintained in order to keep a consistent generation of energy. The uncertainty in energy production in renewable energy technologies is making integration more complex.

Biofuel is also a source of renewable energy which are derived from biomass such as plants, algae or animal wastes. Unlike other renewable energy sources, biomass can be directly converted into liquid fuels, called "biofuelsThe best example for Biofuel in India is biogas and biodiesel. Biodiesel is produced from edible and non-edible vegetable oils such as cooking oils and animal fats. Most vegetable oils are potential renewable resource that is available in daily life. Fuel from these oil emits very less pollution than diesel fuels.. most common type of biofuels that are used in our daily life are ethanol and biodiesel these are first generation of biofuel technology, biodiesel is sustainable, eco-friendly, that can be used in diesel engines. biodiesel decreases greenhouse gas emissions .Many critics express concerns about the scope of the expansion of certain biofuels .There are some challenges associated with using renewable resources. One of the biggest concerns in the field of renewable energy is power generation depending on natural resources that are uncontrollable by humans.

For instance, renewable energy can be less reliable than nonrenewable energy, with seasonal or even daily changes in the amount produced economic and environmental costs associated with refining process However, scientists are continually addressing these challenges, working to improve viability and reliability of renewable resources.

Objective

To study on the challenges on the production and usage of biofuel in India

Methodology

This paper reviews the current literature on the study on the challenges on the production and usage of biofuel in India. The scope of the study on the challenges on the production and usage of biofuel in India is done by review of literature. Biodiesel is not only sustainable, it's a more environmentally-friendly, cleaner-burning option that can be used in diesel engines without modification .The most important challenge for further scaling up renewables in India is the poor financial condition of power distribution companies and lack of awareness and less productivity.

Analysis of the study

The biofuels can be a viable source of renewable energy in contrast to the finite nature, geopolitical instability and deleterious global effects of fossil fuel energy. Biofuels can be classified into two categories: primary and secondary biofuels. The primary biofuels are directly produced from burning woody or cellulosic plant material and dry animal waste. The secondary biofuels can be classified into three generations that are each indirectly generated from plant and animal material. The first generation of biofuels is ethanol derived from food crops rich in starch or biodiesel taken from waste animal fats such as cooking grease. The second generation is bioethanol derived from non-food cellulosic biomass and biodiesel taken from oil-rich plant seed such as soybean or jatropha. The third generation is the biofuels generated from cyanobacterial, microalgae and other microbes, which is the most promising approach to meet the global energy demands.

The major problems with renewable energy production and supplies are far more variant than other means of energy production. Changes in sunlight levels and wind means that supplies are less consistent than those derived from fossil fuels. Renewable energy is slowly becoming a significant part of the mix energy production in different parts of India. In evaluating the economic benefits of biofuels, the energy required in the production of the biofuel has to be taken into consideration. Plant based biofuels is beneficial as they contribute to the environment releasing "carbon neutral" to the polluted air that is produced by the combustion of fuels. For example, in India the process of growing corn required for the production of ethanol we find some drawbacks like the farming process, equipment, manufacturing process and transportation costs which relatively represents small energy gain than the economic process. In this aspect the energy gained from the sugarcane is much greater than the cellulosic ethanol or algal biodiesel that could be even greater than the use of biofuel. Predominantly, biofuels are also produced from photosynthetic organisms such as photosynthetic bacteria, micro- and macro-algae. The primary products of biofuel may be in a gas, liquid, or solid form. These products can be further converted by biochemical, physical, and thermochemical methods. The major impact of biofuel brings safe environment and the drawback as a renewable energy source is how they are manufactured and processed.

The industrial production of agricultural biofuels can result in additional emissions of greenhouse gases that may be a drawback for the benefits of using a renewable fuel. These emissions include carbon dioxide from the burning of fossil fuels during the production process and from that has been treated with fertilizer.. In addition, energy crops grown for biofuel can compete for the world's natural, in diverting arable land and feedstock from the human, biofuel production can affect the food price and availability as there are taken for the production of biofuels. It emphasis that the land used for the corn production is shifting grasslands and brush lands to corn monocultures and biodiesel is bringing down ancient tropical forests to make way for oil palm plantations. Loss of natural habitat can change the hydrology, increase and generally reduce of wildlife areas. The clearing of land can also result in the sudden release of a large amount of carbon dioxide as the plant matter that it contains is burned or allowed to decay.

The most important challenges for further scaling up renewable resources in India is the poor financial condition of power distribution companies (discoms). Almost all renewable energy is purchased by such discoms, resulting in very long and unsustainable payment cycles, the percentage of RE power increases, the variability in its generation due to weather conditions makes operating the transmission grid a technically demanding task.

Findings of the study

- Consistently high power quality is needed to ensure stability and high efficiency power for production of biofuels. . The quality of the power supply allows the system to work well with high reliability and lower costs.
- Most renewable energy plants that share their energy with the grid require large areas of space. Loss of natural habitat can change the hydrology, increase and generally reduce of wildlife areas. In addition to this, renewable energy sources depend on weather, climate and geographical location, therefore meaning that one type of energy generation is not appropriate for the region.
- There is a lack of information and awareness about the benefits and need of renewable energy. Investment and capital allowances have been made available for the implementation of renewable energies. There is a clear need for government agencies to assist and advice applicants and potential recipients how to go about applying for renewable energy incentives. The storage system of the generated energy is expensive and represents a real challenge in terms of Transmission. To sufficiently leverage renewable sources, a great deal of new transmission infrastructure is required.
- With non-renewable energy being well-established, the utilities behind these legacy systems hold immense market,renewable sources of energy have to establish infrastructure, decades of experience and policy.

Conclusion

In this review, we present the recent progresses including challenges and opportunities in biofuel production. Over the course of the 20th century, power transmission infrastructure was built with large fossil fuel plants and nuclear plants in mind. This raises issues for renewable energy sources not located near existing infrastructure. Start-ups must show an ability to scale, as investors typically demand large amounts of energy production, which can be challenging. Future research endeavors in biofuel production should be placed on the search of novel biofuel production species, optimization and improvement of culture conditions, genetic engineering of biofuel-producing species. In recent years, governments and private companies around the globe have ramped up the production biofuels, since the supply is currently so lesser than demand, companies are scaling back their long-term investments and even going out of business.

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21: STUDY ON DIFFERENT PROBLEMS OF AWARENESS AND APPROACH OF DIFFERENT COUNTRIES TOWARDS RENEWABLE ENERGY SOURCES.

Rakshitha L, Spurthi, K, & Tejashree S.

Department of Chemistry, KLE S Nijalingappa College, Rajajinagar, Bengaluru-560010

Abstract

This paper reviews the awareness of renewable energy among people in different countries. Renewable energy sources like hydro, wind, solar and biomass are dealt. Increase in demand for energy leads to further need of sources which are preferably renewable energy. Due to lack of awareness among people, the path to cleaner environment has many hurdles like, global warming and impact of climate change. We witness more use of renewable energy sources in developed countries, while in developing countries lack of awareness about renewable energy sources has led to minimal usage of these resources. The difficulties faced to overcome this problem of sustainable development in few countries have been discussed in this paper.

Keywords: Awareness; renewable energy; sustainable development; environmental education

Introduction

Energy is considered to be basic necessity of life and will remain an essential segment for providing food, medical care, shelter and much more inherent and active demand of population on earth. At present scenario most of the energy obligation are majorly satisfied by non-renewable energy resources like fossil fuels of coal, natural gas, petroleum, and a minor quantity from renewable energy resources that are wind, hydro, solar and biomass [1]. In the contemporary world the utilization of energy is increasing day by day this leads to the rapid depletion in conventional energy sources, the over exploitation threatens the future insufficiency of energy [02]. And also, the prominent impact of using non-renewable energy is the emission of green-house gasses, specifically, carbon dioxide and methane which are feud to healthy and stable environment. These complications can be overcome by reducing the use of fossil fuels and shift to other energy sources such as nuclear and renewable energy. [3] Unlike fossil fuels renewable energy is also known as clean energy, which are naturally replenished and has moderate environmental effect. Hence it is required to shift from non-renewable to renewable sources. But is this shift possible? Renewable energy accounts for about 19% of world-wide energy consumption in 2012, with the addition of contemporary renewable technologies

accounting for 10% [3] Renewable energy sources significantly contribute to the economic and social, environmental sustainability which is knocked down by increase in population, rapid urbanization, deforestation and over exploitation of conventional sources.Enhancement in the field of renewable resources by implementing numerous innovation and technology follows the requirement of more manpower which promotes employment and in turn escalates socio-economic welfare of the country. An active, supportive and educated public is very essential to attain the goal of a clean and healthy environment.

Renewable sources are available in plenty but still it cannot be utilized to its fullest for the day-to-day life due to lack of technology and public awareness [2].

Table1: Factors affecting the performance of renewable energy for sustainable development [2]

1. Factors
2. Leadership
3. Strategic planning
4. Availability of technology
5. Public awareness
6. Top management support
7. Sustainable growth
8. Return on investment
9. Availability of finance
10. Skilled man power
11. Government support
12. Availability of data and information
13. Availability of energy resources
14. Support from interested stake holders
15. Efficiency of process and execution

Problems and approach of different countries and cities.

India

The government of India is aiming to create solar schemes to use renewable energy source efficiently. The most successful solar schemes are as follows [4]

1. Jawaharlal Nehru National Solar Mission (JNNSM)
2. Government Yojana: Solar energy subsidy scheme
3. Development of solar park scheme
4. UDAY scheme
5. SECI scheme
6. Rooftop scheme

Islands

The fossil fuels are too expensive for water transportation or when there is no electricity grid to feed the desalination plant in remote and arid areas, where the use of conventional energy is expensive or unavailable. This is applicable to many islands. If desalination is an energy-intensive activity and energy supply in the island is based on fossil-fuel sources, then a supply crisis could lead to a parallel water availability problem. This problem is provoked by large tourist inflows, thus leading to significant increases in water and energy demand during the tourist seasons. [5]

At present, 70% of pacific citizens do not have access to electricity and rely on mix of fuel wood, kerosene and batteries for supply of energy. There are usually tourist sites, receiving a significant, and often increasing, number of tourists, which provokes the problem of energy and water supply with the existing capacity, especially during peak tourist periods.[5]

The use of renewable energy in islands was proposed to resolve some inherent problems of islands like brackish or sea water to supply drinking water, tourism, education, seasonal energy buffering and to support private investment. [5]

Africa

In African countries, generation of electricity from renewable energy resources can play a major role in electricity generation. It is required that rules and regulations, as well as voluntary structures such as the “clean development mechanism” and Renewable Energy Certificates will offer better maintenance for an extended role of renewable energy in the economy. [6]

South Africa

South Africa is the 25th largest country in the world with a population of closed to 53 million people. This country started a renewable energy policy in 2003. The renewable energy resources of South Africa have large, essential potential that will supply exceptionally to its energy sector, society and economy at large.[6]

Egypt

Egypt has enormous potentials of renewable energy resources. It has a population of more than 83 million people, predominantly along the river Nile and is only 6% of the land and 94% of the land as a desert. It is a country with rich solar energy. It is amidst the global Sun Belt. In January 2008 the first solar thermal power plant with the power rating of 140 MW was started.The generation of power in Egypt is largely by fossil fuels and hydropower. Egypt has an plenteous energy resource. Zafarana wind farm is the largest of its kind in Africa, that can generate 545 MW and also gulf of El-zeyt generate 200 MW.[6]

Nigeria

The Nigerian government approved the country's Renewable Energy Master Plan (REMP) in November 2005. It was drawn by the Energy Commission of Nigeria (ECN) with the support of the United Nations Development Program (UNDP) . Nigeria has been positioned as the 9th African country with technical and economic feasibility of hydro power energy at 32,450 GW hrs/yr and 29,800 GW hrs respectively. If the country's average sunshine of 6 hrs a day, is tapped over 1% of land area for the PV power plant, it will be able to generate 1850,000 GW hrs of energy per year make up over one hundred times the current amount of electricity it generates. Currently the percentage of wind energy consumption in Nigeria is very low with no connection to the national grid. The first wind farm project in Nigeria is the 10 MW farm located at Rimi village 25 km south of the state capital, Katsina. Biomass is one of the key alternative energy resource whose sustainability needs to be carefully understood.[6]

Kenya

It is also significant that countries such as Kenya, Ethiopia, and Rwanda have shown remarkable progress in increasing electricity access. This has made Kenya one of the fastest-growing countries in terms of electricity access growth. The low electricity access levels in some SSA countries result from poverty, poor energy planning, financial misappropriation, unstable economies, lack of foreign investment, deficient infrastructure, lack of capital, insufficient governance, and lack of institutional capacity. Kenya relied on diesel-powered generators for electricity production, due to irregular seasonal patterns, which disrupted the hydropower sources, in the 1990s and early 2000s. Kenya has set its target to increase the share of renewable energy sources in energy production. Climate change concerns and increased energy demand have put many nations under pressure to review their energy portfolio in the quest for reliable and cleaner sources of energy. To address the negative effects of climate change, global citizens, need to change their energy consumptions habits and develop renewable energy sources. At a 5% significance level, the evidence for the rejection of the null hypothesis of the equality of means

was found for only one socio-demographic variable, where annual household income was significantly higher in the sample as compared to the general population. In the case of biomass, lack of a significant relationship with the variables can be associated to the slow rate of diffusion of biomass conversion technology for electricity. In addition, traditional biomass mainly used as a cooking fuel in both rural and urban households, and their unsustainable use have resulted in a negative impact on the environment [7].

Ways of Educating the Public

Man's daily activities has continued to disturb the balance of the environment in the following ways: Huge industrial installations every year, urbanisation, deforestation, over exploitation of natural resources, use of insecticides, pesticides, improper use of fertilizers and chemicals in environment and global warming/ozone layer depletion. Mine wastes and effluents from mining and metallurgical industries give a number of physical and chemical problems to human beings. Certain other industries like paper and pulp industries, fertilizer industries, explosive industries, soap and detergent industries, chemical industries, food processing industries, textile, tannery, leather, and petroleum industries release/discharge undesirable and harmful constituents which are responsible for air and water pollution and cause great public concern. Therefore, it is necessary to check all these devastating processes. Environmental education is a way of creating knowledge, understanding, values, attitudes, skills, abilities and awareness among individuals and social groups towards the environment protection. Environmental education is an attempt to reorient education so that environmental competence is restored as one of its basic aims along with personal and social competence. The existing curricula at primary, secondary and college levels provide a lot of opportunities to make the students aware of environment. The integration of environmental education is possible if teachers have a will to introduce it in a quite natural way while teaching different curricular areas at primary, secondary and higher education level. The media's role in environmental education is important because it is through newspapers, magazines, radio, and television that people gain awareness. Awareness is simply a step in EE.[8]

Role of School Education in Generating Environmental Literacy

Science and socio-scientific topics (SSTs) in the science curriculum play an important role in preparing students to participate in modern social life effectively, shape the society in a sustainable way, and become responsible citizens in the future. Negev, Sagy, Garb, Salzburg, and Tal (2008) do not find a significant correlation between environmental knowledge and environmental behaviour in Israel. Another contribution that uses Israel as a case study examines the impact of environmental education programs conducted by out-of-school environmental organizations: while the program increased student's sensitivity to human–environment interrelationships, its impact on the cognitive domain, in developing a more systemic understanding of environmental issues, was limited (Goldman et al., 2013). [10]
It is very important to measure the awareness of the youth either at schools or universities toward RE. This helps in spreading technology and assures the social acceptance which will support the

development of this sector. However, in Palestine there is no enough information regarding student awareness of RE [11].

Conclusion

This review study focuses on the three major African countries namely South Africa, Egypt and Nigeria. Of the three, South Africa has the best model for tackling its energy challenge through the use of wind and solar energy. Egypt too is promising with its use of hydropower and emergent solar power base. Nigeria has great potential but very weak hydro, solar and wind power in that order. Mass media and social media are becoming more and more influential on the behaviour. And values of young citizens so new measures are therefore needed to utilize opportunities in the digital world. Public education needs to be interactive, contemporary, and to be able to accommodate emerging problems and effectively deal with challenges and societal difficulties. Use of the media, awareness raising campaigns, incorporation of environmental issues in mainstream education, increasing awareness and education in target groups and encouragement of public participation in environmental matters. Celebrities' environmental campaigns; and other individuals and institutions could also be a mean of reaching people. An educated public can be one of the most powerful weapons in the world's battle against harm to the environment. Caring for the environment will not require one to become an environmental activist, but just to know more about one's environment.

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22: ROLE OF MICROORGANISMS IN PRODUCTION OF BIOFUELS "ADVANCEMENTS IN RENEWABLE SOURCES OF ENERGY FOR GLOBAL SUSTAINABLE ENVIRONMENT"

Pankaj Kumar Choudhary*

Department of Zoology

MES College of Arts, Commerce and Science, Malleswaram

Abstract

The human society is facing a severe challenge of energy crisis coupled with increasing pollution-related problems. Even though various renewable sources of energy are being exploited now-a-days, but all of them together also do not seem to be a suitable replacement for fossil fuels. In this situation, biofuels are giving the new possibility of sustainable long-term energy solution, but it is still in its nascent stage and a great deal of research is required to find a suitable and feasible way of producing biofuels without compromising on food grain production. This review article is an attempt to highlight the various microorganisms, like microalgae, bacteria, and fungi; that can be used for biofuel production. Further research is required to find out economically suitable species which can be safely utilized for biofuel production on a sustainable basis.

Keywords

Biofuel, fermentation, metabolic engineering, ethanol, biodiesel.

Introduction

Biofuels are made from living things or the waste they produce. One of the most common biofuels, ethanol, is produced from plants. Not only is it expensive to convert edible plant material into ethanol, but also ethical issues are involved. It has been argued that we should not grow foodstuffs for fuel when people in some developing countries do not have enough to eat. There is a worry that Brazil will remove large areas of their rain forests to produce sugarcane. This is a problem because rainforests absorb huge amounts of CO_2. Therefore, biofuels from foodstuffs such as sugarcane are unlikely to provide a long term solution as a replacement to

fossil fuels. A probable solution to this problem can be use of cellulose to produce ethanol, which is exactly the same as the ethanol produced from edible plant parts. Cellulose ethanol is produced from lignocellulose which is a mixture of lignin, hemicellulose and cellulose. The lignocellulose makes the non-edible plant parts and there is a huge amount of that available for recycling. There have been a number of microbes that produce a group of enzymes called cellulose, which breaks down cellulose into glucose [1]. An archaea *Sulfolobus solfataricus*, which lives in volcanic pools near Mount Vesuvius in Italy, produces cellulose. Research is on to modify this microbe to see if its cellulose production can be improved. Another common wood digester is the fungus *Trichoderma reesei*, which is found in nearly all soils and secretes huge quantities of cellulase.

Structure of lignocellulosic biomass feedstock

Lignocellulose is a renewable resource that can become a major source of energy. Apart from this, its abundance and ill-management adversely affects efficient land use. Biomass feedstock from plants is naturally recalcitrant because of complex polymer composition [6]. Lignocellulose is a complex polymer of carbohydrates comprising of 40% - 50% cellulose, 20% - 40% hemicellulose, 18% - 25% lignin, and other extractable components. Each component has a definite function in lignocellulose. Lignin provides structural support, cellulose provides strength and flexibility, and hemicellulose is a link between them.

Lignocellulolytic enzymes involved in polysaccharide biomass hydrolysis

Lignocellulases are a group of enzymes such as cellulases, hemicellulases, pectinases, lignases, and polysaccharide oxygenases; and are required to completely breakdown lignocellulose. These hydrolytic enzymes stimulate plant cell wall extension indirectly by decreasing the size and viscosity of matrix polymers and augmenting the action of wall loosening agents [7]. The cell wall of plants comprises of cellulose and hemicellulose, which when hydrolyzed, gives rise to fermentable sugars such as glucose, galactose, etc. Based on the structure, the cellulases can be categorized into three types:

(i) Endoglucanases.

(ii) Exoglucanases.

(iii) Beta-glucosidases (cellobiases).

These enzymes work in unison to hydrolyze cellulose in the cell wall of plants. Endoglucanases act by randomly attacking the internal sites of the amorphous part of cellulose, thereby paving the way for cellobiohydrolase action on the crystalline region of celluloase hydrolyzing it to cellobiose. The cellobiose is then cleaved by beta-glucosidases to glucose molecules. Microbes then utilize the energy stored in glucose converting it to hydrocarbon fuel through transforming the sunlight energy to chemical energy [8].

The hemicellulose-degrading enzymes are produced by bacterial and fungal species. For example, end beta-1,4 xylanase of the CAZy family are synthesized by fungi such as the *Trichoderma longibrachiatum*, *Aspergillus niger*, and *Ustilago maydis*. Apart from cellulose and hemicellulose, lignocellulosic biomass also contains little proportion of polysaccharides called pectin, which accounts for about 5% of total dry weight and is often found as a major component of agricultural wastes [9]. Pectin is hydrolyzed by three different types of pectinases – hydrolases, lyases and esterases.

Lytic polysaccharide monooxygenases (LPMOs) play essential roles in the bioconversion of recalcitrant polysaccharides such as chitin and cellulose, which is required for biofuel production [10]. They belong to a group of copper-dependent oxygenase that split polysaccharides into monomeric units. LPMOs have been identified in several strains of fungi including *Thermoascus terrestris*, *Neurospora crassa*, *Podospora anserine*, *Aspergillus nidulans*, *Myceliophthora thermophile*, and *Sporotrichum pulyverolentum* [11]. The catalytic action of LPMO from *Aspergillus nidulans* on the oxidative degradation of different types of polysaccharides was studied by Jagadeeswaran et al. An LPMO in *A. nidulans* was found to be very active in the degradation of cellulose and hemicellulose xyloglucan, which also had a synergistic effect with some sorghum stover-degrading hydrolases, as it resulted in approximately 1.25 fold increase in glucose yield compared to sole treatment with endoglucanase. The synergistic effect of LPMOs in increasing the yield of reducing sugars is dependent on the type of substrate used. This is an important factor to be taken into consideration when selecting LPMOs for biofuel production [12].

Actinobacteria are an essential group of microorganisms known for their ability to degrade several substrates and synthesize products of economic value from the bioconversion of

agricultural and urban wastes. Members of this group have been found to produce a variety of useful enzymes such as xylanases, chitinases, cellulases, laccases, and proteases required for degradation of lignocelluloses, lignin, cellulose and other plant residues. *Streptomyces* spp. is recognized for their metabolic potentials in the biosynthesis of antibiotics and their capacity to degrade a range of distinct compounds such as lignocellulose, keratin, pectin, xylan, cellulose, lignin, chitin and styrene. Adegboye et al. identified two new strains of Streptomyces (NWU339 and NWU49) isolated from maize rhizosphere soil with the ability to utilize starch, xylan, and cellulose as substrates which could be used for biofuel production. The hydrolytic enzymes synthesized by *Streptomyces fulvissimus* CKS7 effectively hydrolyzed horsetail waste resulting in maximum yield of bioethanol from the fermentation process with Saccharomyces cerevisiae [13].

Apart from microbes, cellulolytic enzymes can be obtained from insects such as termites. In recent times, wood-eating termites have received much interest as a valuable source of cellulotytic enzymes which are useful for biofuel production. The *Cohnella* genus of bacteria is known for its high cellulolytic activities in different habitats, including the gut of termites. It was recently confirmed as a part of cellulolytic microbiome associated with wood-eating termites and was identified in the intestinal tracts of three Neotropical termites, viz., *Nasutitermes aquilinus*, *Nasutitermes corniger* and *Cortaritermes fulviceps*. These wood-eating termites are essential as they have an efficient lignocellulolytic digestion system that could be harnessed for the advancement of the current bioconversion mechanisms of lignocellulosic biomass for the production of useful bioproducts [14]. Yeast (*Saccharomyces cerevisiae*) is the preferred choice of microorganism for fermentation of sugars to bioethanol due to its ability to tolerate high ethanol concentration and inhibitors produced during the fermentation process.

Strains for biofuel production

The successful production of biofuel from lignocellulosic biomass depends mainly on finding out a suitable microorganism for the whole fermentation process [15]. *Saccharomyces cerevisiae* and *Zymomonas mobilis* are the best known microbes with the ability to ferment hexose sugars and sucrose into ethanol, but are inhibited by end products. The pentose-fermenting microbes *Pichia stipites*, *Candida shehatae* and *Pachysolen tannophilus* are also inhibited by end products [16]. Metabolic engineering has been used to enhance biofuel production abilities of other microbes

like *Bacillus subtilis* for ethanol production, *Clostridium* for butanol production and strain BS35 (developed *Escherichia coli* and *Bacillus subtilis*) for ethanol and butanediol production [17]. *Klebsiella pneumonia* HR526 strain was engineered by Chen et al. for the production of 2-butanol [18]. Similarly, *Clostridium cellulovorans* was modified by inserting adhE2 gene of *Clostridium acetobutylicum* to increase the yield of n-butanol and ethanol from crystalline cellulose. *Clostridium cellulovorans* is a very useful bacterium for metabolic engineering due to its ability to utilize several substrates and also possesses numerous cellulosomal genes.

Bioprospecting for native strains with the gene of interest

Research has shown that several microbes belonging to the class fungi, yeast and bacteria can exhibit cellulolytic activity. Today, the process of bioethanol production exploits cellulolytic enzymes from microbes with some strains having established industrial applications, a high conversion rate of glucose to ethanol and tolerance to end products and other inhibitory compounds [19]. Native strains produce diverse extracellular and intracellular enzymes naturally that could exhibit activities of industrial importance. One of the common methods used for finding these strains is bioprospecting. It involves screening native strains isolated from diverse sources for novel and functional enzymes which might be relevant. Consequently, the selection of the best candidate is based on the high production of the desired end products.

Another approach is probing the genome contents of environmental samples through metagenomics. This approach is especially useful because many microbes cannot be cultured in laboratory conditions. It also allows identification of uncultured microorganism. Advanced technologies such as clustered regularly interspaced short palindromic repeats (CRISPR/Cas-9) is being used to accelerate genetic engineering of microbes as it permits rapid and efficient editing of the genome by replacing 20-nucleotide sequences of a chimeric single-guide RNA (sgRNA) complementary to the target sequence of interest. The CRISPR/Cas-9 system is naturally used by prokaryotes as a defensive mechanism against foreign nucleic acids from viruses or any foreign DNA. This technology has surpassed previous technologies in genetic engineering such as zinc-finger nucleases (ZFNs) and transcription-activator-like effector nucleases (TALENs). The CRISPR/Cas-9 systems have been employed in the manipulation of genes in several bacterial cells belonging to the genera *Bacillus, Clostridium, Corynebacterium, Escherichia coli, Lactobacillus, Mycobacterium, Pseudomonas, Staphylococcus,* and

Streptomyces to get several genetically modified microorganisms with high biofuel-producing abilities. Some examples to quote are *Escherichia coli* strain MG1655 which produced 5.4 g/L n-butanol in a glucose medium, Clostridium saccharoperbutylacetonicum N104 yielded 19.0 g/L of butanol, Clostridium acetobutylicum ATCC824 produced isopropanol-butanol-ethanol mixture.

Microalgae in production of biofuels

Microalgae have been experimented as a potential feedstock for biofuel generation in current era owing to its rich energy content, inflated growth rate, inexpensive culture approaches, the notable capacity of CO_2 fixation, and O_2 addition to the environment. Algal lipids have emerged as an alternative that can be processed into biodiesel, while algal carbohydrates can be processed into bioethanol [2]. Moreover, nano-additive applications at different stages from microalgae culture to end product utilization presented strong possibility in mercantile approach as well as positive impact on the environment along with valuable co-products generation into the near future [2]. To accelerate the biofuel yield and improve the efficiency of biofuel utilization in petrol and diesel, nanotechnology has been initiated via nano-additives such as nano-magnets, nano-crystals, nano-fibres, nano-droplets, and others. There have been promising results obtained in terms of higher yield of microalgae biomass, enhanced cell density, high biofuel yield, pure co-products, complete and cleaner combustion, and improved thermal efficiency [3,4,5]. The microalga cultivation has following advantages:

(i) They do not clash with human or animal food chains.

(ii) They are very rich in carbohydrates, proteins and oil content.

(iii) They can grow in a variety of aqueous media such as wastewater, freshwater, saline water, brackish water or highly polluted water.

(iv) They demand low water.

(v) They have the capability to grow whole year naturally with sunlight presence.

(vi) They can be cultivated in the waste dump area, sea, ponds, rivers, industrial and municipal waste drainage, and wet bare lands especially in cold regions.

(vii) They develop sustainable O_2 generation system.

(viii) They diminish CO_2 by using it for photosynthesis.

(ix) They have very short harvesting life cycle and yield nascent biomass that drives higher productivity of the desired biofuel.

Nano-particles incorporation with microalgae cultivation (e.g., cell suspension, cell separation and cell harvesting), biofuel conversion technologies, and biofuel application have amplified the overall yield in every stage [20]. According to previous studies, a very small amount of colloidal hydrous iron (III) oxide particles boosted almost 100% microalgae cell suspension; magnetic particles incorporated with aluminum sulfate were very effective for cell separation from the mixed culture of *Anabaena* and *Aphanizomenon* microalgae species; silver nano-particles application on *Chlamydomonas reinhardtii* and *Cyanothece* 51142 microalgae harvesting increased 30% higher biomass productivity; and calcium oxide nano-particles escalated the large biodiesel conversion yield up to 91% via catalytic transesterification [21].

Conclusion

The current research in production of biofuels has to be focused towards long-term sustainable energy solution. It requires financial support from various public and private entities. It is being increasingly realized that sooner or later the world will run out of fossil fuels and the problem may be aggravated due to increasing energy demands from the more populous third world countries due to increase in standards of living. Most probably a single solution or a standardized procedure for bioenergy production will not be feasible. Rather step-by-step advances on multiple fronts with a final scheme of a combination of approaches for biofuel production can be achieved. Currently, biodiesel production from algae seems to be the closest technology for economic viability, with the hurdles still to overcome. Whether biofuels will completely replace fossil fuels is not certain, but they will be certainly an important future supplement for fossil fuel energy.

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23: OCEANIC WAVE A BOON TO SUSTAINABLE ADVANCEMENT IN RENEWABLE ENERGY TECHNOLOGIES - A REVIEW

Chethana M and K H Byadgi, Department of chemistry, KLE Society's Gudleppa Hallikeri College, Haveri

Abstract

Generation of electric power to satisfy the growing demands in present technology has become a researcher's nightmare. Generation of electric power serves as one of the solution to the growing needs. This conventional renewable energy resources are highly available than any other mode of renewable energy resources, cost-effective and reliable electricity, and this specialty is making oceanic waves very popular. This paper throws light on construction, working principle, obstacles to electrical power generation from oceanic waves for different cases explicitly. Piezoelectric materials are also being implemented in the design of wave energy converters as they convert mechanical motion directly into electrical power. For this reason, various models of piezoelectric material-based wave energy devices are illustrated. The statistical reports and extensive literature survey presented in this review show that there is huge potential for oceanic wave energy.

Keywords: Oceanic waves, conventional renewable energy, piezoelectric materials, mechanical motion

Introduction

Electric power consumption is increasing rapidly all over the world due to the increased population and growth in technology. Hence, it is necessary to enhance the generation of electric power. The energy obtained from this technology is green, harnessing wave energy doesn't emit any harmful gases, and it can easily replace energies using fossil fuels, energy is renewable this all benefits attracts the scientists to work on the present problems of generation of electric power using oceanic waves. The conventional methods of generating electric power using fossil fuels causes environmental issues such as rise in sea level, floods, storms, cyclone, etc., that are diminishing gradually the emission of carbondioxide increases global warming and it is estimated that by the end of 21th century, the average temperature of the earth surface will have increased by 1.4 - 5.8 ^{O}C (1). To reduce the emission of carbondioxide, scientist are investigating

for many years alteranative ways to generate electric power rather than using conventional fuel (2). Electricity generation from renewable energy sources (RESs) are the possible best alternative solutions, as they are widely available and environmental friendly. Wind, solar, hydropower, geothermal, and biomass are some example of easily available RESs that are being used to harvest green electric power (3). RESs is the best option to solve all these issues, many countries have started to generate green energy from RESs, including oceanic wave energy (OWE). Among RESs, the energy conversion from OWE, which is performed by converting mechanical wave energy into the electrical form of energy, is considered as being able to generate more than 1,000-10,000GW electric power, which could greatly contribute to the increasing demand of electrical power in daily life. The wave energy density of oceanic wave has a range of 50–100 kW/m, depending on whether it is shoreline, nearshore, or offshore [4]. This paper addresses almost all the key facts regarding wave energy conversion. It presents various principles of energy conversion methods including rotating machinery and linear electrical generator, which are operated by electromagnetic induction.

Prospects of oceanic wave energy

Clean and environmental friendly energy has become the priority in this century, and wave energy is one of the leading technologies to produce bulk electricity (5). Wave energy can produce up to several thousand tera watt-hours/year, and it as the highest production of energy compared to the other renewable source of energy (6). OWE can decrease the impact of carbon emissions caused by non-renewable energy sources, according to the goal set by the UK government in 2003 (7). UK is one of the leading countries for using OWE, and electricity produced is around 50% of the European continent (8). There are largely untapped energies which are available in the ocean such as wave, tidal energy, marine current and ocean thermal (9). OWE has the highest energy production compared to other renewable energy sources as it can produce energy 90% of the time, which is more than that of the solar and wind energy (10). Table 1 show the total power generated from different renewable energy sources in Europe. Though OWE is more efficient in producing electric power it takes the least consideration may be due to it is just beginning its journey, high cost involved in installation, weak in monitoring, less of adaptability in all countries etc.,

Table 1: Total power generation from different renewable energy sources

RESs	2017 (GW)	2018 (GW)
Wind Power	540	591
Hydropower	1112	1132
Solar	405	505
Bio-power	121	130
Geothermal power	12.8	13.3
OWE	0.5	0.5

In 2011, a US Company named Ocean Power Technology installed a wave energy project which can produce 150 kW in Scotland (11). Irish company Wavebob established one-quarter scale model in Galway Bay, Ireland, in 2006 (12). In Denmark, the half scale 600 kW wave energy converter was installed at Hanstholm in 2009 (13). A quarter and a half size model Wave Dragon was tested at Nissum Bredning in 2003 (14).

Classification of wave energy devices

Wave energy devices (WED) means a physical structure which receives the mechanical power from the oceanic wave and drives it in a specific direction. Here irregular mechanical energy is converted to regular mechanical motion; this motion could be rotational, linear, and translational. Rotational motion drives the turbine, to produce ratating electrical generator. Translational motion drives a linear electrical generator. WED is classified into many different types, which are based on operational concept such as oscillating water column. It could be on the basis of locating the WED that can be situated near shore or onshore or based on vertical position it can be fixed, floating (figure 1), or submerged and the other point of view is orientation (15). There are different types of WEDs, and it can be classified based on the site they are mounted.

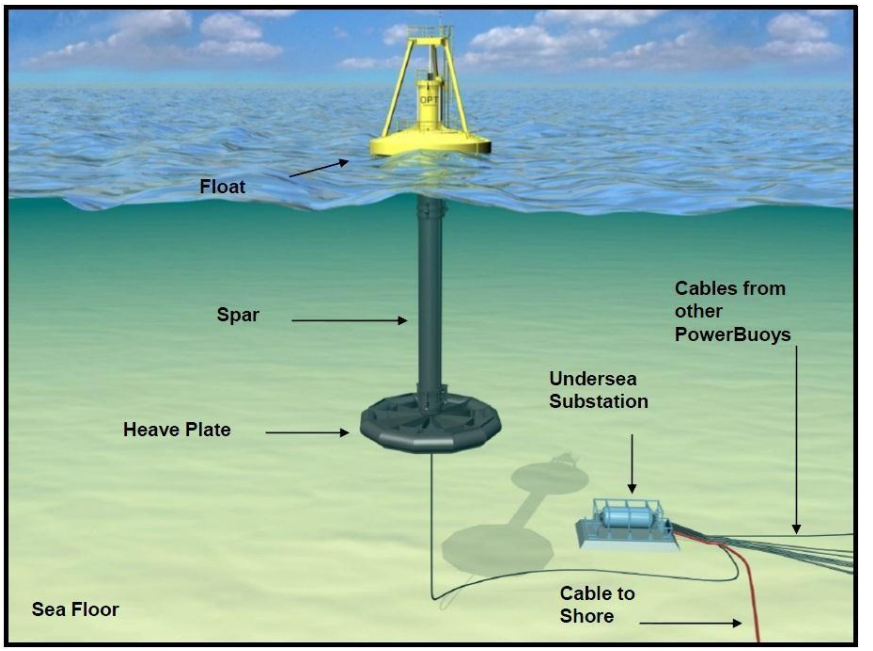

Figure 1.vertical position floating type WED

Power device

Power device is an important part for producing energy, and there are different types of wave power devices such as point absorber, overtopping or terminator device, oscillating water column, oscillating wave surge converter, submerge pressure differential, bulge wave converter. However, most researchers focus on the point absorber (16), which is cost effective and can produce adequate energy. It as moving parts where the horizontal dimension is less than the vertical one, which take advantage of wave action at a single point, one part is almost motionless and the other part is mounted near the sea surface. It moves in a perpendicular motion, catching the wave energy which drives linear generator for producing electricity. There are different examples of point absorbers, but the well-known one is the Ocean Power Technology's "Power Buoy", as shown in Figure 1.

Overtopping device

It has a huge structure that allow it to catch these water when the wave reaches the channel, the water falls through the hole and passes through the turbine, which is connected to as rotating

electrical generator. The most familiar example of overtopping wave power device is wave dragon Figure 2.

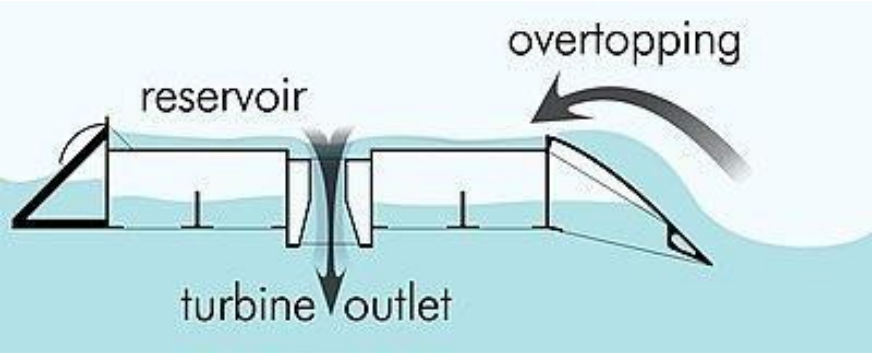

Figure 2: Overtopping device model

Oscillating water column

Oscillating water column (OWC) is built onto or near to rocks and it is close to the sea bottom, the water is compressed and decompressed, and when the wave enters the chambers, the water level increases, and it creates high air pressure which drives the turbine. The air pressure inside the chamber under this condition is much greater than atmospheric pressure (14.7 psi). When the water falls back to the sea, the air pressure under this condition is much lower than atmospheric pressure. For this reason, air enters again into the chamber from outside, finding no other way. As a result, the air then flows in negative direction. It drives the turbine in such a way that it can produce electricity. An example of OWC is Wavegen Limpet (Figure 3)

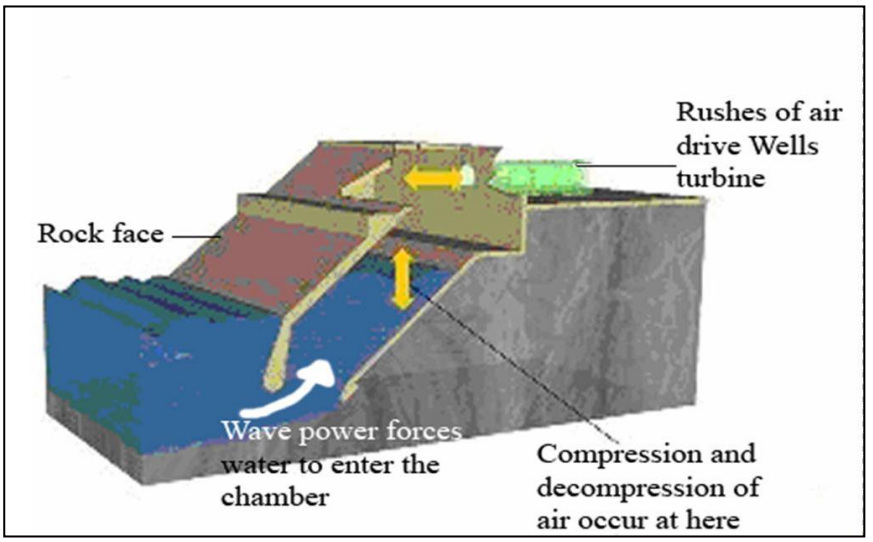

Figure 3: Wavegen limpet model

Attenuators

Attenuators consist of connected sections including main tubes and bends that move when the wave hits serially to consecutive segments of this device one by one. Main tube includes nose tube mid tube, and end tube and inside the tubes where a power conversion module is placed in between two main tubes, as shown in Figure 4. Hydraulic cylinder moves with the wave and pumps high pressure oil through hydraulic motors. Electricity is generated by electrical generator, which is driven by hydraulic motors. The most used example of this type of WEC is Pelamis

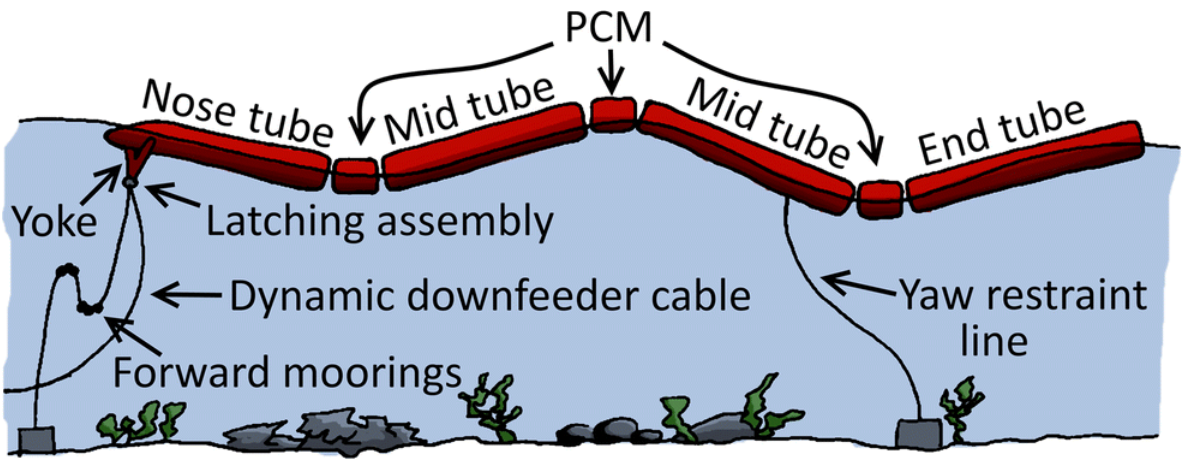

Figure 4: Attenuator wave energy harnessing device.

Oscillating wave surge converters

Oscillating wave surge converters uses back and forth motion of ocean waves. This device is submerged in the bottom of the sea in deep water. This movement pumps the water to a hydraulic power converter for driving generator to produce electricity. An example of this device is Wave Roller (Figure 5)

Figure 5: waver roller device

Submerged pressure differential

Submerged pressure differential devices are normally at lower level of the sea. When the wave moves, it makes the float move up and down overhead the device, creating alternating pressure that either pumps fluid through a system or drives a linear generator to produce electricity. The example of this type of wave energy converter is the Archimedes wave swing (17) Figure 6.

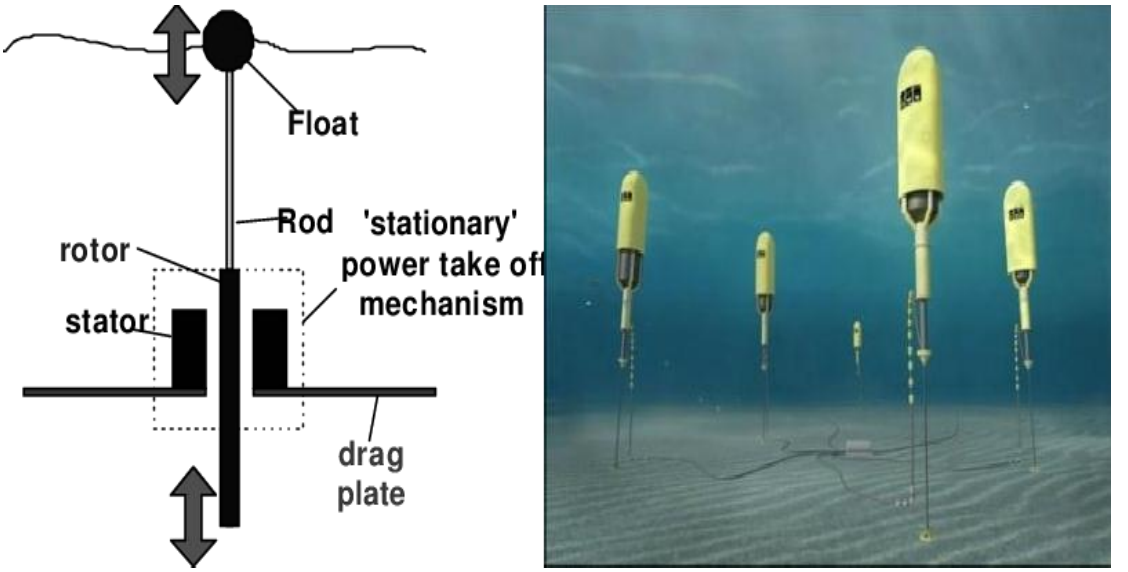

Figure 6: Archimedes wave swing model

Rotaing mass

Rotaing mass wave power device operates the motion of wave to roll a physical heavy object that produce mechanical energy from the oceanic wave and supplies it to the electrical generator as shown in figure 7. Few examples of rotating mass wave energy converter are Witt Energy, Wello: Penguin, Enorasy Labs: Robotic Juggler.

Figure 7: Rotating mass type model

Bulge head wave energy converter

Bulge head wave energy converter uses entirely new principles to convert oceanic wave energy into electrical power. It is made up of elastic pipe, which is submerged just under the water surface as low pressure. One of the two sides of this elastic pipe is fixed as anchored with its head to the base. As the sea wave passes along the tube, abulge wave is created, which moves in front of the wave. This energy is captured which drives the turbine generator to produce electricity (Figure 8).

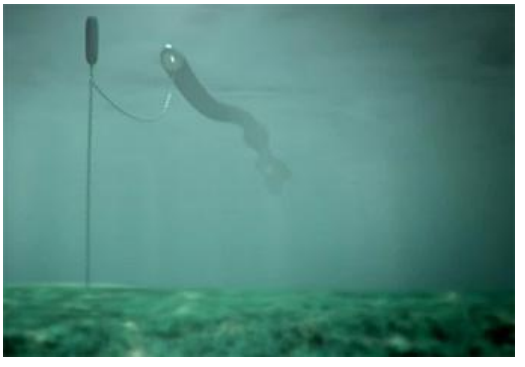

Figure 8: Bulge head wave energy converter

The great challenges

The first and foremost problem regarding the OWE harvesting is high cost and environmental challenges. Environmental issues such as sun balanced frequency. It also faces harsh marine environmental situations. These significant difficulties lessen the improvement of the devices, and it essentially requires quality operational material plan. Cyclone affects wave power level to increase up to 2000 kW/m, which is liable for uncertain condition, and it is also useless for production of electricity (18). Wave energy has lower ecological effect compared to tidal energy, and there is uncertainty about cabling and marine life impact (19). The rough sea atmosphere and sea saltiness makes adverse weather condition for OWE (20). Shoreline erosion would lessen because of energy production through OWE (21). Boring or digging up for the building results in contamination or generates unbalance in the natural habitat of the ocean plants and animals (22). Sea weather can be terrible because of natural disasters and the production of electricity could be irregular at that time. Inspite of all these difficulties the benefits and advantages are more.

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24: NEW TRENDS AND TECHNOLOGIES FOR RENEWABLE SOURCE OF ENERGY: A BRIEF REVIEW

SUSHMA H PRASAD*

Department of Chemistry, KLE'S S Nijalingappa College, Rajajinagar, Bengaluru – 560010, Karnataka, India.

Author for Correspondence: sushmaprasad24999@gmail.com

Abstract

The renewable energy market is changing thanks to falling prices and increased demand for cleaner energy sources. The emergence of renewable energy has revolutionised world markets, and renewables-driven change continues with unprecedented speed. Even several years ago, few would have guessed the scope of the new technologies that have been developed to help countries begin the process of de-carbonising their economies or predicted that household names like Google would be investing large sums in solar energy projects. Little did people knew that renewable resources would have so much importance in coming days. There are some drastic changes in usage of energies, some of these changes have been gradual, some sudden. Others are only just beginning, and their significance is not yet widely understood. Advancements in technology, industrial revolution and growth of world's population push for energy demand. In order to overcome energy demand, reducing the import cost and environmental protection developed countries and developing countries are concentrating towards the non-conventional and renewable sources of energy. One such reliable for of energy source are renewable resources. From replacing any synthetic to everything renewable resources play a key role for development and sustaining lives on earth. For example, replacing the fossil fuels with renewable sources most of the countries has been move on to the cost-effective techniques, technological requirements, geographical constraints for better replacements and effective production and usage of renewable resources. This paper shall be presenting a brief overview on how modern technologies and trends have adopted and shaped for maximization of renewable resource utilization.

Key words: Renewable energy, technologies, trends, improvements, strategies, developments, efficiency, storage, energy.

1. Introduction

Energy can be defined as ability of a system to cause an external work or motion. It is important to have sources energy to be identified and procured optimally. According to law of conservation of energy, energy neither can be created nor destroyed, however it
can be transferred from one form to another. Hence it is necessary to transform the unexplored energy for sustainability. Energy based on its exhaustibility can be categorized into renewable and non-renewable energy sources. Renewable energy sources like
wind, tidal, solar, biomass etc… prospects the strategies for a viable development.
The strategies involve (i) energy savings on demand side, (ii) efficiency improvement and

(iii) Replacement of fossil fuel. Sustainable energy should be capable of meeting the energy crisis for increasing demand. Environmental issues like global warming and climatic change possess consequences which was created turmoil among developed countries [1]. Renewable energy plays a crucial role in the energy sector notably wind and solar energy. The call of the oil industry all over the world expanded. The investment of hydrocarbon extraction is not affordable. Because of more production, the amount of oil is getting reduced day by day and the pollution such as emission of carbon contributing to global warming. 170 countries work to reduce global warming so they call for a carbonless energy source. Thailand oil and gas companies attempt the deal and conclude that renewable energy sources help, and
this increases the importance of wind and solar energy becomes an emerging sector and turn into a big investment in oil industries. World industries are investing more on renewable energy industries hence by the year of 2040 it may become one of the fastest-growing and major money-making business providing industries a private firm has invested a huge amount of renewable energy sources and humans are facing uncertainties managing natural resources are increasing as a consequence of global environmental change [2]. These rising uncertainties pose additional challenges to management and, increase the urgency of developing efficient and robust strategies to adapt to these changes [3–7]. While climate change effects on species' distributions and abundance is a known uncertainty [8–10] to over come these uncertainties a smart way of

adapting technologies and trends are in-demand and in fast need. Followings are some technologies and trends that are being adopted by many countries for a better future and balance.

2. Technologies for renewable resources utilization

Here's a look at five of the most important trends and technologies in renewable energy — some have radically re-shaped the energy market over the last decade, while others are set to make waves in the years to come.

Wind and solar

It is wind turbines and solar panels that represent, for most people, the onward march of renewable energy. The two power sources are visible in many rural landscapes and have transformed the market. "The biggest impact has been wind and solar technologies leading to a very rapid drop in the production costs of electricity," says Petteri Laaksonen, Research Director at the School of Energy Systems at Finland's Lappeenranta-Lahti University of Technology (LUT). Renewable energy is expected to make up 30 percent of the world's energy by 2024, according to the International Energy Agency, and most of this is driven by solar and wind projects that continue to be rolled out at a startling pace. This is a growth in the use of solar panels, which made up 60 percent of the renewable energy capacity installed in 2019. Even technology giants like Apple, Google, and Amazon have invested in solar. In future we can expect many other counties to head towards this kind of utilizations.

Electrification

Experts agree that the advance of electrification in the coming decades will super-charge the shift to renewables. The renewables-based electrification of European industry, buildings, and transport will allow the continent to reduce its energy-related carbon dioxide emissions by 90 percent by 2050, according to some predictions. This trend is already visible. For instance, Wartsila and Pivot Power are installing a world-first 100 MW of utility-scale transmission-connected energy storage alongside high-volume power connections that will provide essential capacity for a national network of rapid electric vehicle charging stations. The project is expected to play a big role in accelerating the UK's energy transition push towards net-zero

emissions by 2050. What's more, data from the Wartsila Energy Transition Lab shows that in the first months of 2020, the percentage of renewable energy being used to generate electricity in Europe increased dramatically with a corresponding drop-off in electricity generated by traditional sources. Laaksonen points out that there will also be new uses for electricity, including the production of hydrogen from water via electrolysis, recycling carbon dioxide by capturing it from the air, while nitrogen for fertilisers will also be made by taking it from the air. He predicts that, eventually, electricity demand could increase as much as 3-4 times in European countries, and the price will fall (thanks to the boom in renewable power). Switching to electricity is key to achieving the de-carbonisation of economies, but there are other, less obvious, knock-on benefits including improved energy security (independence from fossil fuel exporters) and better urban air quality.

Power-to-X

One of the game-changing new technologies, Power-to-X is an umbrella term that covers different processes that turn electricity into heat, hydrogen or renewable synthetic fuels. It offers a significant opportunity to speed up the shift to renewables by ramping up synthetic fuel production, and rapidly reducing fossil fuel emissions in sectors ranging from the steel industry and food production to the chemical industry and fertilisers. The technology can also play a key role in solving long-term energy storage challenges, regulating the ups and downs in supply from renewable sources. "Power-to-X is needed because re-investing in whole infrastructures and technologies (aviation, shipping, heavy-duty, and even electric cars) is not possible in the coming two decades during which we need to accomplish the transition," says Laaksonen.

Distributed Generation

A quiet revolution in the field of renewables is the increasing affordability and popularity of so-called distributed generation. This means local power generation either in the retail or commercial sector: from solar panels on private homes to factories using combined heat and power systems. There are numerous advantages to the scaling up of distributed generation, from reducing reliance on centralised power sources to increasing grid reliability and making small-scale renewable power sources viable. When combined with smart grids, which are regulated by

computers to fine-tune transmission, distributed generation is even more effective. There has been a rapid growth in distributed generation in recent years, and this is expected to continue: according to one estimate, the distributed generation market will be worth EUR 147.5 billion by 2026.

Energy storage

The potential of energy storage to accelerate the shift to renewables has been widely discussed in scientific circles and looks set to be key in the years to come. “Energy storage will be needed in the system due to variable wind and solar production,” explains Laaksonen. “There are multiple energy storage technologies and the skill is to combine them in a system. “Examples include smart energy management technology like Wartsila’s GEMS which optimises multiple technologies under a single portfolio. “Some of the solutions that are likely to expand in the coming years include hydro-reservoirs, batteries, Power-to-X fuels, and seasonal thermal energy storage. These same technologies will also be useful for countries with large nuclear power industries. Above all, energy storage allows an efficient flow of power to be maintained despite the intermittent nature of wind or solar sources. “Storage technologies will evolve within the energy system along with the increased use of renewable energies,” says Laaksonen.

3.Today’s trends in renewable energy

China stands first in population density and Hong Kong is one of the major ports and business capital of southeast China. With population growth pollution also increases. For reducing pollution, Hong Kong turned towards Renewable Energy and renewable energy management. The recent trends used in renewable energy management and also the various methods of producing energy such as Solar PV cells, the hydropower plant, sewage water treatment and turning waste into energy. The Drainage Services Department plays a important role in the advancement facilities of sewage water management. Focuses on the bio-fuel and heat and mass-energy production using the turbines and micro-turbines, etc [11]. China’s power market has been taking here and sectioned into two-level power markets namely interprovincial markets and inner provincial markets. The advantage of segment bidding mechanism based on Minimum Dispatchable Interval (MDI) model is that it reduces the exposure of actual operation on power

markets and effective usage or consumption of renewable energy. Interprovincial markets use power grid companies. Based on the supply, need and intervals they are sending provinces and receiving provinces. The inner provincial markets are lying as a boundary condition for clearing interprovincial markets. If the sending provinces and receiving provinces start, then the transmission line is marked as to the lower limit and locked as soon as the provinces are transferred. Renewable energy's interval predicted using this two-level market model and used to obtain mdi and form the segment bidding mechanism to increase the effectiveness in the consumption of renewable energy [12] According to the report provided by World energy balances 2020, the electricity consumption is increasing. The Fig. 1, shows the increase in electricity consumption. The major contributing factors towards the increase is due to population growth, industrial development, technological development etc.

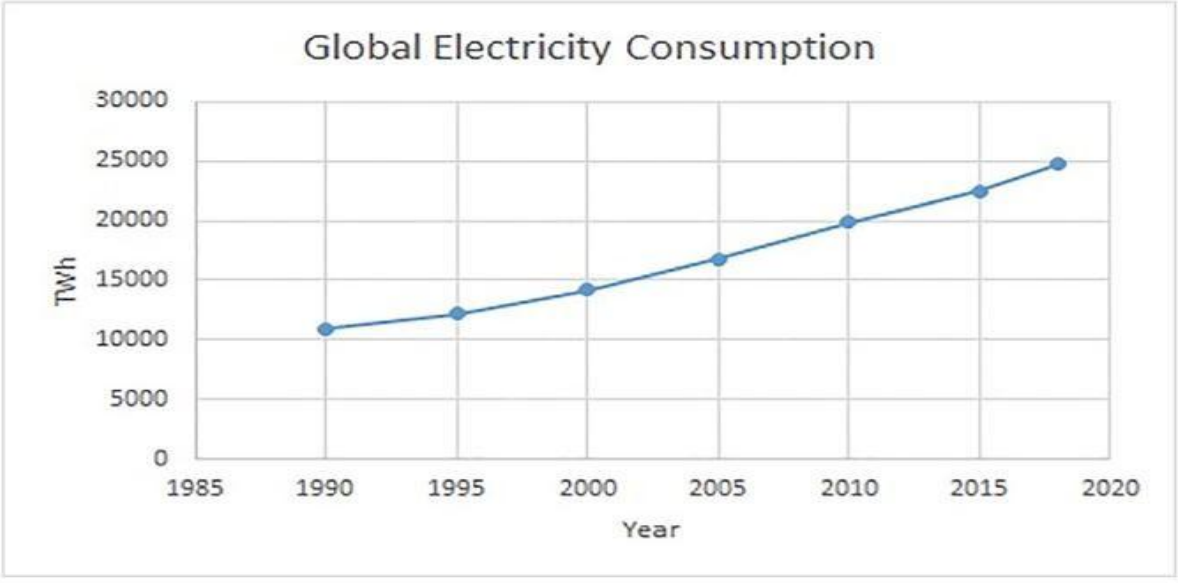

Fig. 1.Schematic diagram of the increase in electricity consumption.

As is evident from the preceding discussion, scientific and engineering advances continue to strongly influence the progress of renewable energy technology development, as do advances in information technology. Easily accessed web sites relating to renewable energy technologies provide valuable and accurate information that is easily accessible by everyone. Real-time metering is opening up innovative electricity pricing [13]; sophisticated equipment and controls are improving the use of energy in buildings;

and complex systems are being modelled in the laboratory, accelerating technology development. But despite the excellent technical progress of the last 20 years, electricity and fuels from renewable energy are still generally more expensive than electricity and fuels from conventional fossil-fuel sources, with some exceptions. Table 1 summarizes the economic potential of major renewable energy electric systems. Although it is difficult to compare costs of electricity from renewable technologies to those of conventional grid electricity, it should be noted that the average retail price of electricity in the United States is $0.07/kW h, which is less than most renewables. The cost of electricity and fuels from renewable energy would easily be less expensive than fossil fuels if the true, hidden costs of fossil fuels—environmental costs, health costs, and energy security costs—were considered. But our society has not yet found acceptable ways to incorporate these hidden costs into the cost of our energy.

Resource	Application or Technology	Current Cost[56] (¢/kWh)	Next Generation Cost[56] (¢/kWh)	Grid-connected Generating Capacity, 1998 [57] (MW)
Photovoltaics	All types	20–30	15 or less	10
Concentrating Solar Power	Dish-Stirling	10–15	4–6	0
	Trough	10–12	7–9	354
	Power Tower	6–9	3–5	0
Biopower	Direct Combustion	7–15	4–6	7,500
	Cofiring	2–3	2–3	500
	Gasification	8–10	4–5	0
Wind Energy	All types	4–6	2–4	2,500
Geothermal Energy	Steam and Hot Water	5–8	3–5	3,000

TABLE 1: Economic Potential of Renewable Electric Systems

4. Future issues for renewable energy

From the dawn of human civilization to about 100 years ago, the sources of energy used by mankind were predominantly human and animal muscle and wood, with lesser amounts of solar, wind, hydro, and geothermal. With the discovery of oil, the development of natural gas fields, and the widespread distribution of electricity from coal-powered central power plants, fossil fuels became the predominant sources of energy in the United States and the world. Is there

another major transition ahead for energy? Can the renewable resources that sustained early civilization be harnessed with enough efficiency and availability and at a cost to meet a significant portion of the much higher energy needs of today's society? Although there are always risks in predictions, the convergence of some of today's trends suggests interesting possibilities [14]. In summary, today's converging trends related to renewable energy include:

• relevant scientific discoveries and engineering progress;
• emergence of a new economic structure in the electricity sector;
• trends toward decentralization and modularity;
• explosive advances in computers, information, and telecommunications;
• globalization of markets;
• persistent, pervasive support for a clean environment;
• limited future availability of inexpensive fossil fuels.

Do these converging trends mean that we are on the brink of a new energy transition from fossil fuels to renewables? Several independent entities have recently developed scenarios indicating that renewable energy will play a major role in the energy mix for the world, with increasing impacts beginning as early as 2000–2010 and major impacts by 2050 [15-20]. In both of the Shell International scenarios, energy contributions from conventional energy resources begin to level off in 20–30 years, with petroleum consumption actually decreasing (see Fig.2) [21]. According to these scenarios, the increases in world energy demand will be supplied by renewable energy technologies, which will provide 30%–50% of world energy by 2050.

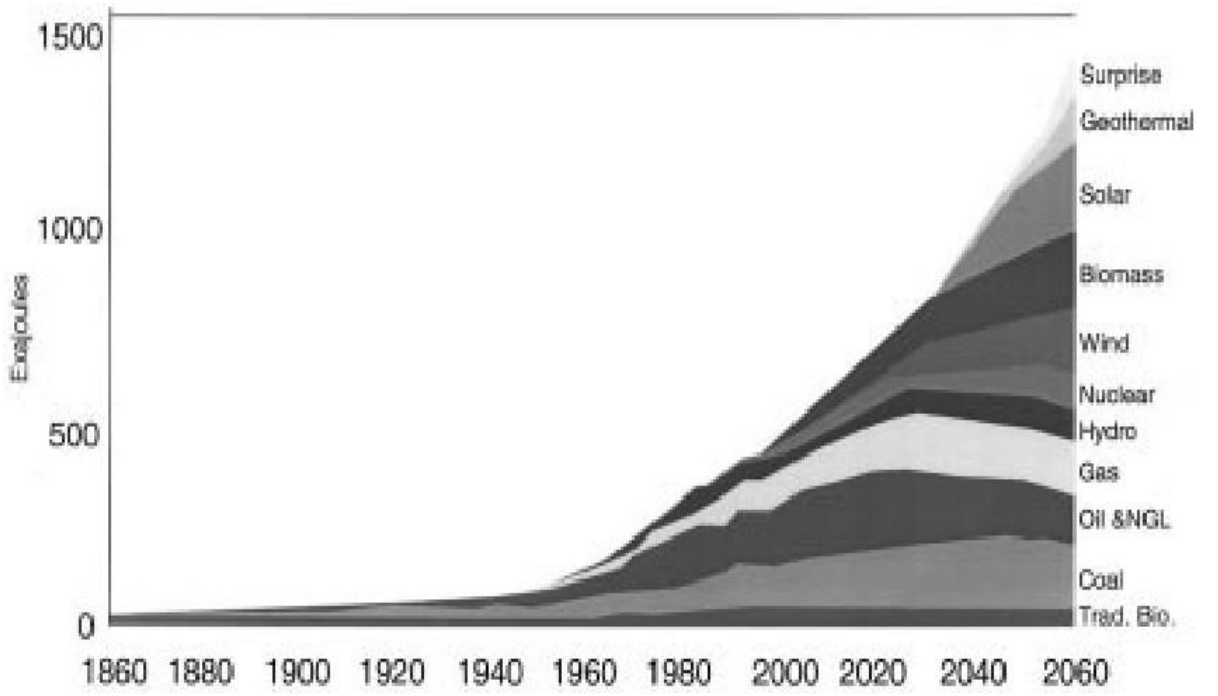

Fig. 6. Shell sustained growth scenario.

Although these scenarios are important, and should be studied and debated, it may be even more significant that four international companies have recently made major investments in renewables. In October 1997, the Royal Dutch/Shell Group created Shell International Renewables with a $500 million investment, focusing on solar, biomass, and forestry [22]. In January 1998, British Petroleum (BP), through its BP Solar subsidiary, opened a 10–15 MW photovoltaics facility (its sixth in the world) in California. Enron Corporation, one of the world's largest natural gas companies, entered into a joint venture with Amoco Corporation in 1995 to form the largest U.S.-owned producer of PV cells and the second largest in the world. Enron then acquired the largest U.S. wind energy company in 1997 and formed a new business unit, Enron Renewable Energy Corporation [23] Most recently, Amoco and British Petroleum announced a merger. And Bechtel, the international engineering an project development giant, recently formed a joint venture with another U.S. firm to develop small, renewable energy systems including solar, wind, and hybrids. Leaving aside the controversial question of when we might transition to an energy mix with significant proportions of renewable energy, but accepting the inevitability of the transition, what could be the impact on global society? [24], [25] Although

the topic is worthy of many pages of discussion, here three areas relating most closely to the direct impact on human beings:

• rural economy;

• community planning and lifestyles;

• international socioeconomic equity;

Meeting the rapidly growing demand for energy, while also maintaining a clean global environment, requires clean energy to power the economy. Higher oil prices and environmental and security concerns will eventually prompt the transition from oil-based fuels to renewables-based fuels and fuel cells. Distributed energy resources, international markets, continuing technical advances, and public opinion will increase the use of renewable electric technologies, replacing coal-based, nuclear and perhaps natural gas power plants. The advent of the substantial use of renewable energy will result in energy production and use that will no longer be as harmful to the environment [26].

Conclusion

Within the broad variety of technologies that constitute renewable energy, some are already making large inroads in the marketplace. Other technologies, perhaps those most beneficial to a sustainable future, are further from commercialization. Most, however, are progressing more quickly than ever; there are no technical stumbling blocks for renewable energy. Renewable energy is a force today and will be a major force in future—the only question is when. The answer will depend only on the will of the people for clean energy—or the next major political disruption in the world.

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25: RENEWABLE ENERGY SOURCES FOR SUSTAINABLE DEVELOPMENT IN INDIA

Narayanaswamy S Y
Dept. of Zoology, KLE`s S. Nijalingappa College Rajajinagar, Bengaluru

Abstract

Sustainable development is feasible by use of renewable energy and by ensuring access to affordable, reliable, sustainable, and modern energy for citizens. The first objective for deploying renewable energy in India is to advance economic development, improve energy security. India is accountable for nearly 6.65% of total global carbon emissions, ranked fourth next to China (26.83%), the USA (14.36%), and therefore the EU (9.66%). Global Climate change may additionally change the ecological balance within the world. The utilization use of solar, wind, biomass, waste, and hydropower energies. It`s evident that clean energy is smaller amount harmful and infrequently cheaper. India is going to attain 175 GW of renewable energy it might be accommodates 100 GW from solar energy, 10 GW from bio-power, 60 GW from wind generation. The renewable potential was estimated as 85,000 MW with wind 4500 MW, solar 35 MW, biomass/bioenergy 25,000 MW, and littlt hydropower of 15,000 MW. The estimated potential of wind generation was 302.251 GW (at 100-m mast height), of small hydropower 19.749 GW, biomass power 17.536 GW, bagasse cogeneration 5 GW, waste to energy (WTE) 2.554 GW, and solar 748.990 GW.

Keywords: India, Sustainable, Renewable energy, Global climate change, wind generation and solar power

Introduction

Renewable energy sources play an important role in securing sustainable energy with lower emissions [1]. Its already accepted that renewable energy technologies might significantly cover the electricity demand and reduce emissions. In recent years, the country has developed a sustainable path for its energy supply. India has an increasing energy demand to satisfy the economic development plans that are being implemented. The National Electricity Plan [NEP] [2] framed by the Ministry of Power (MoP) has developed a 10-year detailed action plan with the to supply electricity across the country, and has prepared an additional commit to make sure that power is supplied to the citizens efficiently and at an expensive cost. India is chargeable for nearly 6.65% of total global carbon emissions, ranked fourth next to China (26.83%), the USA (14.36%), and therefore the EU (9.66%). Global climate change may also change the ecological balance within in the world. Intended Nationally Determined Contributions (INDCs) are submitted to the World organization Framework Convention on global

climate change and also the Paris Agreement.

The sources of electricity production like coal, oil, and fossil fuel natural gas have contributed to one-third of world greenhouse emission. Its essential to boost the quality of living by providing cleaner and more reliable electricity [3]. In line with World Energy Council [8] prediction, global electricity demand will peak in 2030. India is one among the most important coal consumers within the world and imports costly fuel [4]. Nearly 74% of the energy demand is supplied by coal and oil. Awareness of saving energy has been promoted among citizens to extend the utilization of solar, wind, biomass, waste, and hydropower energies. I`ts evident that clean energy is smaller amount harmful and infrequently cheaper. India is progressing to attain 175 GW of renewable energy which might be comprises 100 GW from alternative energy, 10 GW from bio-power, 60 GW from alternative energy, and 5 GW from small hydropower plants by the year 2022 [5].

Advancement in technology, proper regulatory policies [6], education and attempts in efficiency enhancement because of due to research and development (R&D) [7] are number of the pathways to conservation of energy and environment that ought to guarantee the natural resource bases are employed in a price effective and quick manner. This text also manifests technological and financial initiatives [8], policy and regulatory framework, like wise as training and academic initiatives [9, 10] launched by the government for the expansion and development of renewable energy sources. The event of renewable technology has encountered explicit obstacles, and thus, there is a necessity to debate these barriers. Additionally, it`s also to get possible solutions to beat these barriers, and hence, proper recommendations have been suggested for the steady growth of renewable power [11–13]. Given the large potential of renewables within the country, coherent policy measures and an investor-friendly administration may be the key drivers for India to become a world leader in clean and green energy. This paper aims to present significant achievements, prospects, projections, generation of electricity. The recommendations supported the review outcomes will provide useful information for project developers, associated stakeholders and departments, researchers, and scientists.

Objectives

Discuss renewable energy sources and sustainability and global climate change.

Elaborates on the varied renewable energy sources.

Elaborates on the renewable energy sources and sustainable development.

Elaborates on challenges affecting renewable energy sources and policy recommendations.

Result and Discussion

An energy source may be a necessary element of socioeconomic development. Energy supply and security haven`t only increased the essential issues for the event of human society but also for his/her global political and economic patterns [14]. Table 1 shows the first energy consumption of the planet, supported the BP Energy Outlook 2018 reports. In 2016, India's overall energy consumption was 724 million plenty of oil equivalent (M toe) and is anticipated to rise to 880 M toe within the year 2020. Energy consumption of assorted major countries comprises commercially traded fuels and modern renewables would not to produce power. In 2016, India was the fourth largest energy consumer within the world after China, the USA, and also the Organization for economic co-operation and development (OECD) in Europe [15]. The projected estimation of world global energy consumption demonstrates that energy consumption in India is continuously increasing [16]. The rise in India's energy consumption will push the country's share of worldwide energy demand.

Table 1: Projected primary energy consumption (million tones oil equivalent)

Region	1990	1995	2000	2005	2010	2016	2020
United States	1966	2119	2310	2349	2284	2273	2334
Brazil	126	158	188	211	268	298	330
EU	1672	1661	1732	1819	1754	1642	1667
Russia	865	662	620	647	673	674	711
Middle East	264	351	423	565	734	895	980
Africa	222	244	274	327	389	440	509
China	683	889	1008	1800	2491	3053	3387
India	195	251	316	394	537	724	880

The size and growth of a country's population significantly affects the demand for energy with 1.368 billion citizens, India is ranked second, of the foremost populous countries as of January 2019 [17]. The yearly rate is 1.18% and represents almost 17.74% of the world's population. The country population within the year 2020 has quite than 1.383 billion. Each year, India adds a better number of individuals to the planet than the other nation and therefore the specific population of many countries. The expansion of India's energy consumption is the fastest among all with coal meeting most of this

demand followed by renewable energy. Renewables became the second most vital source of domestic power production, overtaking gas and so oil. The demand for renewables in India will have an incredible growth with an annual increase of 12%, as shown in Table 2. India consumed around 40 Mtoe of renewable energy in 1990, and 41 Mtoe in 2020. Its probable that India's energy consumption will grow fastest among all major economies, with coal contributing most in meeting this demand followed by renewables.

Table 2: Projected primary energy consumption of India (including renewable energy) [28]

	1990	1995	2000	2005	2010	2016	2020
Total	195	251	316	394	537	724	880
Oil (Mb/dl)	58	75	106	122	155	212	251
Gas (Bcf/dl)	11	17	24	32	54	45	57
Coal	110	140	164	211	290	412	485
Nuclear	1	2	4	4	5	9	11
Hydro	15	17	17	22	25	29	36
Renewables	0	0	1	2	7	17	41

Strong economic process in India is escalating the demand for energy, and more energy sources are required to hide this demand. At the identical time, thanks to the increasing population and environmental deterioration, the country faces the challenge of sustainable development. The gap between demand and provide of power is predicted to rise within the future [18]. Table 3 presents the ability supply status of the country from 2009–2010 to 2018–2019. In 2018, the energy demand was 1,212, 134 GWh, and therefore the availability was 1,203,567 GWh, i.e., a deficit of −0.7% [19]. According to the Load generation and Balance Report (2016–2017) of the Central Electricity Authority

of India (CEA), the voltage energy demand for 2021–2022 is anticipated to be a minimum 1915 terawatt hours (TWh), with a peak electric demand of 298 GW [20]. Increasing urbanization and rising income levels are liable for an increased demand for electrical appliances, i.e., an increased demand for electricity within the residential sector.

Table 3: The power supply status in the country [33]

Year		Energy				Peak		
	Requirement(GWh)	Availability(GWh)	Surplus(+) (GWh)	Deficits(−) (%)	Peak Demand	Peak Met	Surplus(+) (GWh	Deficits(−) (%)
2009–2010	830,594	746,644	−83,950	−10.11	119,166	104009	−15,157	−12.72
2010–2011	861,591	788,355	−73,236	−8.50	122,287	110256	−12,031	−9.84
2011–2012	937,199	857,886	−79,313	−8.46	130,006	116,191	−13,815	−10.63
2012–2013	998,114	911,209	−86,905	−8.71	135,453	123,294	−12,159	−8.98
2013–2014	1,002,257	959,829	−42,428	−4.23	135,918	129,815	−6103	−4.49
2014–2015	1,067,085	1,028,955	−38,130	−3.60	148,166	141,160	−7006	−4.70
2015–2016	1,114,408	1,090,850	−23,558	−2.10	153,366	148,463	−4903	−3.20
2016–2017	1,142,928	1,135,332	−7596	−0.66	159,542	156,934	−2608	−1.63
2017–2018	1,212,134	1,203,567	−8.567	−0.7	164,066	160,752	−3314	−2.0
2018–2019	769,399	764,627	−4773	−0.6	177,022	175,528	−1494	-0.8

The increased demand in materials for buildings, transportation, capital goods, and infrastructure is driving the commercial demand for electricity. An increased mechanization and also the shift to groundwater irrigation across the country is pushing the pumping and tractor demand within the agriculture sector, and hence the big diesel and electricity demand.

The estimated potential of wind generation within in the country during 1995 [21] was found to be 20,000 MW (20 GW), alternative energy was 5 × 1015 kWh/pa, bioenergy was 17,000 MW, bagasse cogeneration was 8000 MW, and tiny hydropower was 10,000 MW. In the year 2006, the renewable potential was estimated as 85,000 MW with wind 4500 MW, solar 35 MW, biomass/bioenergy 25,000 MW, and tiny hydropower of 15,000 MW [22]. According to the annual report of the Ministry of recent and Renewable Energy (MNRE) for 2017–2018, the estimated potential of alternative energy was 302.251 GW (at 100-m mast height), of small hydropower 19.749 GW, biomass power 17.536 GW,

bagasse cogeneration 5 GW, waste to energy (WTE) 2.554 GW, and solar 748.990 GW. The estimated total renewable potential amounted to 1096.080 GW [23] assuming 3% wasteland, which is shown in Table 4. India could be a tropical country and receives significant radiation, and hence the solar potential is very high [24-26].

Table 4: The estimated renewable potential in India [40]

Sl. No	States/UTs	Wind power (MW)	Small hydro power	Biomass power	Bagasse cogeneration	Waste to energy	Solar	Total
1	Andhra Pradesh	44.229	0.978	0.578	0.3	0.123	38.44	84.648
2	Arunachal Pradesh	0	1.341	0.008	0	0	8.65	9.999
3	Assam	0	0.239	0.212	0	0.008	13.76	14.219
4	Bihar	0	0.223	0.619	0.3	0.073	11.2	12.415
5	Chhattisgarh	0.077	1.107	0.236	0	0.024	18.27	19.714
6	Goa	0.001	0.007	0.026	0	0	0.88	0.914

7	Gujarat	84.431	0.202	1.221	0.35	0.112	35.77	122.086
8	Haryana	0	0.11	1.333	0.35	0.024	4.56	6.377
9	Himachal Pradesh	0	2.398	0.142	0	0.002	33.84	36.382
10	Jammu & Kashmir	0	1.431	0.043	0	0	111.05	112.524
11	Jharkhand	0	0.209	0.09	0	0.01	18.18	18.489
12	Karnataka	55.857	4.141	1.131	0.45	0	24.7	86.279
13	Kerala	1.7	0.704	1.044	0	0.036	6.11	9.594
14	Madhya Pradesh	10.484	0.82	1.364	0	0.078	61.66	74.406
15	Maharashtra	45.394	0.794	1.887	1.25	0.287	64.32	113.932
16	Manipur	0	0.109	0.013	0	0.002	10.63	10.754
17	Meghalaya	0	0.23	0.011	0	0.002	5.86	6.103
18	Mizoram	0	0.169	0.001	0	0.002	9.09	9.262
19	Nagaland	0	0.197	0.01	0	0	7.29	7.497
20	Odisha	3.093	0.295	0.246	0	0.022	25.78	29.436
21	Punjab	0	0.441	3.172	0.3	0.045	2.81	6.768
22	Rajasthan	18.77	0.057	1.039	0	0.062	142.31	162.238
23	Sikkim	0	0.267	0.002	0	0	4.94	5.209
24	Tamil Nadu	33.8	0.66	1.07	0.45	0.151	17.67	53.801
25	Telangana	4.244	0	0	0	0	20.41	24.654
26	Tripura	0	0.047	0.003	0	0.002	2.08	2.132
27	Uttar Pradesh	0	0.461	1.617	1.25	0.176	22.83	26.334
28	Uttarakhand	0	1.708	0.024	0	0.005	16.8	18.537
29	West Bengal	0.002	0.396	0.396	0	0.148	6.26	7.202
30	Andaman & Nicobar	0.008	0.008	0	0	0	0	0.016
31	Chandigarh	0	0	0	0	0.006	0	0.006
32	Dadra & Nagar	0	0	0	0	0	0	0

	Haveli							
33	Daman & Diu	0	0	0	0	0	0	0
34	D elhi	0	0	0	0	0.131	2.05	2.181
35	Lakshadweep	0.008	0	0	0	0	0	0.008
36	Puducherry	0.153	0	0	0	0.003	0	0.156
37	Others	0	0	0	0	1.022	0.79	1.812
	Total	302.251	19.749	17.536	5	2.554	748.99	1096.08

As of June 2018 reports, the country intends to acmieve 225 GW of renewable power capacity by 2022 exceeding the target of 175 GW pledged during the Paris Agreement. The world is that the fourth most tasty renewable energy market within the world. As in October 2018, India ranked fifth in installed renewable energy capacity [27].

The overall generation (including the generation from grid-connected renewable sources) within the country has grown exponentially. Between 2014–2015 and 2015–2016, it achieved 1110.458 BU and 1173.603 BU, respectively. The identical was recorded with 1241.689 BU and 1306.614 BU during 2015–2016 and 1306.614 BU from 2016–2017 and 2017–2018, respectively. The annual renewable power production increased faster than the traditional power production. The increase accounted for 6.47% in 2015–2016 and 24.88% in 2017–2018, respectively. Table 5 compares the energy generation from traditional sources there with that from renewable sources. The energy generation from conventional sources reached 811.143 BU and from renewable sources 9.860 BU in 2010 compared to 1.206.306 BU and 88.945 BU in 2017, respectively [28]. Its observed that worth of electricity production using renewable technologies is above than that for conventional generation technologies, but is probably going to fall with increasing experience within the techniques involved [29].

Table 5: Cumulative energy generation from renewable energy and conventional energy [33]

	Energy generation from conventional sources (BU)	Energy generation from conventional sources (BU)
2010–2011	811.143	9.860
2011–2012	876.887	51.226
2012–2013	912.056	57.449
2013–2014	967.150	65.520

2014–2015	1048.673	61.719
2015–2016	1107.822	65.781
2016–2017	1160.414	81.548
2017–2018	1206.306	101.839
2018–2019 (30.11.2018)	749.173	88.945

The highest renewable energy generation (Table 6) was achieved from Karnataka (16.57%), Tamilnadu (15.82%), Andhra Pradesh (11.92%), and Gujarat (10.87%) as per November 2018. While adding four years from 2015–2016 to 2018–2019 Tamilnadu [30] remains in the first position followed by Karnataka, Maharashtra, Gujarat and Andhra Pradesh.

Table 6: Cumulative electricity generation from renewable energy [48]

Renewable energy generation (MU)	2018-19 (April-November 2018)	2017-18 (April-March)	2016-17 (April-March)	2015-16 (April-March)
Himachal Pradesh	1989.26	1903.05	2110.71	1921.77
Punjab	1544.73	2343.87	2149.49	1474.2
Rajasthan	7912.68	9484.23	7973.85	6600.24
Uttar Pradesh	2554.50	4606.29	3638.26	3201.49
Gujarat	9670.07	11759.63	9497.99	8003.73
Madhya Pradesh	5406.34	6292.9	5268.67	2910.42
Maharashtra	9811.79	12036.98	11292.7	10756.58
Andhra Pradesh	10602.81	10597.47	5488.26	3106.61
Telangana	4503.35	4632.28	1999.89	1027.9
Karnataka	14734.92	13463.98	9585.68	10061.03
Tamilnadu	14073.94	16179.86	15153.87	9331.47
West Bengal	1093.37	1590.54	1569.77	1608.15
Others	5047.58	6948.4	6138.86	5777.26
Total Generation (MU)	88945.34	101839.48	81868.69	65780.85

The wind-based energy generation as per 2017–2018 is (Table 7) most prominent with 51.71%, followed by solar power (25.40%), Bagasse (11.63%), small hydropower (7.55%), biomass (3.34%), and WTE (0.35%). There has been a continuing increase within the generation of all renewable sources from 2014–2015 up to now. Wind energy was the best contributor to the full renewable power production. The share of alternative energy produced within the overall renewable power production comes next to wind and is often reduced during the monsoon months. The definite improvement in wind energy production will be related to a "good" monsoon. Cyclonic action during these months also facilitates high-speed winds. Monsoon winds play a big part with in the uptick within alternative energy production, especially within the southern states of the country.

Table 7: Cumulative energy generation from renewable energy—source-wise, 2014–2019 [48]

	Renewable generation (MU)	Wind	Solar energy	Biomass	Bagasse	Small Hydropower	WTE
2014–2015	61719	33,768	4599	3160	11,785	8060	348
2015–2016	65781	33,029	7448	3727	12,953	8355	269
2016–2017	81,548	46,004	13,499	4198	9960	7673	213
2017–2018	101,839	52,666	25,871	3405	11,847	7692	358
2018–2019	88,945	50,335	24,506	1789	5140	6894	282

An estimation of gross electricity generation from(Table 8) renewable energy supported on the 2015 report of the National Institution for Transforming India (NITI Aayog) [51]. Its predicted that the share of renewable power are going to be 10.2% by 2022, but renewable power technologies contributed a record of 13.4% to the cumulative power production in India as of the 31st of August 2018. The power ministry report shows that India generated 122.10 TWh and out of the entire electricity produced, renewables generated 16.30 TWh as on the 31st of August 2018.

Table 8: The past generation capacity and the estimation of the generation capacity (electricity mix) of renewable energy in India compared with conventional energy [51]

TWh generation (BU)	2011–2012	2021–22	2029–2030	2046–2047
Coal	708.3	1444.7	1848	3153.6
Gas	115.4	127.7	155	198.1
Nuclear	26.7	82.5	109	183.1
Hydro	143.8	213.9	227	263
Renewables	58.6	213.1	424	1187.5
Imports	4.6	15.3	40	92
Total	1057	2097	2803	5077
Share of renewable energy	5.50%	10.20%	15%	23.40%

The "Made in India" initiative to push domestic manufacturing supported this great height in solar installation capacity. Currently, India has the fifth highest solar installed capacity worldwide. By the 31st of December 2018, alternative energy had achieved 25,212.26 MW against the target of 2022, and an additional 22.8 GW of capacity has been tendered out or is under current implementation. Under the National Solar Mission, the MNRE has updated the target of grid-connected solar energy projects from 20 GW by the year 2021–2022 to 100 GW by the year 2021–2022. In 2008–2009, it reached just 6 MW. MNRE is preparing to bid out the remaining alternative energy capacity every year for the periods 2018–2019 and 2019– 2020, in order that bidding may contribute with 100 GW capacity additions by March 2020. During this way, 2 years for the completion of projects would remain.

Table 9: Solar capacity addition compared to the target between 2013–2014 and 2018–2019.

Year	Solar power capacity additions in MW	
	Target	Achievements
2013–2014	1100	962.1
2014–2015	1100	1112
2015–2016	1400	3019
2016–2017	9100	5526
2017–2018	10,000	9363
2018–2019	10,000	3270

Tariffs are determined through the competitive bidding process (reverse e-auction) to bring down tariffs significantly. The very cheap solar tariff was identified to be INR 2.44 per kWh in July 2018. In 2010, solar tariffs amounted to INR 18 per kWh. Over 100,000 lakh (10,000 million) acres of land had been classified for several planned solar parks, out of which over 75,000 acres had been obtained. The Kurnool solar park was founded with 1000 MW; and with 2000 MW the biggest solar park of Pavagada (Karnataka) is currently under installation. As of November 2018, 47 solar parks of a complete capacity of 26,694 MW were established. The combination capacity of 4195 MW of solar projects has been commissioned inside various solar parks (floating solar power). Table 9 shows the capacity addition compared to the target. It indicates that capacity addition increased exponentially.

Conclusion

The renewable sector suffers notable obstacles. A number of them are inherent in every renewable technology; others are the end result of a skewed regulative structure and marketplace.

The absence of comprehensive policies and regulation frameworks prevent the adoption of renewable technologies.

The renewable energy market requires explicit policies and legal procedures to reinforce the eye of investors.

The country should take measures to draw in private investors. Inadequate technology and the absence of infrastructure required to ascertain renewable technologies should be overcome by R&D.

The government should allow more funds to support research and innovation activities during this sector.

Awareness of renewable energy among communities should be fostered, and a major concentrate on their socio-cultural practices should be considered.

The government should regularly organize awareness programs throughout the country, especially in villages and remote locations such as the islands.

The government should open more educational/research organizations, which will able to help in spreading knowledge of renewable technology in society. People should regularly be trained with relation to new techniques that would be beneficial for the community.

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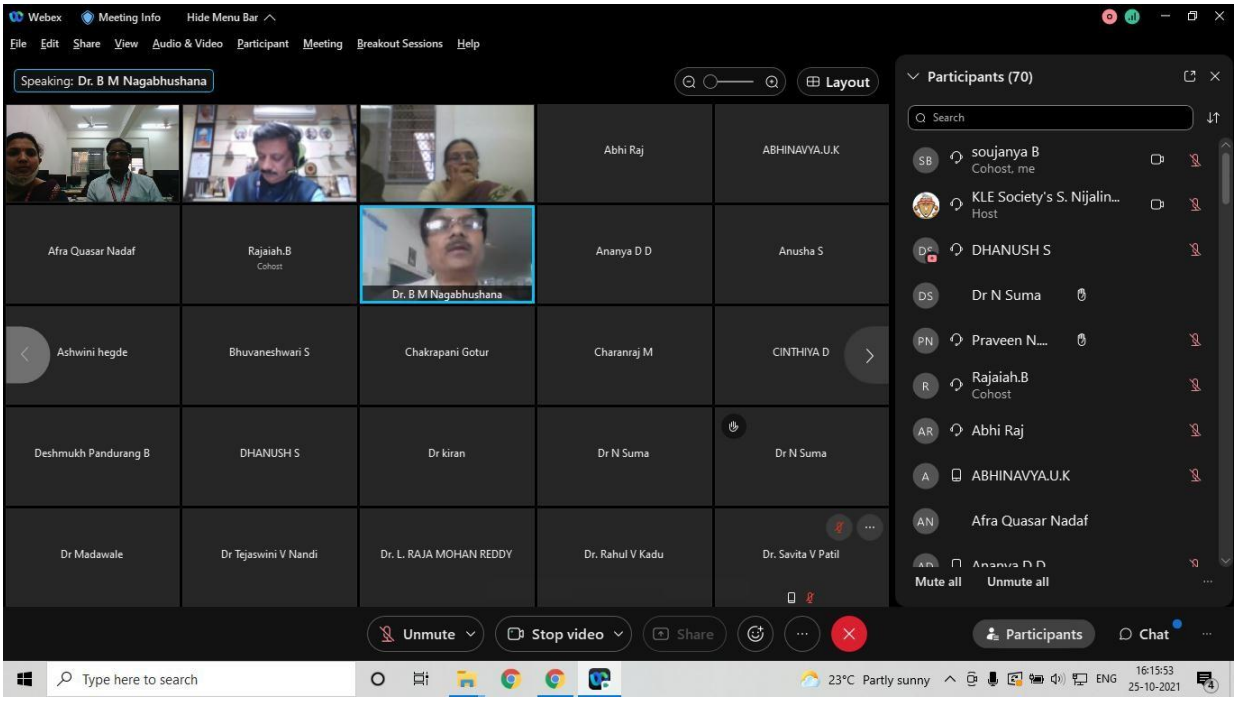

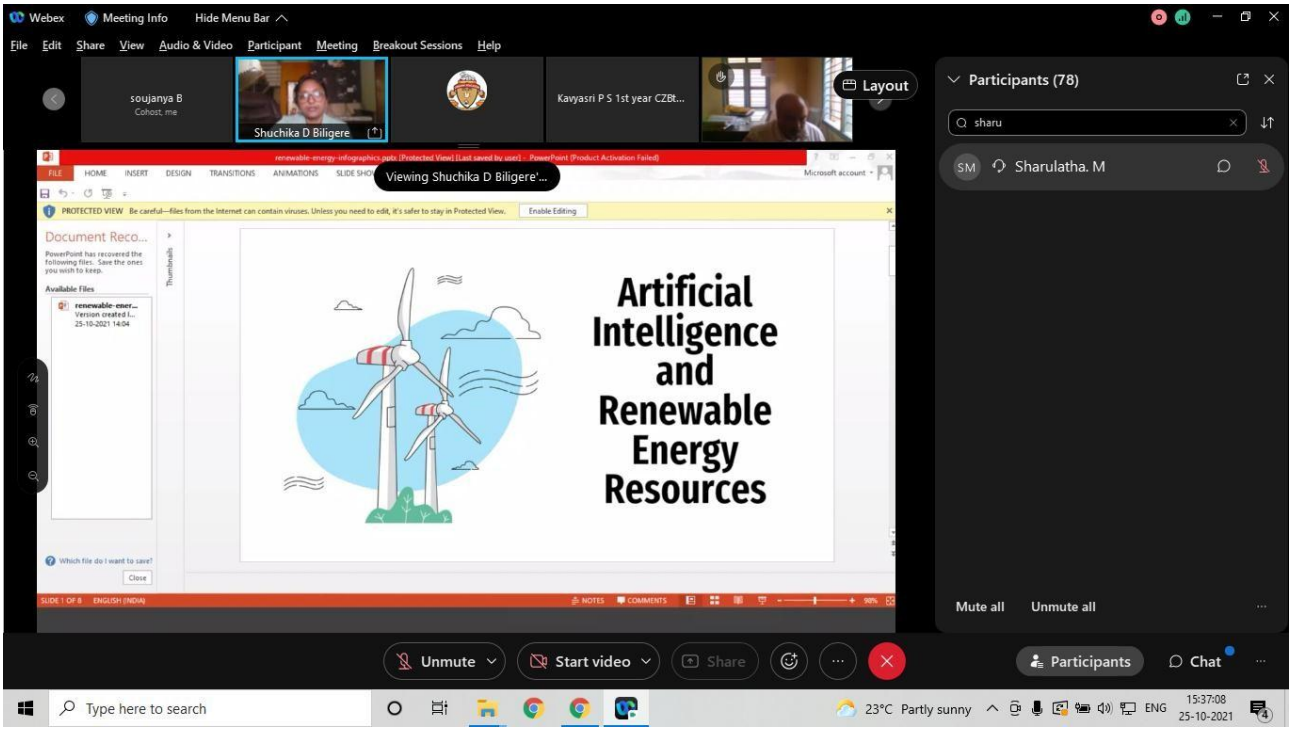

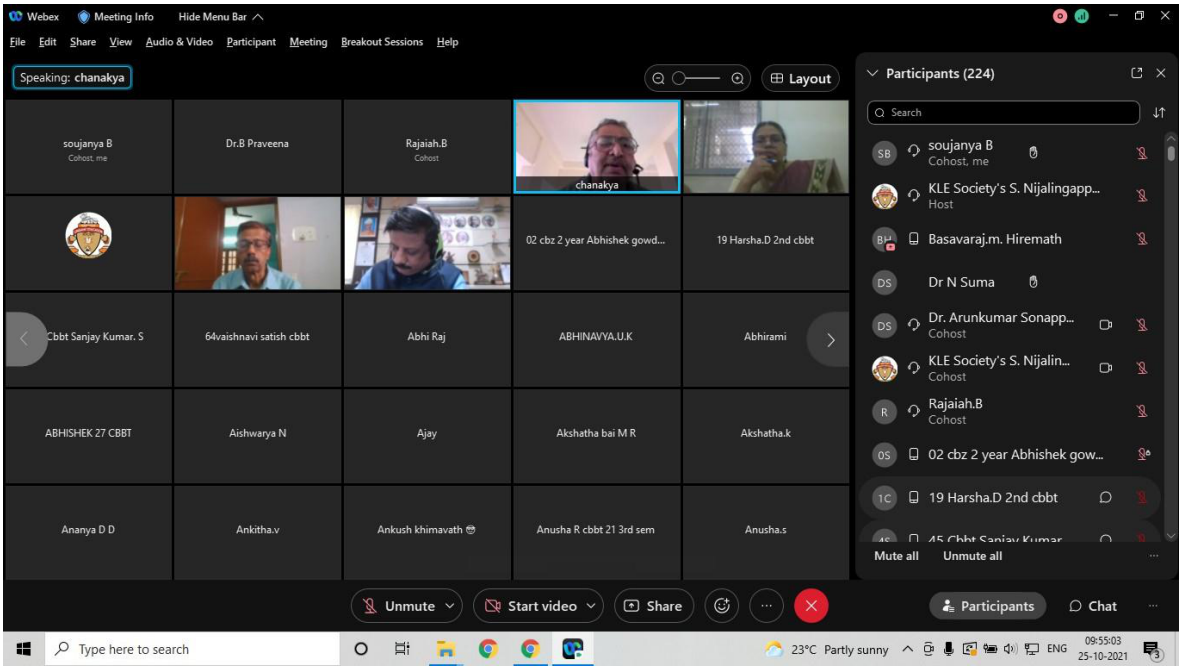
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